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INDEX OF VOL. VI.—1887.

INDEX OF AUTHORS' NAMES.

INDEX OF SUBJECTS.

LIST OF MEMBERS.

A

Abbott, John, Braemar House, Lancaster Gate, Hyde Park, W.
Abel, Sir F. A., Royal Arsenal, Woolwich, London, S.E.
Abney, W. de W., Capt., Willeslie House, Wetherby Road, South Kensington, S.W.
Abraham, A. C., 87, Bold street, Liverpool
Acland, Sir H. W., Radclyffe Library, Oxford
Adam, A. Learmouth, 40, Sir Michael Street, Greenock, N.B.
Adam, J. B., 172, Leith Walk, Edinburgh
Adams, M. A., Ashford Road, Maidstone, Kent
Adams, J. W., 74, Oxford Street, Regent Road, Salford, Manchester
Addenbrooke, Edwin, 18, Cawley Road, South Hackney, E.
Addie, J., Langloan Ironworks, Coatbridge, N.B.
Addyman, F. T., Laboratory of Roy. Agric. Soc., 12, Hanover Square, London, W.
Adkins, H., Chemical Works, Smethwick
Affleck, J., Mill House, Woolton, near Liverpool
Aikman, Charles M., 183, St. Vincent Street, Glasgow
Aitken, A. P., 8, Clyde Street, Edinburgh
Aitken, J. B., Gerard's Fold Chemical Works, Widnes
Akitt, Thomas, Belsund Factory, Tirhoot, India
Albright, G, S., The Elms, Park Road, Edgbaston
Albright, W. A., Marièmont, Birmingham
Allbright, W. B., Dorchester, Mass., U.S.A.
Alexander, J.O., 4, Belhaven Terrace, Kelvinside, Glasgow
Alexander, W, T., 20, Booth Street, Mosley Street, Manchester; and Crumnock Bank, Victoria Crescent, Eccles
Allan, Jno., 2, Blythwood Villas, Crouch Hill, N.
Alldred, C. H., 35, Crisp Terrace, Upper Park Road, Plumstead Common, Kent
Allen, A. H., Sydenham Cottage, Park Lane, Sheffield
Allen, J., 164, Upper North Street, Poplar, London, E.
Allen, J. Fenwick, Newham, Whalley Range, Manchester
Allen, Walter S., 13 Beacon St., Boston, Mass., U.S.A.
Allen, Wm., Edenholme, Bournemouth, Hants
Allen, W. H., c/o F. Stearns & Co., Detroit, Mich., U.S.A.
Allender, G. M., Stammerham, Horsham, Sussex
Allhusen, A., Gateshead-on-Tyne
Allhusen, Wilton, 102, Quay Side, Newcastle-on-Tyne
Allibon, G. H., Seaview, Litherland Park, near Liverpool
Alsberg, M. (Sondheim, Alsberg & Co.), P.O. Box 2437, New York, U.S.A.
Anderson, C. Torre, Messrs. Bass & Co., Burton-on-Trent
Anderson, Geo. B., Victoria Square, Felling-on-Tyne
Anderson, John, Glengarnock Ironworks, Ayrshire, N.B.
Anderson, J. M. T., Explosives Co., Ld., Stowmarket, Suffolk
Anderton, G. H., Howendyke, Howden, Yorks.
Angell, J., The Grammar School, Manchester
Angus, James, Lugar, Ayrshire, N.B.
Angus, John, Ingram House, 165, Fenchurch St., London, E.C.
Angus, W. Mathwin, St. John's Leather Works, Newcastle-on-Tyne
Annandale, J. H., Polton, Midlothian, N.B.
Annison, R. H., 16, Water Lane, Tower Street, London, E.C.
Ansdell, G., 45, Courtfield Rd., South Kensington, S.W.
Ansdell, T. C., Kearsley Cottage, Farnworth, Bolton
Archbold, George, Laboratory, Phœnix, Oswego Co., N.Y., U.S.A.
Archbutt, L., Argyle Terrace, Rose Hill, Derby
Armstrong, Dr. H. E., Central Institution, Exhibition Road, London. S.W.
Armstrong, Sir William G., Newcastle-upon-Tyne
Ash, T. E., 4, Saltram Place, Citadel Road, Plymouth
Ashwell, H., Woodthorpe Grange, Sherwood, Nottingham
Ashwell, J. H., Woodthorpe Grange, Sherwood, Nottingham
Ashwell, J. R., Midanbury Lodge, Bentinck Road, The Forest, Nottingham
Ashworth, L., The Barlows, Radcliffe, near Manchester
Aston, Theo., 11, New Square, Lincoln's Inn, London, W.C.
Atcherley, R. J., 37. Ashchurch Grove, Starch Green, W.
Atkins, S. R., Market Place, Salisbury
Atkinson, A. J., 44, Loudoun Square, Cardiff
Atkinson, Geo., Aldersgate Chemical Works, Southall, Middlesex; and 66, Aldersgate Street, London, E.C.
Atkinson, R. W., 44, Loudoun Square, Cardiff
Attfield, J., Ashlands, Watford, Hertfordshire
Aubrey, W. H., Caledonia Estate, Province Wellesley, Penang
Auer, H., Lathom House, Halebank, near Widnes
Auerbach, C. G., Farbenfabriken vorm. F. Bayer & Co., Elberfeld, Germany
Austin, E., 126, Bermondsey Street, London, S.E.
Aykroyd, W. H., Oakwood Villas, Toller Lane, Manningham, Bradford, Yorks.

B

Bailey, Edwin M., Royal Bank of Scotland, Ardrossan, Ayrshire; and 38, Berkeley Street, Glasgow
Bailey, Wm., The Terrace, Oaken, near Wolverhampton
Bailey, G. H., Owens College, Manchester
Bainbridge, Herbert A., Union Club, Trafalgar Square, London, S.W.
Baker, E., Stoneleigh, Eastern Avenue, Reading, Berks.
Baker, Harry, 262, Plymouth Grove, Manchester
Baker, W. G., Garden Wharf, Church Road, Battersea, London, S.W.
Baker, Theodore, Clifden, Overcliff, Gravesend
Bald, J. H., Braddock, Pa., U.S.A.
Ball, T. B., 12, Edmund Street, Rochdale
Ballard, E. G., Queen's Park, St. Helens
Ballard, J. F., Somerby Villa, Norfolk Park, Maidenhead
Bamber, H. K., 5, Westminster Chambers, Victoria Street, London, S.W.
Banister, H. C., 31, Dale Street, Liverpool

Banks, Arthur J., 229, Wavertree Road, Liverpool ; and c/o Jas. Morrell & Co. Limited, Morpeth Dock, Birkenhead
Banner, Samuel, 4, Ivanhoe Road, Liverpool
Bannister, R., The Laboratory, Somerset House, London, W.C.
Bannister, W., 108, Patrick Street, Cork, Ireland
Barclay, H., Rose Hill, Harrington, Cumberland
Barclay, Thos., 17, Ball Street, Birmingham
Bardsley, Robt., c/o Jewsbury & Brown, 44, Downing St., Manchester
Barlow, E., 2, Old Palace Yard, Westminster, S.W.
Barnes, H. J., Phœnix Chemical Works, Hackney Wick, E.
Barnes, J., 37, Avenue Parade, Accrington, Lancashire
Barnes, Jonathan, Buckton Vale, near Stalybridge
Barnes, R. L., Phœnix Chemical Works, Hackney Wick, E.
Barr, J., Dinting Vale, Glossop
Barr, R., 44, Granby Terrace, Hill Head, Glasgow
Barret, E. L., 53, Springfield Road, St. John's Wood, London, N.W.
Barrow, J., Helme House, Sandwich Road, Ellesmere Park, Eccles, Manchester
Barrow, Jos., Oldham Road, Failsworth, Manchester
Bartholomew, G., Halstow House, Windsor Road, Forest Gate, London, E.
Bassett, H., 26, Belitha Villas, Barnsbury, N.
Bateson, Percy, Emsworth, Wavertree, Liverpool
Battershall, Jesse P., 402, Washington Street, New York, U.S.A.
Batty, R. B., Drayton Villa, Erdington, near Birmingham
Baxter, W. H., The Lawn, Brixton Hill, London, S.W.
Bayley, F. S., 88, King Street, Manchester
Bayley, Thos., 7, West End Chambers, Broad Street Corner, Birmingham
Baynes, J., jun., Royal Chambers, Scale Lane, Hull
Beadle, Clayton, Beadon Well, Belvidere, Kent
Beanes, E., Moatlands, Paddock Wood, Brenchley, Kent
Beardmore, Wm., Parkhead Forge, Glasgow
Beaven, E. S., 5, Boreham Terrace, Warminster, Wilts.
Bechler, M., The Manbré Saccharine Co., Limited, Fulham Road, Hammersmith, London, W.
Beckett, G. H., Hartford, Khedive Road, Forest Gate, E.
Beckett, J. H., Wilmslow Park, Cheshire
Beckingham, J. H., Messrs. Scott Brothers, Royal Insurance Buildings, Newcastle-on-Tyne
Bedford, J., Woodhouse Cliff, Leeds
Bedingfield, C. H., 4, Tichborne Street, High Fields, Leicester
Bedson, P. P., Durham College of Science, Newcastle-on-Tyne
Beilby, G., St. Kitts, Slateford, N.B.
Belcher, J. C., 19, Charles St., Marine Parade, Brighton
Bell, C. Lowthian, Middlesbrough-on-Tees
Bell, G., Runcorn Soap and Alkali Co., Runcorn
Bell, H. S., 2, St. Anne's Park Villas, Wandsworth, S.W.
Bell, Jno., 118, Southwark Street, London, S.E.
Bell, J. Carter, Bankfield, The Cliff, Higher Broughton, Manchester
Bell, Sir I. Lowthian, Bart., Rounton Grange, Northallerton
Bell, J. Ferguson, Stafford
Bell, J. Ralston, Appleby Iron Co., Frodingham, Doncaster
Bell, Jno., Millburn, Renfrew, N.B.
Bell, O., 13, Northumberland Terrace, Tynemouth
Bell, T. Hugh, Middlesbrough-on-Tees
Bellingham, Wm., Dalston Distillery, London, E.
Bendix, D., The British Alizarin Co., Limited, Silvertown, Victoria Docks, London, E.
Benger, F. B., 7, Exchange Street, Manchester
Benjamin, M., 43, East 67th Street, New York, U.S.A.
Bennett, James M., 12, Hamilton Drive, Hillhead, Glasgow
Bennett, Thos., Birch Vale, near Stockport
Bennie, J. W., Guaranteed Manure Works, Cubitt Town, E.
Bentley, J. W., Stakehill Works, Castleton, Manchester
Benton, W. E., Littleworth House, Hednesford, Staffordshire
Berdoe, Walter, 51, South John Street, Liverpool
Beringer, J. J., 10, South Terrace, Camborne, Cornwall
Beringer, C., 67, Farrant Avenue, Wood Green, London, N.
Bernays, J., 96, Newgate Street, London, E.C.
Berry, E. E., 76, George Street, Gower Street, London, N.W.
Best, T. T., 4, Markt Platz, Erlangen, Bavaria
Bevan, A., Bryn Chemical Works, Llanelly, S. Wales
Bevan, E. J., 4, New Court, Lincoln's Inn, London, W.C.
Bevan, I., Llanelly Chemical Works, Llanelly, S. Wales
Bevan, J. Williams, Southview House, Shirehampton, near Bristol
Bevan, Thos., 122, Cheshire View, Broad Street, Pendleton, Lancashire
Beveridge, J., 19, Rectory Road, Cardiff
Bewick, T. Burrell, Hebburn-on-Tyne
Bibby, E. V., Garston Copper Works, Garston, near Liverpool
Bickerdike, W. E., Clayton Grange, Wilpshire, near Blackburn
Bickerton, C. W., The Hollies, Bosden, near Stockport
Bickett, J. H., Medical College, London Hospital, E.
Biggart, J. Wm., 29, Cathcart Street, Greenock, N.B.
Biggs, B., 3, Lawrence Pountney Hill, London, E.C.
Bihn, G. F., Pennsylvania Salt Manufacturing Co., Philadelphia, U.S.A.
Billing, H. S., Messrs. Burnard, Lack & Alger, Plymouth Chemical Works, Plymouth
Bindschedler, R., Société pour l'Industrie Chimique, Basle, Switzerland
Bingley, J., Chemical Laboratory, Northampton
Binks, J. B., 4, Criffel Street, Silloth, Cumberland
Binney, H. A., Sutton, St. Helens
Bird, R., Ellerslie, Roath, Cardiff
Birley, R. K., Messrs. Chas. Macintosh & Co., Cambridge Street, Manchester
Birch, R. W. Peregrine, 2, Westminster Chambers, Victoria Street, London, S.W.
Bischof, Gustav, 4, Hart St., Bloomsbury, London, W.C.
Bishop, Frank, 6, Holly Terrace, West Hill, Highgate, N.
Bishop, Fred, 12, Charles Street, Edinburgh
Bishop, Jos. J. F., 39, Market Street, Manchester
Bishop, A. Conway, Three Mills Lane, Bromley-by-Bow, London, E.
Bishop, G. A., Royal Bank House, Coatbridge, N.B.
Black, Wm., St. Bede Chemical Co., Newcastle-upon-Tyne
Black, Wm., Stanrigg, Airdrie, N.B.
Blackwell, G. G., 26, Chapel Street, Liverpool
Blades, C. M., Stanley Mount, Northwich, Cheshire
Blagden, W. G., 1, Fenchurch Avenue, London, E.C.
Blair, J., Irvine Bank Chemical Works, Kilmarnock, Ayrshire
Blake, C. A., 47, Piccadilly, London, W.
Blake, F. C., Mansfield Valley Allegheny Co., Pa., U.S.A.
Blake, Jas., Thames Sugar Refinery, Silvertown, London, E.
Blenkinsop, W., Garden Wharf, Battersea, London, S.W.
Bles, A. J. S., 32, Chorlton Street, Manchester
Blinkhorn, W. J., 31, Grove Park, Liverpool
Blount, Bertram, 23, Queen Anne's Gate, Westminster, S.W.
Blundstone, E. R., 10, Wellington Mansions, North Bank, Regent's Park, N.W.
Blythe, F. C., Newholme, Victoria Park, Manchester
Blythe, H. F., Holland Bank Chemical Works, Church, near Accrington
Blyton, J., 12, Cromford Court, Market Street, Manchester
Boa, Peter, 119, George Street, Edinburgh
Boake, A., Highgate, London, N.
Board, J. T., Distillery, Cheese Lane, Bristol
Bogle, Wm., Wappinger's Falls, Duchess Co., N.Y., U.S.A.
Bolas, Thos., 8, Grove Terrace, Chiswick, W.
Bolton, C. A., 40, Carlton Street, Nottingham
Bolton, G. H., Widnes Alkali Co., Limited, Widnes
Booth, Geo., Irk Vale Dyeworks, Middleton, near Manchester

Borland, John, Etruria, Kilmarnock, N.B.
Borland, W. D., 35, Petherton Road, Highbury New Park, N.
Boston, H. G., Nunthorpe Crescent, Bishopthorpe Road, York
Bothamley, C. H., Yorkshire College, Leeds
Böttinger, H. T., Elberfeld, Germany
Bottle, Alex., 4, Godwyne Road, Dover
Boulton, H. E., 64, Cannon Street, London, E.C.
Boulton, S. B., 64, Cannon Street, London, E.C.
Boulton, T. S., Mountford House, Barnsbury Square, London, N.
Bountiff, G. R., Cloncurry Copper and Smelting Company, Cloncurry, Queensland
Bourcart, R., 18, Chaussée de Dornach, Mulhouse, Alsace
Bow, R. H., 7, South Gray Street, Edinburgh
Bowen, S. B., Brickfield Chemical Works, Llanelly, South Wales
Bower, G., St. Neots, Huntingdonshire
Bower, H., P.O. Box 946, Philadelphia, Pa., U.S.A.
Bowler, G. S., Crystal Palace District Gas Co., Limited, Lower Sydenham, S.W.
Bowley, Jos. John, Wellington Works, Battersea Bridge, London, S.W.
Bowly, J. E., Elm House, Trinity Road, Birchfield, Birmingham
Bowman, F. H., West Mount, Halifax
Bowman R., Eglington Chemical Works, Irvine, N.B.
Bowrey, J. J., Kingston, Jamaica; West Indies
Boyd, Pythagoras, Box 77, North Adams, Mass., U.S.A.
Boyd, W., Tharsis Works, East Moors, Cardiff
Boyd W., c/o Messrs. Tennant & Co., St. Rollox, Glasgow
Bracewell, Wm., Brinscall, near Chorley
Bradburn, J. A., 5, Chester Road, Northwich
Bradbury, A., Mason's Buildings, Exchange Street East, Liverpool
Bradbury, W. A., Steetley Chemical Works, Worksop
Braden, Herman
Bradley, N., 49 and 51, Chapman Street, Hulme, Manchester
Bramham, W., 82, Bow Road, London, E.
Bramley, Wm., 18, Clarence Street, Middlesbro'-on-Tees
Bramwell, E., Charlwood House, Huyton, near Liverpool
Bramwell, Sir F., 5, Great George Street, Westminster, London, S.W.
Bramwell, G. H., Cowley Hill, St. Helens, Lancashire
Bramwell, Samuel, 4, St. Ann's Square, Manchester
Branson, F. W., 14, Commercial Street, Leeds
Bray, Geo., Blackman Lane, Leeds
Brayne, Francis W., Bow Pottery, Three Mills Lane, Bromley-by-Bow, E.
Breckon, J. R., 32, Fawcett Street, Sunderland
Breen, George, Irvine Chemical Co., Limited, 204, Vincent Street, Glasgow
Brenemann, A. A., 97, Water Street, New York, U.S.A.
Brewis, E. T., 111, Great Brunswick Street, Dublin
Briant, L., 24, Holborn Viaduct, London, E.C.
Briggs, T. Lynton, c/o Read, Holliday & Sons, Huddersfield
Briggs, W., Springfield Terrace, Arbroath, N.B.
Brinjes, J. H., Whitechapel Engine Works, Fieldgate Street, London, E.
Bristow, G. W., Worcester House, 35, Eastcheap, London, E.C.
Broad, Jas., 66, High Street, Lewes, Sussex
Brock, J., British Alkali Works, Widnes
Brooke, Edwd., Oakley House, Edgerton, Huddersfield
Brookes, E. A., 15, Withington Road, Whalley Range, Manchester
Brotherton, E. A., Fern Cliffe, Ilkley, Yorkshire
Brown, A. Crum, 8, Belgrave Crescent, Edinburgh
Brown, Arthur E., Morden Cliff, Lewisham, S.E.
Brown, D., 93, Abbey Hill, Edinburgh
Brown, D., Donaghmore, Tyrone, Ireland
Brown, H., Royal Oak Brewery, Stockport
Brown, J. Campbell, 27, Abercrombie Square, Liverpool
Brown, J. Kinniburgh, 5, Saxe Coburg Place, Edinburgh
Brown, J. T., 46, Kilmaine Road, Fulham, London, S.W.
Brown, Oliphant A., Lennoxmill, Lennoxtown, N.B.
Brown, T., The Chemical Works, King's Lynn
Brown, Horace T., 47, High Street, Burton-on-Trent
Brown, Walter, c/o Jas. H. Dennis & Co., Widnes
Brown, F. W., 17, Walterton Road, St. Peter's Park, London, W.
Brown, S. B., Strines, near Stockport
Brown, W. A., Overton Paper Mills, Greenock, N.B.
Browning, W., Broad Oak, Accrington
Bruce, Edw. M., Union Pacific R. R., Omaha, Nebraska, U.S.A.
Brundrett, A., Rhymney Ironworks, Monmouthshire
Brunner, H., Cliff House, Appleton, Widnes
Brunner, J. F. L., Trinity Hall, Cambridge
Brunner, J. T., Winnington, Northwich
Brunner, J. P., 28, Exchange Street East, Liverpool
Bryan, E., Gas Works, Beverley, East Yorkshire
Bryce. A. S., Glenpark Oil Works, East Nelson Street, Glasgow
Bryce, A. S., jun., 8, Broompark Terrace, Dennistown, Glasgow
Buch, Carl Von, 17, Cavendish Place, London, W.
Buchan, A., 13, Willowbank Crescent, Glasgow
Buchanan, J. Y., 10, Moray Place, Edinburgh
Buckeridge, Herbert L., 53, Palace Road, Crouch End, N.
Buckley, W., Brookside Printworks, West Leigh, Lancashire
Budden, E. R., Camelot, Netherhall Terrace, South Hampstead, N.W.
Bullock, J. L., 3, Hanover Street, Hanover Square, London, W.
Bumby, H., Solway Ironworks, Maryport, Cumberland
Bunker, H. E., 24, Great Cheetham Street West, Lower Broughton, Manchester
Burdekin, G., jun., Sutton Lodge Chemical Co., St. Helens
Burghardt, C. A., Bridgwater Club Chambers, 110, King Street, Manchester; and Owens College, Manchester
Burgmann, C. F., 41, Warwick Gardens, Kensington, W.
Burnard, R., Plymouth Chemical Works, Plymouth
Burnett, E. E., 118, Huddleston Road, Tufnell Park, London, N.
Burrell, B. A., Bank Chambers, 70, South Mall, Cork
Burroughs, S. M., Bell Lane, Wandsworth, S.W.
Burton. F., 2, Green Street, Bethnal Green, E.
Bury, J. H., Church Chemical Works, near Accrington
Bush, R. A., 20, Artillery Lane, London, E.C.
Bush, W. E., 20, Artillery Lane, London, E.C.
Bush, W. J., 20, Artillery Lane, London, E.C.
Bushill, C. D. T., Broom Hill, Great Barr, Birmingham
Butt, E. N., 25, Sussex Gardens, Hyde Park, London, W.
Butler, Samuel, Compton, Wolverhampton
Butler, W. W., Crown Brewery, Broad Street, Birmingham
Butterfield, J. C., Westbury Cottage, Barking
Button, H., Faraday Chemical Works, Rainham, Essex
Byard, A. G., 70, Fisher Street, Canning Town, E.
Bythway, M., 43, Lloyd Street, Albert Square, Manchester

C

Cabot, Godfrey L., 82, Water Street, Boston, Mass., U.S.A.
Calderwood, J., 1, Alverton Villas, Wandsworth Common, London, S.W.; and Price's Patent Candle Co., Battersea
Caley, A. J., Chapel Field, Norwich
Callard, S., Pontamman Chemical Works, Ammanford, Carmarthen
Calvert, J. H., Oakenshaw Printworks, Clayton-le-Moors, Accrington
Cameron, Ian, Nickel Co., Kirkintilloch, N.B.
Cameron, R., Priory Lodge, Blantyre, Lanarkshire
Cammack, J., 8, Salisbury Street, St. Helens
Campbell, A., 19, Harold Road, Upton Park, Essex
Campbell, Andrew, Linlithgow Oil Co., Linlithgow, N.B.

Campbell, John, 25, New Chambers Street, New York, U.S.A.
Cannon, M., Beaufoy's Chemical Works, Lavender Hill, London, S.W.
Carey, E., Widnes, Lancashire
Carey, W. H., Forest Works, Bulwell, near Nottingham
Carlile, T., 27, St. Vincent Place, Glasgow
Carlyle, W. A., The Elms, Yardley, Worcestershire
Carmody, Patrick, Laboratory, Somerset House, London, W.C.
Carnelly, Thos., University College, Dundee
Caro, H., Mannheim, Germany
Carpenter, H. S., 32, Holborn Viaduct, London, E.C.
Carpenter, R. F., Bent Terrace, Prestwich, near Manchester
Carpenter, W. L., 36, Craven Park, Harlesden, London, N.W.
Carran, T. W., Girton House, Shiel Road, Liverpool
Carrick, H., Holly House, Gateshead-on-Tyne
Carruthers, J. G., Burnbrae House, Milngavie, N.B.
Carter, W. C., 2, Weech Road, Burgess Hill, Hampstead, N.W.
Carteighe, M., 180, New Bond Street, London, W.
Casthélaz, Chas., 19, Rue Ste. Croix de la Bretonnerie, Paris
Castner, Hamilton Y., 23, Cecil Street, Strand, London, W.C.
Cawley, G., 2, Birch Villas, Northern Grove, Didsbury, Manchester
Cawley, J., 278, Passaic Street, Newark, New Jersey, U.S.A.
Chadwick, Edmund, Witton Mill, Blackburn
Chadwick, L. N., Ivy Lawn, Ponders End, Middlesex
Chaloner, G., 35, King's Road, Green Lanes, N.
Chamberlain, J., Gas, Light & Coke Co., Beckton, North Woolwich, E.
Chambers, J. M., Te Mata, Havelock, Hawkes Bay, New Zealand
Chance, A. M., Alkali Works, Oldbury, near Birmingham
Chance, J. F., Alkali Works, Oldbury, near Birmingham
Chandler, Dr. C. F., School of Mines, Columbia College, New York
Chaney, Harry, North Mexican Silver Mining Co., Cusihuiriachic, Chihuahua, Mexico
Chapman, S., 84, Eccleston Square, London, S.W.; and 36, Mark Lane, E.C.
Chapman, W., Crescent Road, Ipswich
Charlton, J., Ellesmere Park, Eccles, near Manchester
Charlton, J., c/o Levinstein & Campbell, 25, New Chambers Street, New York, U.S.A.
Cheesman, A., Bedford Road Brewery, Luton, Beds.
Cheesman, W., c/o F. Kendall & Son, Chemical Works, Stratford-on-Avon
Cheetham, F. W., Carlton Bank, Hyde, Manchester
Cheyne, A. M., c/o Messrs. Burgoyne, 16, Coleman Street, London, E.C.
Chidley, J. R., Abbey Mills Distillery, West Ham, Essex
Chisholm, M. E., 8, Kennington Park Road, London, S.E.
Christie, J., Messrs. John Orr-Ewing & Co., Alexandria Works, Dumbartonshire
Christie, W., 222, Brunswick Road, Bromley, E.
Christopher, G., 8, Rectory Grove, Clapham, London, S.W.
Christy, Thos., Malvern House, Sydenham, S.E.; and 155, Fenchurch Street, London, E.C.
Chrystal, W. J., Shawfield Works, Rutherglen, near Glasgow
Chubb, Harry, 21, Lansdowne Place, Brighton
Church, A. H., Shelsley, Kew, Surrey
Claisen, L., 36, Gereonstrasse, Coln-am-Rhein, Germany
Clanahan, H. C., 88, King Street, Manchester
Clark, E. B., Rangoon Oil Co., Rangoon, Burmah
Clark, J., 138, Bath Street, Glasgow
Clark, H. G. D., Brewery, Twickenham, Middlesex
Clark, R. Ingham, 2, Park Prospect, Queen Anne's Gate, Westminster, S.W.
Clarke, Arthur, St. Ann's Hill Factory, Nottingham
Claudet, A. C., 6, Coleman Street, London, E.C.
Claudet, F. G., The Grange, Weston, near Runcorn
Claus, C., 24, Merton Road, South Wimbledon, S.W.
Claus, Carl F., jun., 9, Nassington Road, Hampstead, N.W.
Clayton, E. G., Chemical Laboratory, 54, Holborn Viaduct, London, E.C.
Clayton, F. C., 18, St. James' Road, Edgbaston, Birmingham
Clemes, J. H., Penrhyn Lodge, Woodbury Down, Finsbury Park, N.
Cleminshaw, E., Windsor Street Gasworks, Birmingham
Clemons, G. H., Cudbear Street, Hunslet Road, Leeds
Clerk, Dugald, c/o Messrs. Tangye's, Limited, Cornwall Works, Birmingham
Cliff, D. Y., 7, Wellington Street, Leeds
Cliff, J., Nesbitt Hall, Fulneck, Leeds
Cliff, Stephen, Wortley, near Leeds
Clift, J., Kemp Field House, Knottingley, Yorks.
Clifton, C. D., Royal Oak Brewery, Stockport
Cloud, T. C., Wallaroo Smelting Works, Wallaroo, South Australia
Clowes, F., University College, Nottingham
Clowes, G. A., Needham Market, Suffolk
Coates, John, 106, Cannon Street, London, E.C.
Cobb, F., 79, Cornhill, London, E.C.
Cochrane, Wm. P., Ormesby Ironworks, Middlesbro'; and 3, Belmont Terrace, Coatham, Redcar
Cockburn, J., 11, Heathcote Street, Mecklenburgh Square, London, W.C.
Coghill, P. G., 16, Hornton Street, High Street, Kensington, W.
Cogswell, W. B., Syracuse, New York, U.S.A.
Cohen, J., Beech House, Pendleton, Manchester
Colby, W. H., Oakley, Ruthin Road, Denbigh
Coleman, Jos. B., University College, Nottingham
Coleman, J. J., Ardarroch, Bearsden, near Glasgow
Collens, E., Vinegar Works, Stourport, Worcestershire
Collins, J. H., 64, Bickerton Road, Highgate New Town, London, N.
Collins, John, Bradford Chambers, Mawdsley Street, Bolton-le-Moors
Collins, H. S., Messrs. Langton & Co., 230, Upper Thames Street, London, E.C.
Collyns, C. S. A., 47, Park Street, Greenheys, Manchester
Colson, A., Gas Office, Millstone Lane, Leicester
Connor, C. C., Notting Hill House, Belfast, Ireland
Conrad, E. C., 23, Well Street, Wellclose Square, London, E.
Cook, E. M., 154, East 37th Street, New York, U.S.A.
Cook, E. R., East London Soap Works, Bow, London, E.
Cook, H. J., East London Soap Works, Bow, London, E.
Cook, Robt., Atlas Chemical Works, Widnes
Cooke, Leonard, Horwich Vale, near Bolton-le-Moors
Cooke, Samuel, Poona, Bombay, India
Cookson, N. T., Newcastle-on-Tyne
Coomber, Thos., 9, Osborne Road, Clifton, Bristol
Cooper, A., North-Eastern Steel Co., Middlesbrough-on-Tees; and the Laurels, Linthorpe, near Middlesbrough-on-Tees
Cooper, Claude H., The Towers, Old Sneinton, Nottingham
Cooper, H. P., 15, Haringey Road, Hornsey, N.
Corbett, E., Plaskynaston Chemical Works, Ruabon, North Wales
Corbett, Jno., M.P., Stoke Works, near Bromsgrove, Worcestershire
Cottam, J. C., 39, Lombard Street, London, E.C.
Cottell, O. D., 101, Long Lane, Bermondsey, S.E.
Cotterell, Roeke, 35a, Ann Street, Glasgow
Cotterill, Thos., Lombard Street West, West Bromwich
Cotton, J., Church Street, St. Helens
Couper, W. G., 1, Fenchurch Avenue, London, E.C.
Coutts, F. J. H., 61, East View, Turton Road, near Bolton
Cowan, A. B., Tudhoe Ironworks, Spennymoor, Newcastle-on-Tyne
Cowell, Peter, Free Public Library, Liverpool
Cox, J., Dersingham Hall, Dersingham, Norfolk

Cox, Walter J., Rock House, Basford, Nottingham
Crabb, W., Border Counties Chemical and Manure Works, Silloth, Cumberland
Crabtree, Thos., Spring Valley Dyeworks, Failsworth, near Manchester
Craig, G., Lugar Iron Works, Cumnock, N.B.
Crake, William, Corrall Quemado, Andacollo, Coquimbo, Chili
Crapper, J. R., Lime House, Walsall
Craw, John, Meadowbank, Greenock Road, Paisley, N.B.
Crawford, D., Langdale's Manure Works, Newcastle-on-Tyne
Crawford, D., Glengowan Printworks, Caldercruix, by Glasgow
Crawford, Thos., 10, Haldane Terrace, Newcastle-on-Tyne
Cresswell, C. G., 20, Colinett Road, Putney Park, London; and 9, Bridge Street, Westminster, S.W.
Cresswell, C. N., 1, Hare Court, Temple, E.C.
Crichton, Donald G., Mount Albion, by Herberton, Queensland
Crompton, Percy R., Dearden's House, Bury, Lancashire
Crookes, W., 7, Kensington Park Gardens, Notting Hill, London, W.
Cropper, L., Eagley Mills, near Bolton
Crosfield, A. L., c/o Richardson Bros. & Co., Short Strand, Belfast
Cross, C. F., 53, Eaton Terrace, London, S.W.; and 4, New Court, Lincoln's Inn, London, W.C.
Cross, C. J., Brentford, Middlesex
Cross, J., Widnes
Crossley, R., Bentcliffe House, Accrington
Crow, J. K., 2, Colham Villas, West Drayton, Middlesex
Crowder, W., 271, Evering Road, Upper Clapton, London, N.
Crowther, Horace W., Messrs. Chance Brothers, Alkali Works, Oldbury, near Birmingham
Crowther, W. M., Field House, Gomersal, near Leeds
Cruikshank, G. M., 62, St. Vincent Street, Glasgow
Crum, A., Thornliebank, Glasgow
Crumbie, W. D., U.S. Govt. Laboratory, 402, Washington Street, New York
Cubley, G. A., 4, High Street, Sheffield
Cuming, James, jun., Chemical Works, Yarravilli, Melbourne, Australia
Cunliffe, E. T., The Parsonage, Handforth, near Manchester
Curphey, W. S., 268, Renfrew Street, Glasgow
Curr, R. G., 5, Nelson Street, Plymouth Grove, Manchester
Curry, W. A., Giltbrook Chemical Works, Awsworth, Notts.
Cuthbert, H. W., 88, Bishopsgate Street Within, London, E.C.
Cuthbert, R. M., 27a, Ashley Place, London, S.W.
Cuthbertson, J. N., 29, Bath Street, Glasgow
Cuthbertson, William, Caroline Park, Edinburgh

D

Dacie, J. C., Soap Works, Putney, London, S.W.
Dagger, J. H. J., 3, West Bank Road, Edge Lane, Liverpool
Dale, R. S., Ivy Cottage, Cornbrook, Manchester
Daniell, Louis C., 10, Swan Lane, Upper Thames Street, London, E.C.
Darby, J. H., Pen-y-Garth, near Wrexham
Darling, W. H., 126, Oxford Street, Manchester
Dauber, H., jun., Kenmore, Waterloo Park, near Liverpool
Davidson, G., c/o W. & H. M. Goulding, Limited, The Glen, Cork, Ireland
Davidson, J. E., 16, Hawthorne Terrace, Newcastle-upon-Tyne
Davidson, R., c/o John Walker & Co., sugar refiners, Greenock, N.B.
Davidson, R. H., c/o Messrs. Golding, Davis & Co., Marsh Alkali Works, Widnes
Davies, A. E., 6, Rumford Place, Liverpool
Davies, Meurig D., 77, Everton Terrace, Everton, Liverpool
Davies, R. H., Apothecaries' Hall, London, E.C.
Davis, A. R., 9, Ebor Terrace, Woodhouse Hill, Leeds
Davis, Chas., 10, Oakfield Cottages, Oakfield Road, East Ham, E.
Davis, G. E., South Cliff House, Higher Broughton, Manchester
Davis, H. W., The Laboratory, Somerset House, London, W.C.
Davis, J. F., 236, East 51st Street, New York, U.S.A.
Davis, R. H. (Messrs. Goldiog, Davis & Co.), Widnes
Davis, T. S., 199, South Lambeth Road, London, S.E.
Dawson, B., York House, Malvern Link, Worcestershire
Dawson, C. A., 127, Church Street, Runcorn
Dawson, Jno., Kirkheaton Coal-Tar Colour Works, Huddersfield
Dawson, Thos., Stonecroft House, Milnsbridge, near Huddersfield
Dawson, W. E., Pretoria, Transvaal, South Africa
Dawson, W. Haywood, British Alizarin Co., Limited, Silvertown, Victoria Dock, E.
Day, St. John V., 115, St. Vincent Street, Glasgow
Deacon, H. W., Appleton House, Widnes
Deakin, E., Belmont Bleach and Dyeworks, near Bolton
Deakin, H., Ryecroft Dyeworks, Belmont, near Bolton
Deans, J. A., Oxalic Acid Manufactory, Morriston, Swansea
Dearden, Thos., 12, Heywood Street, Bury, Lancashire
De Deken, A., 18, Rue Villette, Liège, Belgium
Deering, W. H., Chemical Department, Royal Arsenal, Woolwich, S.E.
Defries, D. C., 53, Redcliffe Square, South Kensington, S.W.
De la Rue, W., 73, Portland Place, London, W.
Dempster, A., Rosemount, Elland, Yorkshire
Demuth, Dr. L., Wharfdale, Church Road, Edgbaston, Birmingham
Dent, W. Y., Royal Arsenal, Woolwich, London, S.E.
Denton, E. Bailey, Palace Chambers, 9, Bridge Street, Westminster, S.W.
Dewar, J., 1, Scroope Terrace, Cambridge
Dey, Preo Lall, 4, Beadon Street, Calcutta
Dibdin, W. J., Metropolitan Board of Works, Spring Gardens, London, S.W.; and Mayfield Grange Road, Sutton, Surrey
Dick, A., 110, Cannon Street, London, E.C.
Dicketts, William, 9, Mincing Lane, London, E.C.
Dickinson, A. J., Neptune Tar and Chemical Works, Deptford, London, S.E.
Dickson, Jno., 16, Dale Street, S.S., Glasgow
Dittmar, W., Anderson's College, Glasgow
Divers, E., Imperial College of Engineering, Tokyo, Japan
Dixon, Jos., Spring Grove, near Sheffield
Dixon, M. T., 5, Brandling Park, Newcastle-on-Tyne
Dixon, William, jun., Belle View Park, Sunderland
Dobbie, J. J., University College of North Wales, Bangor
Dobbin, L., Chemical Laboratory, University, Edinburgh
Dobson, Geo., Grange Alkali Works, near Cardiff
Doggett, C. S., Boston, Mass., U.S.A.
Doidge, H., 22, Alberta Terrace, Sherwood Rise, Nottingham
Domeier, A., 13, St. Mary-at-Hill, London, E.C.
Donald, George, Arnold Printworks, North Adams, Mass., U.S.A.
Donald, Jas., 5, Queen's Terrace, Glasgow
Donald, W., New Explosives Co., Limited, Pembrey, South Wales
Donald, W. J. A., 2, Belgrave Terrace, Glasgow
Doolittle, Orrin S., Altoona, Pa., U.S.A.
Dott, D. B., 93, Abbey Hill, Edinburgh
Dougall, A., Gasworks, Sculcoates, Hull
Dougall, Archibald, Gasworks, Kidderminster
Douglas, William, Diamond Plantation, Demerara
Doulton, Henry, Lambeth Pottery, London, S.E.
Doux, Jules, jun., 55, Bleecker Street, Utica, New York, U.S.A.
Dowling, Edmund, 83, Cable Street, London, E.
Down, F. J., 13, Victoria Road, Charlton, S.E.

Down, T., Willington upon-Tyne
Dowson, J. Emerson, 3, Great Queen Street, Westminster, S.W.
Drake, Chas. A., Three Mills Distillery, Bromley-by-Bow, E.
Dreaper, W. P., 8, Albert Square, Clapham Road, London, S.W.
Drew, D., Lower House Printworks, near Burnley
Dreyfus, C., Clayton Aniline Co., Limited, Clayton, Manchester
Driffield, V. C., Farnworth, Widnes
Drinkwater, T. W., Chemical Laboratory, 41, Chambers Street, Edinburgh
Dryden, J., Messrs. Chance's Alkali Works, Oldbury
Duckworth, C. W., Garner's Buildings, North Road, Clayton, Manchester
Duckworth, William, 93, Corporation Street, Manchester
Duffy, B., Sutton Alkali Works, St. Helens
Duggan, T. R., 32, Narford Road, Upper Clapton, E.
Duncan, J., 9, Mincing Lane, London, E.C.; and Clyde Wharf, Victoria Dock, E.
Duncan, Archibald, 1, Teneriffe Street, Higher Broughton, Manchester
Duncan, James, Cleland, Lanarkshire
Dunn, J., 53, Brown Street, Manchester
Dunn, J. T., 115, Scotswood Road, Newcastle-on-Tyne
Dunn, P., 53, Brown Street, Manchester
Dunn, S., Stirling Chemical Works, West Ham, London E.; and 14, South Hill Park Gardens, Hampstead, N.W.
Dunscombe, M. W., St. Augustine's Parade, Bristol
Dunstan, W. R., 17, Bloomsbury Square, London, W.C.
Dupee, H. D., 44, Oliver Street, Boston, U.S.A.
Dupré, A., Westminster Hospital Medical School, Caxton Street, London, S.W.
Durrant, Reg. G., Marlborough College, Wilts
Dyer, B., 17, Great Tower Street, London, E.C.
Dyson, C. E., Flint, North Wales
Dyson, Geo., Hurworth, Darlington
Dyson, G., 231, Wilton Terrace, Cheetham, Manchester
Dyson, H., Calder Vale, Wakefield
Dyson, John, Derby Court, Long Millgate, Manchester

E

Earp, W. R., Halton Road, Runcorn, Cheshire
East, Walter, Speen Cottage, Oil Mill Lane, Kingston-on-Thames
Eastick, J. J., Chemical Laboratory, Plaistow Wharf, North Woolwich Road, London, E.
Eastick, C. E., Chemical Laboratory, Plaistow Wharf, North Woolwich Road, London, E.
Eastlake, Thos. L., 23, Great George Street, Westminster, S.W.
Eastwood, Edward, Tunnel Soap Works, Wapping, E.
Eaton, W. H., Chemical Works, Lostock Hall, near Preston
Edge, Anthony, Readville, Mass., U.S.A.
Edgell, G. E., 4, Hardwick Terrace, Gateshead-on-Tyne
Edmands, H. R., 337, East 27th Street, New York, U.S.A.
Edwards, A. J., The Gasworks, Taunton
Ekman, C. D., Dieppe, France
Elborne, W., The Owens College, Manchester
Elborough, T., 59, Mark Lane, London, E.C.
Elkins, G. W., 423, Walnut Street, Philadelphia, Pa., U.S.A.
Elliott, A. H., School of Mines, Columbia College, New York, U.S.A.
Ellis, C. J., Young Laboratory of Technical Chemistry, 60, John Street, Glasgow
Ellis, G. E. R., 10, Colville Road, Bayswater, London, W.
Ellis, H., 112, Regent Street, Leicester
Ellis, Hervey R., Moreland Cottage, Shooter's Hill, London, S.E.
Elmore, A. S., 359, Clapham Road, London, S.W.
Elworthy, H. S., Rosa, N.W.P., India
Emmens, S. H., Silver Valley Railroad, Thomasville, N.C., U.S.A.
Endemann, H., 33, Nassau Street, New York City, U.S.A.
England, R. J., Farmer & Co., Dunster House, Mark Lane, London
Ermen, F., jun., Nassau Mills, Patricroft, Manchester
Ernst, Adolf, Oberlangenbielau, Schlesien, Germany
Eschellman, George, Dyar Terrace, Winnington, Northwich, Cheshire
Esilman, A., North Road, Clayton, Manchester
Estcourt, C., 20, Albert Square, Manchester
Evans, John, Nash Mills, Hemel Hempstead
Evans, Enoch, 181, Herbert Road, Small Heath, Birmingham
Evans, W. N., 66, Stackpole Road, Bristol
Everitt, F. Douglas, Finstall House, Bromsgrove
Evershed, F., Atlas Works, Hackney Wick, London, E.
Evershed, Wallis, c/o Whitwell & Co., Limited, Kendal, Westmoreland
Ewing, H. M. R., Alexandria Works, Alexandria, Dumbarton

F

Fahlberg, C., Saccharin fabrik, Salbke-Westerhüsen, a/Elbe, Germany
Fairley, T., 16, East Parade, Leeds
Fairlie, H. C., Summerford House, Falkirk, N.B.
Fairweather, W., 62, St. Vincent Street, Glasgow
Fallowfield, T., Clayton-le-Moors, near Accrington
Farrant, N., 180, St. Paul's Road, West Smethwick, near Birmingham
Farries, T., 16, Coleman Street, London, E.C.
Farrington, T., 4, Waterloo Place, Cork, Ireland
Fasnacht, A. E., Sandy Lane Chemical Works, Clayton, Manchester
Faulkner, F., Crosswells Brewery, Oldbury, near Birmingham
Fawsitt, C. A., Atlas Chemical Works, East Nelson Street, Glasgow
Fellows, A., Hebburn-on-Tyne
Felton, Thos., 364, Romford Road, Forest Gate, E.
Fenner, N. J., The Cedars, Mazehill, Blackheath, London, S.E.
Ferguson, J., The University, Glasgow
Fergusson, H., 78, Acomb Street, Moss Side, Manchester
Field, E. W., The Brewery, Nottingham
Field, S. E., The Brewery, Nottingham
Field, J. K., Lombard Road, Battersea, London, S.W.
Fielding, A., 22, Dantzic Street, Manchester
Filcock, P., Chester Road, Macclesfield
Findlay, J. T. J., Silvertown, London, E.
Fisher, W. W., 5, St. Margaret's Road, Oxford
FitzBrown, G., Broughton Copper Works, Manchester
Fitzhugh, R., 21, Long Row, Nottingham
Fletcher, A. E., 57, Gordon Square, London, W.C.
Fletcher, F., North London Chemical Works, Holloway, N.
Fletcher, J. R., Kersley Paper Mills, Stoneclough, Manchester
Fletcher, R. Jopling, Vine Cottage, Hazel Grove, near Stockport
Fletcher, R. Steele, Misterton, Gainsboro', Lincolnshire
Fletcher, T., Thynne Street, Warrington
Flower, Major Lamorock (Lee Conservancy Board), 12, Finsbury Circus, E.C.
Flynn, T. J., c/o D. Heywood & Sons, Mitcham, Surrey
Foord, Geo., Royal Mint, Melbourne, Victoria, Australia
Foote, H. C., 37, Arlington Court, Cleveland, Ohio, U.S.A.
Forbes, J., Chemical Works, Old Ford, London, E.
Formoy, J. Arthur, 12, Railway Approach, London Bridge, S.E.
Forrest, A., Holt Town, Manchester
Forrester, J., 87, Cannon Street, London, E.C.
Forster, Ralph C., c/o Messrs. Bessler, Waechter & Co., Newcastle-on-Tyne
Forshaw, C. F., 8, St. Andrews, Listerhills, Bradford, Yorks
Forster, W. G., Lonesome Chemical Works, Streatham Common, London, S.W.
Forth, Henry, Eland Street, New Basford, Nottingham
Foster, H. Le Neve, Palmer's Shipbuilding and Iron Co., Limited, Jarrow-on-Tyne

Foster, R. Le Neve, The Firs, North Road, Droylsden, Manchester
Foster, R. Francis, 12, Roeland Street, Cape Town, South Africa
Foster, W., Middlesex Hospital, London, W.C.
Foulis, Wm., 2, Montgomerie Quadrant, Kelvinside, Glasgow
Fox, C. J., 66, Aldersgate Street, London, E.C.
Fox, T., jun., Court, Wellington, Somerset
France, G. H., Horsforth, Leeds
France, G. T., Friar's Goose, Gateshead-on-Tyne
France, H. C. D., 31, Portland Road, Edgbaston, Birmingham
Francis, E., Rock Villas, Parkside, Nottingham
Francis, E. G., 1, Halstead Villas, Fulham Road, Hammersmith, W.
Francis, G. B., 5, Coleman Street, London, E.C.
Francis, W. H., 5, Coleman Street, London, E.C.
Frankenburg, Isidor, Greengate Rubber Works, Salford, Manchester
Frankland, Dr. E., The Yews, Reigate, Surrey
Frankland, H., Sebright Villa, Egglescliffe, *viâ* Darlington
Frankland, Dr. P. F., Grove House, Pembridge Square, London, W.
Fraser, W. J., 124, Adelaide Road, Haverstock Hill, N.W.
Free, R., The Elms, Mistley, Essex
Freear, H. M., Edgefield, Harpenden, Herts
Freeman, A., 40, Liverpool Road, St. Helens, Lancashire
Freestone, J. W., 7, Clark Terrace, New Ferry Road, New Ferry, Cheshire
French, Andrew, Glanleam Villa, Bearsden, near Glasgow
Fries, Harold H., Mohrenstrasse 6, Berlin, W.
Friswell, R. J., 115, Darenth Road, Stamford Hill, London, N.
Frost, Joe, Mold Green, Huddersfield
Fryer, A. C., 16, Richmond Hill, Clifton, Bristol
Fullarton, R., 30, Donegal Place, Belfast, Ireland
Fuller, Jno., Rookwood, Chapter Road, Willesden Park, N.W.
Fuller, W. M., Ely House, Wolverhampton
Fulton, H. B., Limni, *viâ* Papho, Cyprus
Fyfe, Jno., West George Street, Glasgow

G

Gabbett, E. R., Prince Regent's Wharf, Victoria Docks, London, E.
Gadd, W. Lawrence, 50, Richmond Grove, Manchester
Gadsden, H. A., 6, Crosby Square, Bishopsgate Street, London, E.C.
Galbraith, William, 136, West Graham Street, Glasgow
Gall, Henry, L'Usine de Produits Chimiques de Villers par Hermes, Oise, France
Galt, Alexander, 61, Sardinia Place, Hillhead, Glasgow
Gamble, D., Windlehurst, St. Helens
Gamble, J. C., Hardshaw Brook Chemical Works, St. Helens
Gamble, W., Haresfinch, St. Helens
Gardiner, E. le Breton, Passaic, New Jersey, U.S.A.
Garrick, A. R., Eccleston Park, near Prescot
Garton, R. (Hill, Garton & Co.), Southampton Wharf, Battersea, S.W.
Gascoyne, Dr. W. J., Department of Agriculture, Richmond, Virginia, U.S.A.
Gaskell, H., jun., Clayton Lodge, Aigburth, near Liverpool
Gaskell, E. H., Woolton Wood, Liverpool
Gaskell, J., 1, Woodlands Road, Cheetham Hill, Manchester
Gatheral, G., Heathfield, Hebburn-on-Tyne
Gatine, L., 23, Rue des Rosiers, Paris
Gatty, F. A., Elmfield Hall, Accrington
Gaussen, W. F. A., 53, Eaton Square, London, S.W.
Gerland, B. W., Messrs. F. Steiner & Co., Church, near Accrington
Gibbins, H. B., Bryntirion, St. George's Road, Cheltenham
Gibbs, D. Cecil, Hanover Court, Milton Street, London, E.C.
Gibbs, R. D., Woodlands Cottage, Six Ways, Smethwick
Gibbs, W. P., Inveresk Mills, Musselburgh, N.B.
Gibson, J., 29, Greenhill Gardens, Edinburgh
Gibson, J. M., c/o Buckley Brick and Tile Co., Buckley, *viâ* Chester
Gilbert, Dr. J. H., Harpenden, near St. Albans
Gilchrist, P. C., Palace Chambers, 9, Bridge Street, Westminster, London
Gilchrist, Peter S., 10, Burlington Crescent, Goole
Giles, W., Clous Keagh Works, Warton Road, Stratford, London, E.
Gill, Aug. H., Mass. Institute of Technology, Boston, Mass., U.S.A.
Gilmour, Geo., Cameron Bridge Distillery, Windygates, Fifeshire, N.B.
Gimmingham, C. H., Stamford House, Northumberland Park, Tottenham, N.
Gladstone, Dr. J. H., 17, Pembridge Square, London, W.
Glaeser, F. A., Carpenter's Road, Stratford, E.
Girdwood, Dr. Gilbert P., 54, Beaver Hall Terrace, Montreal, Canada
Glen, J. M., Fereneze Printworks, Barrhead, N.B.
Glendinning, H., Dyar Terrace, Winnington, Northwich
Glendinning, N., Merton Bank, St. Helens
Glover, G. T., The Phospho Guano Co., Limited, Seacombe, Cheshire
Glover, John, Rothbury Terrace, Heaton, near Newcastle-on-Tyne
Glover, T., Messrs. Mort, Liddell & Co., Widnes
Glover, W., Tower Chemical Works, Silvertown, London, E.
Goddard, F., 1, Clipstone Avenue, Nottingham
Goldenberg, Laz., Edison Machine Works, 107, Goerck Street, New York, U.S.A.
Goldschmidt, S. A., Columbia Chemical Works, 20—30, Jay Street, Brooklyn, U.S.A.
Good, T., Inland Revenue, Alfreton, Derbyshire
Goodhart, E. C., 168, Lower Addiscombe Road, Croydon
Goodwin, C. C., Throstle Nest, Old Trafford, Manchester
Goppelsroeder, F., 14, Brubachstrasse, Mulhausen, Elsass, Germany
Gordon, J. G., Landore Steel Works, Landore, R.S.O., South Wales
Gore, Dr. G., 67, Broad Street, Birmingham
Gorman, W. A., Dunloe, Putney, S.W.
Gossage, F. H., Widnes
Gossling, Frank, The Patent Office, Southampton Buildings, Chancery Lane, W.C.
Gow, Dr. James, High School, Nottingham
Gow, R. J., Pittville Terrace, Ditton, near Widnes
Gowland, W., Imperial Mint, O Saka, Japan
Goyder, G. A., Government Survey Office, Adelaide, South Australia
Gracey, R., 21, Nile Street, Liverpool
Graesser, R., Cefn, near Ruabon, North Wales; and Argoed Hall, Llangollen, North Wales
Grafton, F. W., 91, Portland Street, Manchester
Graham, C., University College, Gower Street, London, W.C.
Graham, C. C., c/o Blundell, Spence & Co., Beverley Road, Hull
Graham, J. A., Sherborne Lodge, Werter Road, Putney, S.W.
Grandage, H., Thornton Road, Bradford, Yorkshire
Gray, G. Watson, 12, Argyle Road, Garston, near Liverpool
Gray, W., Oil Refinery, Hull
Gray, Jno., Clippens Oil Works, by Johnstone, N.B.
Green, A. G., Atlas Works, Hackney Wick, London, E.
Green, C. H., 7, York Street, Liverpool
Green, German, 2, Croft Terrace, Jarrow-on-Tyne
Green, H., Tovil House, Maidstone
Green, John, Iron, Tinplate, and Chemical Works, Abercarne, Mon.
Green, L., Riverdale, College Road, Maidstone
Green, R., Soho Mill, Wooburn, near Beaconsfield
Green, Upfield, Liebenheim, Clarendon Road, Watford, Herts.
Greenaway, A. J., Frognal, Hampstead, N.W.
Greenhalgh, J. Herbert, Shepherd's, Tottington Mill, near Bury
Greenhough, D. W., 16, Mincing Lane, London, E.C.

Greenway, T. J., 378, Eccleshall Road, Sheffield
Greenwood, H., 64, King Street, Accrington
Greville, H. L., 4, Moreland Villas, Lambton Road, Hornsey Rise, London, N.
Grey, W. J., Belle Vue House, Gateshead-on-Tyne
Griess, P., Burton-on-Trent
Griffin, Martin L., Holyoke, Mass., U.S.A.
Griffith, Agnew, Daisy Mount, Blundell Sands, Liverpool
Griffith, R. W. S., Eyeworth Lodge, Lyndhurst, Hants
Griffiths, Azariah, Elmbank, Pleasance, Falkirk, N.B.
Grime, J., Rosebank Cottage, Busby, near Glasgow
Grimshaw, H., Thornton View, Clayton, Manchester
Grimwood, R., 30, Bickerton Road, Upper Holloway, London, N.
Grindley, J., Upper North Street, Poplar, London, E.
Groom, A. J., City of London Brewery, Thames Street, E.C.
Grossmann, Dr. J., Hendham Vale Chemical Works, Manchester
Groves, C. E., 352, Kennington Road, London, S.E.
Grundtvig, C. H. W., Sunnyside, Wimbledon, S.W.
Gunn, W. L., Broad Plain Soap Works, Bristol
Guyatt, T., Ceara Gas Co., Limited, 9, Queen Street Place, Cannon Street, London, E.C.

H

Haacke, A., Kieselguhr Wharf, Hackney Wick, E.
Habirshaw, W. W., 159, Front Street, New York City, U.S.A.
Hacking, W. H., The Grange, Clayton-le-Moors, near Accrington
Haddow, A., 1, Keith Place, Easter Road, Edinburgh
Hadfield, R. A., Newhall Road, Attercliffe, Sheffield
Hadkinson, F., Pamphila Oil and Soap Works, Mitylene, Mediterranean
Hadkinson, R., Smyrna, Asia Minor
Haga, Tamenasa, Chemical Department, Science College, Imperial University, Tokyo, Japan
Haig, Robert, Busby Printworks, Glasgow
Hake, C. N., 14, Great Smith Street, Westminster, S.W.
Hall, Archibald D., 95, Bishopsgate Street, London, E.C.
Hall, C., 5, Bilton Road, Rugby
Hall, Edgar, Queenborough, Kent
Hall, G., Laboratorio, Minas de Rio Tinto, Provincia de Huelva, Spain
Hall, J. Albert, 128, Lloyd Street, Greenheys, Manchester
Hall, Joseph, Park Villa, Queen's Park, St. Helens
Hall, S., East London Soap Works, Bow, London, E.
Hall, T. Farmer, Dunster House, Mark Lane, London, E.C.
Hall, W. J., c/o Boulton & Co., Aurora Mines, Puerto Cabello, Venezuela
Haller, Geo., 86, Leadenhall Street, London, E.C.
Hallett, Shackleton, 1, Hare Court, Temple, E.C.
Hamburger, S., 117, North Road, St. Helens
Hamilton, David, Ash Bank, Shawlands, near Glasgow
Hamilton, Jas. C., Kingscavil, Linlithgow, N.B.
Hamilton, Oswald, Owens College, Manchester
Hamilton, Robert, Muirkirk Ironworks, Muirkirk, N.B.
Hamlen, G. J., 33, Vane Street, Spring Bank, Hull
Hammersley, Wm., Tar Works, Beckton, E.
Hammersley, W. H. L., Daisy Bank Cottage, Leek, Staffordshire
Hammill, M. J., Dunton Green, near St. Helens
Hammond, J., The Gas Co., Lewes, Sussex
Hand, T. W., Public Library, Oldham
Handasyde, C. H., The Dean Works, Dalkeith, N.B.
Hanrez, Prosper, 19, Rue du Prince Albert, Brussels; and 9, Rue Moris, Chaussée de Charleroi, Brussels
Hanson, A. M., Abbey Printworks, Whalley, Blackburn
Hanson, John, Fern Villa, Belle Vue, Wakefield
Hardie, William, The Gas Offices, Newcastle-upon-Tyne
Hardman, J., Milton Chemical Works, Stoke-on-Trent
Hardy, H. J., 163, Edmund Road, Sheffield
Hargreaves, J., Widnes
Harkness, W., The Laboratory, Somerset House, London, W.C.
Harland, R. H., Plough Court, 37, Lombard Street, London, E.C.
Harley, Bostor, Laboratory, Carron Works, Falkirk, N.B.
Harrington, W. B., Ardsullagh, Old Blackrock Road, Cork
Harris, Booth, jun., Clovelly House, Nor[illegible] Forest Gate E.
Harris, D., Caroline Park, Edinburgh
Harris, Evan R., Luckwell House, Bedminster Heath,
Harris, T., The Union Acid Co., Runcorn
Harrison, A., Thames Sugar Refinery, Silvertown, London, E.
Harrison, C., Anglo-American Oil Mills, Church Street, Hull
Harrison, G. D., Netham Chemical Works, Bristol
Harrison, G. King Hagley, near Stourbridge
Harrison, G. H., Hagley, near Stourbridge
Harrison, J., 5, Magdala Terrace, Gardiner's Hill, Cork
Harrison, P. W., 7, Cromwell Road, Peterborough
Harrison, S. M., Sutton Alkali Works, St. Helens
Hart, Bertram H., 106, Trinity Street, Norwich
Hart, E., Lafayette College, Easton, Pa., U.S.A.
Hart, P., c/o Tenants & Co., Mill Street, Clayton, Manchester
Hartland, W. H. H. 114, Hyde Park Street, Glasgow
Hartley, Joseph, 3, Brook Road, Gorton Hall Estate, near Manchester
Hartley, Arthur, Canon Brewery, Brighton
Hartley, W. N., Royal College of Science, Dublin
Hartmann, G., Claverley, Blackheath Park, London, S.E.
Harvey, Ernest W., c/o Mrs. Addie, 9, Main Street, Wishaw, N.B.
Harvey, W., 70, Greffhuregatan, Stockholm, Sweden
Harvey, T. H., Catteown, Plymouth
Hasenclever, R., Chemische Fabrik-Rhenania, Aachen, Prussia
Hastings, C. W., 22, Buckingham Street, Adelphi, London, W.C.
Hastings, H. M., 54, Edith Road, West Kensington, W.
Hatfield, Jno., Windsor Road, Newton Heath, Lancashire
Hatton, Wm. P., 13, St. Quintin Avenue, North Kensington, W.
Hawkins, H., Eyeworth Lodge, Lyndhurst, Hants
Hawliczek Josef, 40, Berey Road, Liverpool
Hazelhurst, C. W., Halton Grange, Runcorn
Head, John, 12, Queen Anne's Gate, Westminster, S.W.
Healey, A. E., Willesden Junction, London, N.W.
Heap, Chas., Caldershaw, near Rochdale
Heap, L., Stacksteads, near Manchester
Heath, R. C., Myton Grange, near Warwick
Heathfield, R., Edgbaston Hall, Birmingham; and Lion Galvanising Works, Birmingham Heath
Heaton, C. W., Charing Cross Hospital, London, W.C.
Hedley, Armorer, Mayfield, Gosforth, Newcastle-on-Tyne
Heer, P. Engen, Obernwyl, Canton St. Gallen, Switzerland
Heerlein, Robert, Pennsylvania Salt Manufacturing Co., Natrona, Pa., U.S.A.
Hehner, O., 11, Billiter Square, London, E.C.
Heisch, C., 79, Mark Lane, London, E.C.
Hellier, Walter J. G., Bristol Channel Chemical Co., Minehead, Somerset
Hellon, R., 47, New Lowther Street, Whitehaven
Helm, H. J., 13, St. George's Villas, Perry Hill, Catford, S.E.
Hemingway, H., 60, Mark Lane, London, E.C.
Hempleman, F. S., Wennington House, Wennington, Romford, Essex
Henderson, G. G., Chemical Laboratory, The University, Glasgow
Henderson, W. F., Moorfield, [illegible]remont Gardens, Newcastle-on-Tyne
Hendrichs, F. H., 21, Mincing Lane, London, E.C.
Henshaw, Jno., Brook Street Soap Works, Manchester
Henning, E. C., Bow Brewery, Bow, E.
Heriot, Wm. Scott, Plu. Leon, Demerara

Herman, W. D., West Park, St. Helens
Herrmann, R. W. (Herrmann, Keller & Co.), 60, Mark Lane, London, E.C.
Heron, J., c/o Gatton, Hill & Co., Southampton Wharf, Battersea, S.W.
Foulis, W E. F., General Steam Navigation Company's
Glasgo s, Deptford, London, S.E.
Fox, C. J. A. S., 47, Lovaine Place, Newcastle-on-Tyne ;
Fox, T., j ollege of Science, Newcastle-on-Tyne
ance, G os., Jarrow Chemical Works, South Shields
H s, Adolph, Oil Works, Leeds
Hewitt, D. B., Winnington House, Northwich, Cheshire
Heycock, C. T., King's College, Cambridge
Heyden, Dr. F. von, 6, Leipsiger Strasse, Dresden, Germany
Heys, W. E., 70, Market Street, Manchester
Heys, Z. J., Stonehouse, Barrhead, N.B.
Heys, Z. G., Springhill Villa, Barrhead, near Glasgow
Heywood, G., Spring Vale Works, Middleton, Lancashire
Heywood, J. G., 68, Sutherland Avenue, Maida Vale, London, W.
Heywood, J. H., Holland Street, Rochdale
Heywood, J. S., 7, Caledonian Road, King's Cross, London, N.
Hibbert, W., 8, St. Dunstan's Road, Margravine Gardens, West Kensington, S.W.
Higgin, A. J., 22, Little Peter Street, Gaythorn, Manchester
Higgin, W. H., Hall Chemical Works, Little Lever, near Bolton
Higgins, C. L., c/o J. Muspratt & Co., Widnes ; and 29, Falkner Square, Liverpool
Hilditch, T., Cedar Grove, Heaton Chapel, near Manchester
Hill, A. Bostock, 14, Temple Street, Birmingham
Hill, A. Bowdler, 101, Southwark Street, London, S.E.
Hill, J. F., Bowker Bank Printworks, Higher Crumpsall, Manchester
Hill, J. K., Waterside, Irvine, N.B.
Hills, A. F., Thames Ironworks and Shipbuilding Co., Victoria Dock Road, E.
Hills, C. H., Anglesea Copper Works, Low Walker, Newcastle-on-Tyne
Hills, H., Chemical Works, Deptford, London, S.E.
Hills, M. H., Tower Varnish Works, Long Acre, Nechells, Birmingham
Hills, W., 225, Oxford Street, London, W.
Hills, W. A., Great Barr, near Birmingham
Hindle, J. H., 67, Avenue Parade, Accrington
Hinds, James, 127, Gosford Street, Coventry
Hirst, Benj., Messrs. Hirst, Brook & Hirst, Leeds
Hislop, L., Saltney, Cheshire
Hodges, J. F., 63, Upper Arthur Street, Belfast, Ireland
Hodgkins, J , Childwall, Church Road, Richmond, Surrey
Hodgkinson, J. H., Messrs. E. Potter & Co., Dinting Vale, Glossop
Hodgkinson, W. R., 29, Pembroke Square, London, W. ; and South Kensington Museum, London, S.W.
Hodgson, C., High House, Eppleby, Darlington
Hofmann, A. W., 10, Doratheen Strasse, Berlin, Germany ; and c/o C. Hofmann, 20, Oxford Mansions, W.
Hogben, W., Redbraes, Broughton Road, Edinburgh
Hogg, Lt.-Col. Sir James, Bart., M.P., 17, Grosvenor Gardens, London, S.W.
Hogg, T. W., c/o John Spencer & Sons, Newburn Steelworks, Newcastle-on-Tyne
Hohenhausen, J. von, Yew Tree Chemical Works, 303, Collyhurst Road, Manchester
Holdich, A. H., Wigan Coal & Iron Co., Ld., Wigan
Holdsworth, H. G., West Ham Abbey, London, E.
Holgate, S. V., 29, Long Row, Nottingham
Holgate, T. E., 146, Blackburn Road, Darwen, Lancashire
Holgate, T., Corporation Gasworks, Batley
Holland, P., 18, Exchange Street, Manchester ; and 12, Talbot Street, Southport
Holliday, R. (Read, Holliday & Sons), Huddersfield
Holliday, T., Clifton Villa, High Street, West Bromwich, Staffordshire
Holloway, Wm., Newlands, Middlesbro'.
Holmes, Ellwood, Wellburn, Jesmond, Newcastle-on-Tyne
Holmes, F. G., Prince Regent's Wharf, Victoria Docks, E.
Holmes, J., 96, Holland Road, Brixton, London, S.W.
Holt, G. Crompton, c/o Hugh Hughes, 4, York Buildings, Sweeting Street, Liverpool
Holt, J. W., North Road, Clayton, near Manchester
Hood, R. W., 46, Sandwell Road, West Bromwich
Hooper, E. G., The Laboratory, Somerset House, London, W.C.
Hooton, Edm., The Vinery, Burton Joyce, Notts.
Hopkin, W. K., 16, Cross Street, Hatton Garden, London, E.C.
Horé, Etsnojo, 88, King Henry's Road, Chalk Farm, N.W.
Horn, W. Freeman, Grove Works, Lombard Road, Battersea, S.W.
Horner, G. F., Old Basford, Nottingham
Horrocks, S., 38, Duke Street, Southport, Lancashire
Howard, A. G., The Green, Tottenham, London, N.
Howard, D., Rectory Manor, Walthamstow, Essex
Howard, D. L., City Mills, Stratford, London, E.
Howard, W. D., City Mills, Stratford, London, E.
Howard, W. Crewdson, Messrs. Howard & Sons, Stratford, London, E.
Howarth, R. S., 21, Bellott Street, Cheetham, Manchester
Howell, H., Pye Bridge Chemical Works, Alfreton, Derbyshire
Hoyle, C. F., Holmeleigh, Woodlesford, near Leeds
Hoyle, T. E., Church Terrace, Blackley, near Manchester
Hughes, E. J., Church Street, Flint
Hughes, H., 7, Geneva Road, Elm Park, Fairfield, Liverpool
Hughes, J., 79, Mark Lane, London, E.C.
Hughes, R., Church Street, Flint
Hughes, T., c/o Herb. Hughes, Lower Gornal, near Dudley
Hulme, J., Vale Printworks, Dinting, Glossop
Hume, William, 18, Lonsdale Terrace, Edinburgh
Humfrey, C., The Villas, Parkgate, Cheshire
Hummel, J. J., Cavendish Villa, Woodhouse Cliffe, Leeds
Humphrys, N. H., Gasworks, Salisbury, Wilts
Humphrys, F. C., Gasworks, Ilkeston, Nottingham
Humphries, Jacob, Apothecaries' Hall, Low Moor, near Bradford
Hunt, B., c/o W. L. Jackson, Esq., M.P., Buslingthorp Tannery, Leeds
Hunt, C., Gasworks, Windsor Street, Birmingham
Hunt, E., Wood Green, Wednesbury, Staffordshire
Hunt, W., Wood Green, Wednesbury, Staffordshire
Hunt, J. S., Appleton, Widnes
Hunter, F. W., 4, Westmoreland Road, Newcastle-on-Tyne
Hunter, John, Minto House Medical School, Edinburgh
Hunter, T. G., Comestoca Printworks, Paschall Street, Philadelphia, Pa., U.S.A.
Huntington, A. K., King's College, Strand, London, W.C.
Hunzinger, Alfred, c/o E. Potter & Co., Dinting Vale, Glossop, Derbyshire
Hurman, F. K., Ryton-on-Tyne
Hurst, G. H., 22, Blackfriars Street, Salford, Manchester
Hurter, F., Messrs. Gaskell, Deacon & Co., Widnes
Huskisson, P. L., 77, Swinton Street, London, W.C.
Husband, J. Cecil, Knowsley Street (and 21, Heywood Street), Cheetham, Manchester
Huson, C. W., 5, York Buildings, Dale Street, Liverpool
Hutcheson, J. B., The University, Glasgow
Hutchings, W. M., Dee Bank Lead Works, Bagillt, North Wales
Hutchinson, A. H., 90. Cannon Street, London, E.C.
Hutchinson, C. C., Messrs. S. H. Johnson & Co., Stratford, London, E.
Hutchinson, Chas. H., Albert Works, Church Street, Barnsley, Yorkshire

Hutchinson, T. J., Leeman's Hill Works, Tottington, near Bury
Huxley, J. H., 40, Brincliffe Edge Road, Sheffield

I

Ikuta, M., Universitats Laboratorium, Erlangen, Bavaria
Imray, Harold, The Grange, Underhill, near Barnet
Ingham, J. W., 2, Bisley Villas, Ferndale Road, Leytonstone, E.
Inglis, R. A., Arden, Bothwell, N.B.
Irvine, R., Royston, Granton, Edinburgh
Irvine, G. H., Cloncurry Copper & Smelting Co., Queensland, Australia
Irving, J. M., 17A, Dickinson Street, Cooper Street, Manchester
Irwin, W., The Grange, Polygon Road, Higher Crumpsall
Irwin, J. T., The Grange, Polygon Road, Higher Crumpsall
Isler, Otto, Marsden Street, Manchester
Ivey, W. E., School of Agriculture, Lincoln, Canterbury, New Zealand

J

Jack, W. F., Ravensworth, Neath, Glamorganshire
Jackson, A. G., The Willows, Martintown, Port Douglas, Queensland
Jackson, Edward, Ashleigh, Beaufort Road, Edgbaston, Birmingham
Jackson, Edgar, 106, Queen Victoria Street, London, E.C.
Jackson, F., Spring Bank, Crumpsall Lane, Manchester
Jackson, G. B., Copthorne House, Congleton, Cheshire
Jackson, John, 260, Dobbie's Loan, Glasgow
Jackson, R. V., Ashurst, West Hill, Sydenham, S.E.
Jackson, T., Clayton, near Manchester
Jackson, Walter, 24, Sydenham Avenue, Sefton Park, Liverpool
Jackson, W. P., Saxilby, near Lincoln
Jacques, G., High Street, Uttoxeter, North Staffordshire
Jago, Wm., Science Schools, Brighton
James, E. T., British Alizarin Co., Ld., Silvertown, Victoria Docks, E.
James, J. Wm., University College, Cardiff
Jameson, J., Akenside Hill, Newcastle-on-Tyne
Japp, Dr. F. R., 27, Woodstock Road, Bedford Park, Chiswick, W.
Jarmay, G., Winnington Park, Northwich
Jarves, Deming, Michigan Carbon Works, Detroit, Mich., U.S.A.
Jayne, H. W., Chem. Lab., Bermuda Street, Frankford, Philadelphia, U.S.A.
Jekyll, H. H., Drury Lane, Lincoln
Jekyll, J., Castle Moat House, Lincoln
Jenner, E., Arthur Villa, Murchison Road, Leyton, Essex
Johnson, A. E., Victoria Street, Wolverhampton
Johnson, D., 52, Fitzjohn's Avenue, South Hampstead, N.W.
Johnson, E., Lawton House, Rainhill, Lancashire
Johnson, Frank, Minas de Rio Tinto, Huelva, Spain
Johnson, Geo., Grange Metal Works, Jarrow-on-Tyne
Johnson, Jno., Franklin Square, and Cherry Street, New York, U.S.A.
Johnson, J. E., Crown Chemical Works, Stratford, London, E.
Johnson, J. Grove, 23, Cross Street, Finsbury, London, E.C.
Johnson, J. H., 47, Lincoln's Inn Fields, London
Johnson, S. H., West Ham Hall, Forest Gate, Essex
Johnson, T. A., Winnington Park, Northwich, Cheshire
Johnston, W. G., Chemical Works, Coatbridge Street, Port Dundas, Glasgow
Johnston, W. G., Stevens' Institute of Technology, Hoboken, N.J., U.S.A.
Johnstone, Jas., Shawfield Works, Rutherglen, Glasgow
Johnstone, L., Newbattle Collieries, Dalkeith, N.B.
Johnstone, W., 16, Alfred Place West, South Kensington, S.W.
Jones, A. F., South Arthurlie, Barrhead, Glasgow
Jones, E. W. T., 10, Victoria Street, Wolverhampton
Jones, E. Fielding, Dalmonach, Bonhill, Dumbartonshire, N.B.
Jones, F., Chemical Laboratory, Grammar School, Manchester
Jones, H. Chapman, Royal Normal School of Science, South Kensington, London, S.W.
Jones, J. W., Bastord House, Seymour Grove, Whalley Range, Manchester
Jones, Lieut.-Col. A. S. (V.C.), Hafod-y-Wern Farm, Wrexham, Denbighshire
Jones, W. Arthur, Kenwith Lodge, Redland, Bristol
Jones, W. Norris, 53, Botanic Road, Edge Lane, Liverpool
Jones, W., 47, New Broad Street, London, E.C.; and c/o H. Jones, 6, Lord Street, Liverpool
Joynson, F., Connahs Quay Alkali Works, Connahs Quay, Flint
Jowett, W., Lower Hall, Mellor, near Stockport
Justice, P. M., 14, Southampton Buildings, Chancery Lane, London, W.C.

K

Kalle, Dr. Wm., Biebrich-am-Rhein, Germany
Kater, R. McCulloch, Nobel's Explosives Co., Stevenston, Ayrshire, N.B.
Kawakita, Michitada, Imperial College of Engineering, Tokyo, Japan
Kay, H. A., 13, Maida Vale, London, W.
Kay, W. E., c/o W. Crum & Co., Thornliebank, Glasgow
Kean, J., Acca House, Grant Street, Jarrow-on-Tyne
Kearns, H. W., Baxenden, near Accrington
Keeling, F., 52, Lansdowne Gardens, South Lambeth, S.E.
Keiser, E. H., Bryn Mawr College, Bryn Mawr, Pa., U.S.A.
Kellner, Dr. Wm., 13, Clarendon Villas, Old Charlton, S.E.
Kelly, R. R., 3, Pall Mall East, London, S.W.
Kemp, W. J., Dingley, Redhill, Surrey
Kennedy, William, 28, Royal Exchange Square, Glasgow
Kenyon, A., Rossendale Brewery, Clough Fold, near Manchester
Kenyon, R., Printworks, Handforth, near Manchester
Kerr, J., Church, near Accrington
Kerry, W. H., Laboratory, 14, Castle Street, Liverpool
Kershaw, J., Grease, Varnish, and Cement Works, Hollinwood, near Oldham
Kershaw, J. B. C., Sutton Lodge Chemical Works, St. Helens
Key, J. T., 8, Machon Bank, Nether Edge, Sheffield
Keys, Jno. G., 1, Thynne Street, West Bromwich
Kiddie, Thos., c/o Orford Sulphur and Copper Co., Box 44, New Brighton, New York, U.S.A.
Kilner, F. J., Royal Infirmary, Bristol
Kilpatrick, W. S., 4, Annfield Place, Glasgow
Kinch, E., Royal Agricultural College, Cirencester
Kindersley, E. N. M., Crown Chemical Works, Marsh Gate Lane, Stratford, London, E.
King, A. J., Ingersley Vale Bleachworks, Bollington, Macclesfield
King, C. M., 5, Ferme Park Road, Hornsey, N.
King, C. M., Campsie Alum Works, Lennoxtown, N.B.
King, J. Falconer, City Analyst, Edinburgh, N.B.
King, J. T., Clayton Square, Liverpool
King, J. Westall, 115, Wellington Street, Glasgow
King, Walter, Tamworth House, Mitcham, Surrey
Kingdon, J. E., 30, Victoria Road, Old Charlton, S.E.
Kingsford, T. P., Oswego, New York, U.S.A.
Kingzett, C. T., Trevena, Amhurst Park, London, N.
Kirkham, Thos., 70, Greenway Road, Runcorn, Cheshire
Kirkman, R., Landore Alkali Works, Swansea
Kirkpatrick, A. J., 179, West George Street, Glasgow
Kitamura, Y., c/o Mr. Goto, 42, Chitose Cho, Honyo, Tokyo, Japan
Kitchen, Theo., Messrs. J. Kitchen & Sons, 28, Flinders Lane North, Melbourne, Australia
Kitto, B., 26, Lancaster Road, Finsbury Park, London, N.

Klein, J., *in firma* Klein, Schanzlin, Becker, Frankenthal, Rheinpfalz, Germany
Knight, Henry, 51, South John Street, Liverpool
Knight, J. B., Silvertown Soapworks, Silvertown, London, E.
Knight, J. J., 10, Key Hill Drive, Hockley Hill, Birmingham
Knipler, F., Starch Works, Wandsworth, S.W.
Knowles, Jno., 58, Greenway Road, Runcorn, Cheshire
Knowles, Joshua, Stormer Hill, Tottington, near Bury
Knowles, Samuel, Stormer Lodge, Crumpsall, Manchester
Knox, E. W., Colonial Sugar Refining Co., Sydney, N.S.W.; and c/o F. Parbury & Co., 7, East India Avenue, Leadenhall Street, London, E.C.
Koechlin, Horace, Loerrach, Duchè de Bade, Germany
Kohn, Chas. A., University College, Brownlow Street, Liverpool
Kolb, J., Soc. Anon. des Manuf. de Produits Chimiques, Lille, France
Kraftmeier, E., 6, Great Winchester Street, London, E.C.
Krause, G., "Chemiker-Zeitung," Cöthen, Germany
Krause, O. H., Box 217, Jersey City, New Jersey, U.S.A.
Krohn, F. W. T., 13, Belsize Square, South Hampstead, N.W.
Kühl, W. H., 73, Jager Street, Berlin, Germany
Kunheim, Dr. Hugo, 23, Lindenstrasse, Berlin
Kupferberg, H., Chemical Works, Blackley, near Manchester
Kur, Emmanuel, 13, Bath Buildings, Huddersfield
Kynaston, J. W., Kensington, Liverpool

L

Lacey, T. S., Lawn House, Beckton Gasworks, North Woolwich, London, E.
Laidler, C. P., 26, Noble Terrace, Gateshead-on-Tyne
Laing, John, 38, Warrender Park Terrace, Edinburgh
Lake, D. E., 36, Mark Lane, London, E.C.
Lake, G., jun., 538, Eccles New Road, Eccles, Manchester
Lake, W. H., 11, St. Julian's Farm Road, West Norwood, S.E.
Lakeman, T., 178, Phillip Street, Sydney, New South Wales
Lamb, Chas., 60, Mark Lane, London, E.C.
Lamond, H. B., Levenshulme Printworks, Manchester
Lane, D., 72, South Mall, Cork, Ireland
Landsberg, Dr. Ludwig, Offenbach à/M., Germany
Langbeck, H. W., 127, Leman Street, London, E.
Larios, P., c/o Messrs. R. Marsden & Co., 47, Spring Gardens, Manchester
Larkin, T., St. Bede Chemical Works, South Shields
Larned, J. N., Young Men's Library, Buffalo, N.Y., U.S.A.
Latham, Baldwin, 7, Westminster Chambers, Victoria Street, London, S.W.
Laurie, A. P., 29, Artesian Road, Bayswater, London, W.
Lawrence, H. A., Brockweir, Grosvenor Road, Gunnersbury
Lawrence, Jas., 7, Bellgrove Terrace, Glasgow
Laws, J. P., 3, Tyfield Road, Oxford
Lawson, Wm., Bellshill, Lanarkshire
Lawson, Arthur J., Marsh Soapworks, Bristol
Lazarus, M. J., Ashburn House, Victoria Park, Manchester
Leathart, J., Lead Works, Newcastle-on-Tyne
Leather, J. W., 13, Redcliffe Street, South Kensington, S.W.
Lee, C. Tennant, 45, Kilby Street, Boston, Mass., U.S.A.
Lee, S. Wright, 7, Church Street, Liverpool
Lee, J. E., Wallsend, Newcastle-on-Tyne
Lee, H. C., Peckham Brewery, Hill Street, Peckham, S.E.
Leeds, F. H., Wearside, Forest Gate, E.
Leeming, T. H., Burneston House, Barking Road, Plaistow, London, E.
Lees, Asa, 76, Duncombe Road, Upper Holloway, N.
Lees, Thos., Daisy Bank, Gorton Road, Reddish, near Stockport
Leete, Jos., 57 and 58, Tooley Street, London Bridge, S.E.
Leffmann, Dr. H., Box 791, Philadelphia, Pa., U.S.A.
Leith, J., Boundary Road Chemical Works, St. Helens
Leipner, H. A. B., 8, Loftus Street, Sydney, New South Wales
Lemon, Jas., Palace Chambers, Westminster, S.W.
Lennard, F., 165, Fenchurch Street, London, E.C.
Lennox, Jno., Cloncurry Copper and Smelting Co., Cloncurry, Queensland
Leonard, Wm. J., Hope Chemical Works, Hackney Wick, E.
Leon, J. T., 38, Portland Place, London, W.
Lester, Wm., Bron Offa, Wrexham, North Wales
Leverkus, Otto, 1 and 3, Leamington Place, Princess Street, Manchester
Levinstein, Ivan, Neuburg, Daisy Bank Road, Victoria Park, Manchester
Lewington, B., 14, Cleveland Street, Fitzroy Square, London, S.W.
Lewis, J. H., c/o Muspratt & Sons, Widnes
Lewis, G. T., 231, South Front Street. Philadelphia, Pa., U.S.A.
Lichtenstein, Theodore, Chemical Works, Silvertown, London, E.
Liddle, W. T., 421, Blackburn Road, Accrington
Liebermann, L., 54, Portland Street, Manchester
Liebmann, Dr. A., 10, Marsden Street, Manchester
Liepmann, H., The Liepmann Carbon Co., Limited, Nelson Wharf, Millwall, London, E.
Lightfoot, T. E., 3, Church Terrace, Accrington
Lightfoot, T. B., Cornwall Buildings, 35, Queen Victoria Street, London, E.C.
Lilley, H. L., Albert Works, Queen's Road, Manchester
Lilly, Oliver M., The Croft, Spondon, Derby
Linde. Carl, Wiesbaden, Germany
Lindley, L., Sherwood Street, Nottingham
Lishman, W. W. L., 36, Washington Street, Girlington, Bradford, Yorks.
Littlejohn, J., 53, Renfield Street, Glasgow
Liversedge, A. J., c/o Watson, Laidlaw & Co., Kingston, Glasgow
Liversidge, A., The University, Sydney, New South Wales; and c/o Trubner & Co., 57, Ludgate Hill, London
Livesey, Frank, South Metropolitan Gas Co., 709A, Old Kent Road, London, S.E.
Livingston, W. J., Metropolitan Board of Works, Spring Gardens, London, S.W.
Lober, J. B., 3409, Race Street, Philadelphia, Pa., U.S.A.
Lodge, A. S., Spring Side, Prestwich, near Manchester
Lomas, T., Cleveland, Minehead, Somerset
Longmore, J., Hillside, Brentwood, Essex
Longshaw, Jas., 7, Park Place, Cross Lane, Salford
Longstaff, G. D., Butterknowle, Southfields, Wandsworth, S.W.
Lorenz, H., 7 and 8, Idol Lane, London, E.C.
Lorimer, J., 42, Hargrave Park Road, Junction Road, London, N.
Lorrain, J. G., Norfolk House, Norfolk Street, Strand, London, W.C.
Lott, F. E., The Laboratory, Bridge Chambers, Burton-on-Trent
Louis, D. A., 77, Shirland Gardens, London, W.
Love, E. G., School of Mines, Columbia College, 50th Street, New York, U.S.A.
Lovett, W. Jesse, Jessamine Cottage, Thornes, near Wakefield
Lovibond, J. W., 26, St. Ann's Street, Salisbury
Lovibond, T. W., Beaumont House, Newark-on-Trent
Lovibond, V. L., The Hermitage, North End, Fulham, S.W.
Lowe, C. W., Summerfield House, Reddish, near Stockport
Lowe, W., 21, Rosamond Street West, All Saints, Manchester
Lowe, W. F., Cambrian View, Chester
Lowman, Oscar, 53/3 Karl Strasse, Munich, Bavaria
Lowson, J. G. F., St. Leonard's Mill, Lasswade, Midlothian, N.B.

Lucas, R. J., 10, North Street, Longsight, Manchester
Luck, A., Powder Mills, Dartford, Kent
Luck, E., 70, Stamford Street, Blackfriars Road, London, S.E.
Luck, H. C., 70, Stamford Street, Blackfriars Road, London, S.E.
Lundberg, Alf., Bergvik, Sweden
Lunge, G., Englisches Viertel, Hottingen, Zürich, Switzerland
Lunn, C., Woodsome Lees, near Huddersfield
Lupton, Sydney, The Harehills, near Leeds
Lüthy, Otto, 220, Church Street, Philadelphia, Pa., U.S.A.
Lye, W. T., The Firs, Luton, Beds.
Lyle, James, Plaistow Wharf, North Woolwich Road, London, E.
Lyle, Jno., 37, Mincing Lane, London, E.C.
Lyon, J. G., The Aire Tar Works, Knottingley, Yorks.
Lyte, F. M., Cotford, Oak Hill Road, Putney, London, S.W.
Lyttle, A. M., North of Ireland Chemical Co., Belfast

M

Macadam, C. T., 116, Fenchurch Street, London, E.C.
Macadam, Dr. S., Surgeons' Hall, Edinburgh
Macadam, W. I., Surgeons' Hall, Edinburgh
Macalpine, G. W., Parkside, Accrington
Macarthur, J. G., 260, Dobbie's Loan, Glasgow
Macdonald, A., 3, Vale View Terrace, Langside, Glasgow
Macdonald, J. W., c/o Messrs. H. Tate & Sons, Love Lane, Liverpool
Macfarlane, J. A., Marquesa 2, Barcelona, Spain
Macfarlane, R. F., Grange Metal Works, Jarrow-on Tyne
Macfarlane, Thos., Inland Revenue Dept., Ottawa, Canada
Macfarlane, W., Monk's Bridge Ironworks, Leeds
MacIlwaine, A. W., Patent Oil Extracting Co., Stoneferry, Hull
MacIndoe, G. D., 1, Reginald Villas, Waterloo Road, Wolverhampton
MacIntosh, C. J., 54, Leadenhall Street, London, E.C.
Mackenzie, Jas., 24, Shuttle Street, Glasgow
Mackenzie, T. E., Tharsis Mines, Huelva, Spain
Mackenzie, W. Cossar, 2, Grove Terrace, Edinburgh
Mackey, J. A., 1 and 2, Bouverie Street, London, E.C.
Mackinlay, Wm., Laboratory, Silicate Paint Works, Charlton, Kent
Mackinnon, A. K., 79, Drayton Gardens, London, S.W.
Maclagan, R. C., 5, Coates Crescent, Edinburgh
MacMahon, J. H., Lancashire Alkali and Sulphur Co., Limited, Widnes
Macmillan, J. L., 1, Mango Lane, Calcutta, India
Macnab, C., Lillyburn, Milton of Campsie, N.B.
Macnab, W., jun., 74, Windsor Road, Forest Gate, Essex
Macnair, D. S., Allan Glen's Institution, Cathedral Street, Glasgow
Macpherson, D. D., Reddish House, near Lymm, Cheshire
Mactear, J., 2, Victoria Mansions, Westminster, S.W.
McAlister, R., Lawes' Chemical Manure Co., Limited, Barking Creek, Essex
McAllum, C. D., 7, Dean Street, Newcastle-on-Tyne
McArthur, J. S., Cassel Gold Extracting Co., Limited, 13, West Scotland Street, Kinning Park, Glasgow
McBeath, J. W., Exeter Street, West Hartlepool, Durham
McCallum, J. M., South Park, Paisley, N.B.
McCalman, D., 116, George Street, Glasgow
McCarnie, T. (Couper, McCarnie & Co.), 1, Fenchurch Avenue, London, E.C.
McCowan, W., Crown Brewery, Cape Hill, Birmingham
McCulloch, J., 2, Tyne View Terrace, Hebburn-on-Tyne
McDaniel, J. J., Bandon. Ireland
McDonald, Donald, Invernevis, Fort William, N.B.
McDonald, T. M., Kirtoun, Seabank Road, Liscard, Cheshire
McEwen, T. G., 53, New Road, Commercial Road, London, E.
McFarlane, Walter, Crosslee House, Thornliebank, near Glasgow
McFarlane, J. F., Newton Schoolhouse, Dalkeith, N.B.
McGlashan, John, Woodneuk, Garteosh, near Glasgow
McGowan, John, Ash House, Talk-o'-th'-Hill, near Stoke-upon-Trent
McKechnie, D., Copper Works, St. Helens
McKechnie, D. M., Olive Mount, St. Anne's, St. Helens
McKechnie, R., Thorndean, Elderslie, by Paisley, N.B.
McKellar, W. G., Eglinton Chemical Works, Irvine, N.B.
McKenny, C., Drogheda Chemical Manure Co., Drogheda, Ireland
McKinlay, J. G., 15, Charing Cross, Glasgow
McKinlay, R. W., Ameliaville, Aytoun Road, Pollokshields, N.B.
McLellan, J. Y., Cullochfaulds Chemical Works, Craig Street, Glasgow
McLeod, H., Cooper's Hill, Staines
McMillan, W. G., Metallurgical Laboratory, King's College, Strand, London, W.C.
McMillan, T. O., 4, Ardgowan Terrace, Glasgow
McRoberts, G., Nobel's Explosives Co., Stevenston, Ayrshire, N.B.
Mahon, R. W., 110, Arch Street, Camden, New Jersey, U.S.A.
Maignen, P. A., 32, St. Mary at Hill, London, E.C.
Main, Robt., Ardeer Ironworks, Stevenston, Ayrshire, N.B.
Major, J. C., The Bhylls, Compton, Wolverhampton
Major, J. L., Sculcoates, Hull
Makins, G. H., Danesfield, Upper Latimore Road, St. Albans
Malcolm, S., Jarrow Chemical Works, South Shields
Malcolmson, J. G., The Grange, East Barnet, Herts.
Mallinckrodt, Edw., Mallinckrodt Chemical Works, St. Louis, Missouri, U.S.A.
Mander, S. T., 17, Gracechurch Street, London, E.C.; and Varnish Works, Wolverhampton
Manning, F. A., 18, Billiter Street, London, E.C.
Mannington, H. T., 61, Rawcliffe Road, Walton-on-the-Hill, Liverpool
Markel, K., c/o Brunner, Mond & Co., Northwich; and 8, Castle Road, Northwich
Markham, A. D., 18, Merrick Square, Trinity Street, Borough, S.E.
Marks, E. G., 38, Cornwallis Crescent, Clifton, Bristol
Marley, J. E., Hebburn-on-Tyne
Marriott, Wm., 8, Belgrave Terrace, Huddersfield
Marsh, W., Greenbank Alkali Works Co., Limited, St. Helens
Marsh, J. T., British Alkali Works, Widnes
Marsh, T. S., Ash Lea, Litherland Park, Liverpool
Marsh, Walter, 4, York Terrace, Northam, Southampton
Marshall, T. E., 4, East Castle Road, Merchiston, Edinburgh
Marshall, Wm., 7, Walter Street, Nottingham
Marshall, Wm., The Baths, St. Andrews, N.B.
Martin, H., Poole, near Wellington, Somerset
Martin, H. R. H., Hong-Kong and China Gas Co., Hong-Kong
Martin, N. H., 29, Mosley Street, Newcastle-on-Tyne
Martin, W. H., 183, King's Road, Chelsea, London, S.W.
Martius, Dr. C. A., 28, Vosse Strasse, Berlin, Germany
Martyn, S. E., Trevemper Bridge, New Quay, Cornwall
Martyn, W., c/o Messrs. Tennant, Hebburn-on-Tyne
Mason, J., Eynsham Hall, Witney, Oxon
Mason, W. B., 117, Derby Street, Bolton-le-Moors
Mason, A. H., 178, Mance Street, Montreal, Canada
Masson, D. Orme, University of Melbourne, Victoria, Australia
Master, C. H., Friary Brewery Co., Guildford
Mather, J., Blaydon Chemical Works, Blaydon-on-Tyne
Mathieson, N., Widnes
Matthews, C. G., Laboratory, Bridge Chambers, Burton-on-Trent
Mavor, James, 134, St. Vincent Street, Glasgow
May, J., Hyde House, Old Battersea, Surrey
Mayenfeld, E. von Salis, Verein Chemischen Fabriken, Waldhof bei Mannheim, Germany
Mayhew, E. W. A., High Street, Freemantle, Western Australia

Mead, Frank, Sutton Gasworks, Surrey
Meadows, H., Spa Place, Humberstone Road, Leicester
Mease, G. D., 23, Killieser Avenue, Telford Park, S.W.
Meldola, R., 6, Brunswick Square, London, W.C.
Mellin V. de M., The Polygon, Ardwick, Manchester
Melliss, J. C., 232, Gresham House, Old Broad Street, London, E.C.
Mellon, W. W., Howdendyke, Howden, Yorks
Mellor, S., Magnesium Metal Co., Patricroft, Manchester
Melville, D., Merrimac Chemical Co., 13, Pearl Street, Boston, Mass., U.S.A.
Menzies, R. C., Inveresk Mills, Musselburgh, N.B.
Menzies, W. J., Greenbank Alkali Works Co., Limited, St. Helens
Mercer. J. B., 322, Lower Broughton Road, Manchester
Mercer, F. M., 89, Bishopsgate Street, London, E.C.
Merrylees, J., Minas de Rio Tinto, Provincia de Huelva, Spain
Messel, Dr. R., Silvertown, London, E.
Metcalf, Jno., 40, Henry Street, Church, Accrington
Metcalf, T., Miles Platting, near Manchester
Metcalf, W. M., Stanhill House, Oswaldtwistle, near Accrington
Mewburn, J. C., 169, Fleet Street, London, E C.
Meynier, J. A., 19, Rue Baudin, Paris
Middleton, J., 179, West George Street, Glasgow
Miest, Emile, Ste Marie d'Oignies, par Tamines, Belgium
Mill, Dr. Hugh R., 3, Glenorchy Terrace, Edinburgh
Miller, E. V., c/o New Zealand Sugar Co., Auckland, New Zealand
Miller, A. K., 40, Bishop's Terrace, Fulham, S.W.
Miller, A. Russell, The Cairns, Cambuslang, near Glasgow
Miller, H. von, Chemische Fabrik, Hruschau, Austria
Miller, N. H., Harpenden, near St. Albans
Miller, Robt., 79, West Nile Street, Glasgow
Miller, W. M., c/o Booker Bros. & Co., Georgetown, Demerara, West Indies
Miller, T. Paterson, The Cairns, Cambuslang, near Glasgow
Mills, E. J., Anderson's College, Glasgow
Milne, G. A., Welham Villa, Norton, Malton, Yorks.
Milne, Dr. J. M., Roy. Infirm. Medical School, 87, Castle Street, Glasgow
Milner, E., Hartford Manor, Northwich
Mitchell, J. W., 63, Burnley Road, Rawtenstall, Lancashire
Mitchell, S. W., Craigbank, Giffnock, near Thornliebank, N.B.
Mitting, E. K., Faversham, Kent
Moffatt, Thos., 5, Brandling Terrace, Felling-on-Tyne
Mohr, B., c/o Rio Tinto Co., 30, St. Swithin's Lane, London, E.C.
Moir, J., Clayton, near Manchester
Moir, R. M., Bankside, Christchurch Road, Hampstead, London, N.W.
Molineux, J., Somerset House, London, W.C.; and Longden Hall, Wellington, Shropshire
Mond, L., 20, Avenue Road, Regent's Park, London, N.W.
Mook, Chas., Douglashall, Westeregeln, Magdeburg, Germany
Mooney, M., Chemical Works, 74, Rogerson's Quay, Dublin
Moore, B. T., Longwood, Bexley, Kent
Moore, G. E., 69, Liberty Street, New York, U.S.A.
Moore, Lock, 28, St. Clair Street, Rochester, N.Y., U.S.A.
Moore, R. T., 134, St. Vincent Street, Glasgow
Moore, Wm. Bailey, Cauldon House, Shelton, Stoke-on-Trent
Moorhouse, J. B., Horton Bank, Bradford
Moretti, Giuseppe, via Cerretani 8, Firenze, Italy
Morgan, O. V., M.P., 13, The Boltons, South Kensington, S.W.
Morgans, Thos., The Guildhall, Bristol
Morgan, Wm., Public Analyst's Laboratory, Nelson Terrace, Swansea
Morison, John, Newbattle, Dalkeith, N.B.
Moritz, E. R., 72, Chancery Lane, London, W.C.
Morley, Dr. H. Forster, University Hall, Gordon Square, London, W.C.
Morice, Jas. A., Tullymet, Aytoun Road, Pollokshields, Glasgow
Morris, G. H., Messrs. Worthington & Co., Burton-on-Trent
Morris, J. H., 63 and 65, Blundell Street, Liverpool
Morris, M. Ivor E., Ammanford, R.S.O., South Wales
Morris, R., Doncaster
Morrison, J., Pottery Lane, Forth Bank, Newcastle-on-Tyne
Morrison, Jno., P.O. Box 74, North Adams, Mass., U.S.A.
Morrison, R. M., The Poplars, Beulah Hill, Upper Norwood, S.E.
Morson, T., 124, Southampton Row, Russell Square, London, W.C.
Morson, T. P., 33, Southampton Row, Russell Square, London, W.C.
Moseley, Chas., Grangethorpe, Rusholme, Manchester
Moseley, Jos., Cringle Hall, Levenshulme, Manchester
Moss, J., Hirdir Lodge, New Thornton Heath, Surrey; and 15, Lawrence Pountney Lane, London, E.C.
Moult, J., 3, Gladstone Terrace, Gateshead-on-Tyne
Muir, J. P., 448, Camden Road, London, N.W.
Mullard, R., 46, Drakefell Road, St. Catharine's Park, Hatcham, S.E.
Müller, Dr. H., 13, Park Square East, Regent's Park, London, N.W.
Mumford, A., 9, Westwell Street, Plymouth, Devon
Mumford, T. W. B., 1, Glendale Villas, Sylvan Road, Wanstead, Essex
Munro, Dr. J. M. H., College of Agriculture, Downton, Salisbury
Muras, T. H., H.M. Patent Office, Southampton Buildings, London, W.C.
Murdoch, H. R. M., 4, Nobel's Villas, Stevenston, Ayrshire
Murphy, John, 11, Wellesley Terrace, Prince's Park, Liverpool
Murray, H. S., Glenmayne, Galashiels, N.B.
Murrie, Jas., 103, Bishop Street, Anderston, Glasgow
Muskett, T., 97, Walton Lane, Stanley Park, Liverpool
Muspratt, E. K., Seaforth Hall, near Liverpool
Muspratt, J. L., Trelawaey House, Flint, North Wales
Muspratt, S. K., 31, Dale Street, Liverpool
Muter, Dr. J., Winchester House, Kennington Road, London, S.E.
Muter, James, c/o West Lothian Oil Co., Fauldhouse, N.B.
Myall, A. A., 21, Cockspur Street, Charing Cross, London, S.W.

N

Naef, P., Uetikon, Zürich, Switzerland
Nakamura, Teikichi, c/o Y. Fukuzawa, Mita-Nichome, Tokyo, Japan
Napier, J., 1, St. Matthew's Place, Norwich Road, Ipswich
Napier, Jas., jun., 10, Carment Drive, Shawlands, Glasgow
Nason, H. B., Troy, New York, U.S.A.
Naylor, W. A. H., c/o Hearon, Squire, & Francis, 5, Coleman Street, London, E.C.
Neil, W., 126, Turner's Road, Burdett Road, London, E.
Neild, A., Mayfield, Manchester
Neill, F. A. R., Bold Ironworks, St. Helens Junction, Lancashire
Neilson, James, 107, John Street, Glasgow
Ness, T., Black Banks Chemical Works, Darlington
Nettlefold, E., 16, Broad Street, Birmingham
Nettlefold, F., The Explosives Co., Stowmarket
Newall, F. S., Washington, County Durham
Newall, R. S., Ferndene, Gateshead-on-Tyne
Newlands, B. E. R., Trelawney House, Cambridg Park, Wanstead, E.
Newlands, W. P. R., 40, Alkham Road, Stoke Newington, London, N.
Newman, G. J., jun., Laurel Bank, Wilmslow, Cheshire
Newton, A. H., Belsize Court, Hampstead, N.W.
Newton, A. H., jun., Belsize Court, Hampstead, N.W.

Newton, Harry, Park Green, Macclesfield
Newton, Jno., Park Green, Macclesfield
Newton, H. C., Belsize Court, Hampstead, N.W.
Newton, Jno , Manor Works, Rotherhithe New Road, London, S. E.
Nichols, J. A., Spring Bank, New Mills, near Stockport
Nicholson, E. C., Carlton House, Herne Hill, London, S.E.
Nicholson, J. C., Chemical Works, Hunslet, Leeds
Nicholson, W. O., 12, Granville Square, London, W.C.
Nicol, W. W. J., Mason College, Birmingham
Nicoll, G. B., c/o Balfour, Guthrie & Co., Portland, Oregon, U.S.A.
Nimmo, J., 2, Bath Villas, Portland Road, South Norwood, London, S.E.
Nishigawa, F., 14, Go Bancho Koji Machi, Tokyo, Japan
Nixon, J., 64, Elswick Road, Newcastle-on-Tyne
Nolting, E., Ecole de Chimie, Mulhouse, Alsace, Germany
Norman, F. J., Messrs. Wigg Brothers & Steel, Runcorn
Norrington, A. Reginald, Cattedown, Plymouth
North, J. S., 12, Roeland Street, Cape Town, South Africa
North, W. H., 4, Whetley Grove, Manningham, Bradford, Yorks.
Northing, J., 93, Tritonville Road, Sandymount, Dublin
Norton, Lewis M., Massachusetts Institute of Technology, Boston, U.S.A.
Norton, S. A., Columbus, Ohio, U.S.A.

O

Oates, H. H., 505, Edge Lane, Droylsden, Manchester
O'Beirne, W. G., North British Chem. Co., Clydebank, near Glasgow
Odling, W., 15, Norham Gardens, Oxford; and 38, Ladbrooke Road, North Kensington, W.
Oehler, K., Offenbach-am-Main, Germany
Ogilvie, T. R., Percy Lodge, Woodford Road, Snaresbrook, Essex
Ogden, J. M., Ellscope House, Sunderland
Ogston, G. H., Junior Athenæum Club, Piccadilly, London, W.
Oldershaw, Wm., 69, Long Row, Nottingham
Oliver, F., 70, Winchester Street, South Shields
Ollerenshaw, S., Sutton Alkali Works, St. Helens
O'Neill, C., Laboratory, 72, Denmark Road, Manchester
O'Neill, E. H., Johnson's Saccharum Co., Limited, Stratford, London, E.
Oram, T., Hudcar, Bury
Orme, J., 65, Barbican, London, E.C.
Orr, A., 1, Park Terrace, Irvine, N.B.
Orr, J. B., Blantyre Lodge, Westcombe Park, London, E.C.
Orr, Robert, 79, West Nile Street, Glasgow; and Falkirk, N.B.
Ostersetzer, J., Oak Lodge, Castleknock, co. Dublin
O'Shea, L. T., Firth College, Sheffield
O'Sullivan, C., 140, High Street, Burton-on-Trent
O'Sullivan, J., 71, Spring Terrace, Burton-on-Trent
Overbeck, Baron Gustavus de, 23, Ryder Street, St. James', London, S.W.
Owen, Thos., Ellsbridge House, Keynsham, near Bristol
Oxland, Robert, 32, Portland Square, Plymouth

P

Packard, E , jun., Bramford, near Ipswich
Packer, G. L., Hall Side Steel Works, Newton-by-Glasgow
Page, F. J. M., 98, Alderney Street, London, S.W.
Pagès, Albert, 34, Boulevard Henri IV., Paris
Paine, S., 7, Exchange Street, Manchester
Palmer, Francis R., Debden Hall, Loughton, Essex
Palmer, T. Chalkley, 22, North Front Street, Philadelphia, U.S.A.
Panton, J. A., The Manor House, Watford, Herts.
Panario, Thos. E., 17, St. Philip's Street, Queen's Road, Battersea, S.W.
Park, J.
Parker, Thos., The Electrical Engineering Co., Commercial Road, Wolverhampton
Parker, W. H., 177, Alfreton Road, Nottingham
Parkinson, Dr. R., Sun Bridge Buildings, Bradford, Yorkshire
Parnell, E. W., Lancashire Sulphur and Alkali Works, Widnes
Parr, Samuel, South Sherwood Street, Nottingham
Pass, A. C., Rushmer House, Durdham Down, Clifton, Bristol
Paterson, John, Hawthorne Terrace, Workington, Cumberland
Paterson, Walter, jun., 178, Buchanan Street, Glasgow
Paton, W. Grant, Greenbank Alkali Co., Limited, St. Helens, Lancashire
Patterson, G., 85, Carleton Road, Tufnell Park, London, N.
Patterson, T. L., Messrs. J. Walker & Co., sugar refiners, Greenock, N.B.
Pattinson, H. L., Scots House, West Boldon, Newcastle-on-Tyne
Pattinson, H. L., jun., Heworth Lodge, Felling-on-Tyne
Pattinson, J., 75, The Side, Newcastle-on-Tyne
Pattison, J., 11, Bothwell Street, Glasgow, N.B.
Paul, Fred. W., c/o The Steel Company of Scotland, Limited, 150, Hope Street, Glasgow
Pauli, Dr., Höchst, Germany
Payne, Geo., Calder Soapworks, Wakefield, Yorks
Payne, J. B., 15, Mosley Street, Newcastle-on-Tyne
Payne, J. H., 17, Croft Terrace, Jarrow-on-Tyne
Peachey, H., Circus Brewery, Shrewsbury
Peacock, A. E., Waverley, Bridlington Quay
Pearce, W., jun., Bow Common, London, E.
Pears, Andrew, Lanadron Soapworks, Isleworth, Middlesex
Pearson, H. E., 6, Woodland Grove, Colwick Vale, Notts.
Pearson, Wm., 30, Mellor's Buildings, Exchange Street E., Liverpool
Peaty, Henry, Longport, near Stoke-on-Trent
Pechiney, A. R., Salindres (Gard), France
Pedler, A., Presidency College, Calcutta, India
Pedler, J. R., Woodbank, Lordship Lane, Dulwich, S.E.
Pegge, J. V., c o Nunneley & Co., Bridge Street Brewery, Burton-on-Trent
Peile, H., Shotley Bridge, co. Durham
Pentecost, S. J., Regent Street, New Basford, Nottingham
Percy, Dr. J., 1, Gloucester Crescent, Hyde Park, London, W.
Perkin, Dr. W. H., The Chestnuts, Sudbury, Harrow
Perkin, T. D., Greenford Green, Harrow
Perkin, A. G., 56, Elizabeth Street, Cheetham, Manchester
Perrett, E., 8, Victoria Chambers, Westminster, S.W.
Petersen, Beatus, 69, Nyhavn, Copenhagen, Denmark
Petherick, E. A., 17, Warwick Square, Paternoster Row, London, E.C.
Peto, A., Plumbago Crucible Works, Battersea, London, S.W.
Petraczek, Dr. Jos., c/o Read, Holliday & Sons, Huddersfield
Pettigrew, J., Varnish Manufactory, Carpenter's Road, Stratford, E.
Petty, A., Silvertown, London, E.; and Wood Lodge, Shooter's Hill, Kent
Peyton, E. P., Chemical Works, Lister Street, Birmingham
Pfeiffer, Karl, 1, Sutherland Road, West Ealing, Middlesex
Phillips, C. D., Odam's Chemical Works, Hudson's Wharf, Victoria Docks, London, E.
Phillips, H., 18, Exchange Street, Manchester
Phillips, A. G., 18, Fopstone Road, South Kensington, S.W.
Phipps, Thos., 169, Bridge Street, Northampton
Phipson, Dr. T. L., Laboratory, 8, Hotham Villas, Putney, London, S.W.
Pick, Dr. S., Direction der Soda Fabrik, Szczkowa, Galizien, Austria
Pickard, Saml., Hope Paper Mills, Cefn-y-Bedd, Wrexham
Pickup, R., Bank Mill Printworks, Tonge, Middleton, Lancashire

Pickles, H., Prussiate Works, Droylsden, Manchester
Pilkington, G., Widnes
Pinkerton, D. J., Tradeston Gasworks, Glasgow
Pinkney, Robert, 18, Bread Street Hill, London, E.C.
Pipe, Jas., Messrs. Wm. Henderson & Co., Irvine, N.B.
Pitt, T., 16, Coleman Street, London, E.C.
Pittuck, F. W., 25, Carr Street, Hebburn-on-Tyne
Player, J. H., 5, Prince of Wales' Terrace, Kensington, W.
Polglase, F. J. W., Tyne Vale Chemical Works, Forth Bank, Newcastle-on-Tyne
Pollock, A., Dillichip Turkey-red Dyeworks, Bonhill, Dumbartonshire
Pond, J. A., 99, Queen Street, Auckland, New Zealand
Poole, Thos., 25, Water Street, Liverpool
Pooley, T. A., 121, The Grove, Denmark Hill, S.E.
Pope, S., Camden Works, Runcorn
Porter, Herbert, Border Lodge, Honor Oak, S.E.
Porter, J. H., 165, Queen Victoria Street, London, E.C.
Pott, W. H., 22, Southwark Bridge Road, London, S.E.
Potter, E. P., Hollinhurst, Bolton-le-Moors
Potter, Chas. E., Love Lane Sugar Refinery, Liverpool
Powell, L. S., 5, Notting Hill Square, Campden Hill, London, W.
Powell, W. A., Maison Marie Louise, Hyères (Var), France
Poynter, J. Edgar, Clydeneuk, Uddingston, near Glasgow
Pratt, J. W., c/o Pratt & Co., Mobile, Alabama, U.S.A.
Prentice, R., Chemical Works, Stowmarket
Preston, R., Bury Ground, Bury, Lancashire
Price, A. F., 715, Post Street, San Francisco, California, U.S.A.
Price, D. S., 26, Great George Street, Westminster, London, S.W.
Price, W. E., Gasworks, Hampton Wick, Middlesex
Pringle, W., 58, St. Oswald's Road, West Brompton, S.W.
Pritchard, W. S., Farnworth, Widnes
Procter, H. R., 30, Hotspur Street, Tynemouth
Procter, J. W., Skeldergate Bridge, York
Proctor, C., Government Laboratory, Somerset House, London, W.C.
Proctor, C. W. Cope, Heathercliffe, Clifton Down, Bristol
Proctor, B. S., 11, Grey Street, Newcastle-on-Tyne
Proctor, W. W., 33, The Side, Newcastle-on-Tyne
Pugh, G., 12, Mark Lane, London, E.C.
Pullar, R., Pullar's Dyeworks, Perth, N.B.
Pullar, R. D., Pullar's Dyeworks, Perth, N.B.
Purser, E. T., 82, James Street, Dublin

Q

Quaas, Gustav, Home Park Mills, King's Langley, Herts.
Quibell, Oliver, Highfield, Newark-on-Trent

R

Rademacher, H. A., 77, Charlestown, Glossop, Derbyshire
Rae, G., Tharsis Sulphur and Copper Co., Widnes
Rait, G. L., Gloucester House, Downshire Hill, Hampstead, London, N.W.
Ramsay, Dr. W., University College, Bristol
Ramsden, J., Lion Brewery, Belvidere Road, Lambeth, London, S.E.
Rawcliffe, Harold, Appleton Lodge, Widnes
Rawes, F. B., 15, Gough Road, Stratford, London, E.
Rawlins, G., Brook Works, Rainhill, Lancashire
Rawlinson, A. J., Newton-le-Willows, Lancashire
Rawson, C., 3, Union Street, Bradford
Rawson, S. G., Chemical Laboratory, University College, Liverpool; and 118, Chatham Street, Liverpool
Ray, Wm., Dyeing Department, Yorkshire College, Leeds
Raymond, C. W., 24, Lawrence Road, Addington Road, Bow, London, E.
Rayner, J. A. E., Sutton Alkali Works, St. Helens
Readman, J. B., 9, Moray Place, Edinburgh
Readman, J. F., Codnor Park Ironworks, by Alfreton, Derbyshire
Reay, T. Burdon, 85, Herrington Street, Sunderland
Reddrop, J., Laboratory, L. & N. W. Railway, Crewe
Redfern, Edwin, 17, Clayton Street, Hulme, Manchester
Redfern, G. F., 4, South Street, Finsbury, London, E.C.
Redfern, Jos., 49, Harvie Street, Bridgeton, Glasgow
Redmayne, J. M., Newcastle-on-Tyne
Redwood, B., 85, Gracechurch Street, London, E.C.
Redwood, I. W., Young's Oil Co., Addiewell, N.B.
Redwood, Dr. T., 17, Bloomsbury Square, London, W.C.
Ree, Dr. A., 121, Manchester Road, Middleton, near Manchester
Reed, Albert E., 21, St. Andrew's Crescent, Cardiff
Reeks, T. H., 71, Chelsea Gardens, Chelsea Bridge Road, London, S.W.
Reid, David E., Kaboonga Mines Co., Kilkivan, Maryborough, Queensland
Reid, Joh., 10, Milton Street, Stockport Road, Manchester
Reid, T. Anderson, 11, Mersey View, Runcorn
Reid, W. C., 7, Graingerville, Newcastle-on-Tyne
Reid, W. Hamilton, c/o Messrs. Mandall & Co., Stockton-on-Tees
Reid, W. F., Fieldside, Addlestone, Surrey
Reid, W. G., Young's Oil Co., Limited, Uphall, N.B.
Remfry, H. H., 5, Fancy Lane, Calcutta, India
Remmers, B. H., 189, St. Vincent Street, Glasgow
Renard, Chas. L'Estaque, Marseilles, France
Renant, F. W., 65, Radipole Road, Fulham Road, S.W.; and 19, Great George Street, S.W.
Rennie, A. G., 27, Lansdowne Crescent West, Glasgow
Rennie, Dr. E. H., University of Adelaide, South Australia
Rennoldson, W. L., St. Bede Chemical Works, East Jarrow
Reoch, R., River Point, Rhode Island, U.S.A.
Reynolds, Dr. J. Emerson, Trinity College, Dublin
Reynolds, R., 13, Briggate, Leeds
Rhodes, E., c/o Thos. Vickers & Sons, Widnes
Richards, J., Clifton Lodge, Swinton, near Manchester
Richards, W. A., Sandbach, Cheshire
Richardson, B. S., Scottdale, Westmoreland Co., Pa., U.S.A.
Richardson, C. F., The Elms, Newark-on-Trent
Richardson, C. T., Monkton Lodge, Jarrow-on-Tyne
Richardson, J. G. F., Elmfield, Stoneygate, Leicester
Richardson, J. G., 24, Windsor Terrace, Newcastle-on-Tyne
Richardson, J. H., 359, Blackburn Road, Accrington
Richardson, F. W., 13, Whetley Grove, Bradford, Yorkshire
Richmond, H. D., 2, Trulock Villas, Park Lane, Tottenham, N.
Richmond, W. H., Liver Alkali Works Co., Limited, Lightbody Street, Liverpool; and 37, Merton Road, Bootle
Rickman, J. Pellatt, Falcon Glass Works, St. Bride Street, London, E.C.
Riddell, Robert, Messrs. Allsopp & Co., New Brewery, Burton-on-Trent
Rideal, Samuel, University College, London, W.C.
Ridsdale, C. H., 24, Outram Street, Stockton-on-Tees
Rigg, R., Messrs. M'Bride & Co., Union Chemical Works, St. Helens
Riley, E., 2, City Road, Finsbury Square, London, E.C.
Riley, Jas., 150, Hope Street, Glasgow
Riley, J. E., Arden Hall, near Accrington
Riley, J. Hapton Chemical Works, Accrington
Riley, J., 3, Alton Terrace, Fairfield, Manchester
Riley, James, Laboratory, Brinscall Works, near Chorley, Lancashire
Riley, W. G., Hapton Chemical Works, near Accrington
Ripley, H., Bowling Dyeworks, Bradford, Yorkshire
Ritchie, W. B., The Grove, Belfast, Ireland
Ritson, T. N., 96, St. Saviour's Road, Jersey
Rix, W. P., Doulton & Co., Lambeth Art Pottery, London, S.E.
Robbins, J., Gibraltar Walk, Bethnal Green Road, London, E.
Robbins, J., 147, Oxford Street, London, W.
Roberts, F. G. Adair, Clydach, Bethune Road, Stamford Hill, N.
Roberts, R. Wightwick, Officina de Ensays, Valparaiso, Chili

Roberts-Austen, W. C., Royal Mint, London, E.
Robertson, John, Mosswell, Milngavie, near Glasgow
Robertson, R. A., 42, Aytoun Road, Pollokshields, Glasgow
Robinson, A. E., Faraday Chemical Works, 5 and 6, Aston Road, Birmingham
Robinson, G. C., Royal Institution, Hull; and Laboratory, Bond Street, Hull
Robinson, H. H., 16, Tower Street, Cirencester
Robinson, J., Farnworth, Widnes; and 50, Irwell Street, Widnes
Robinson, Jno., 5, Elizabeth Terrace, Ditton, Widnes
Robinson, R., Apsley Buildings, Old Hall Street, Liverpool
Robinson, Thomas, 401, West Street, Glasgow
Rodger, Edw., 1, Clairmont Gardens, Glasgow, W.
Rohling, Ferd., c/o Rohling and Rave, Münster, Westphalia, Germany
Rollin, J. C., St. Bede Chemical Co., Limited, Newcastle-on-Tyne
Ronalds, Dr. E., Bonnington House, Edinburgh
Rooke, J. A., Horrocks Lane, Red Bank, Manchester
Rooth, J. S., Walton Chemical Works, Chesterfield
Roques, Adolphe, 36, Rue Sainte Croix de la Bretonnerie, Paris
Roscoe, Sir Henry, M.P., Victoria Park, Manchester
Roscow, Jas., Fairview, Littleborough, Lancashire
Rosicki, Dr. F., 5, Quai Claude Bernard, Lyons, France
Roskell, Jos., Port Tennant Copper Works, Swansea
Ross, J. G., 14, Argyle Place, Edinburgh
Ross, Wm., 12, King Street, Manchester
Rottenburg, Paul, c/o Messrs. Leisler, Bock & Co., 130, Hope Street, Glasgow, N.B.
Routledge, Thos., Claxheugh, Hylton, near Sunderland
Rowan, F. J., 134, St. Vincent Street, Glasgow
Rowell, W. A., c/o Messrs. Sullivan & Co., Limited, British Alkali Works, Widnes
Rowland, W. L., 4800, Chester Avenue, Philadelphia, Pa., U.S.A.
Rowley, Thos., 9, Conyngham Road, Victoria Park, Manchester
Rowley, W. J., Wellington Villas, Wellington Road, Handsworth, Birmingham
Roxburgh, J. W., Levenbank Works, Jamestown. Dumbartonshire, N.B.
Royle, T., The Cedars, West Ham Park, E.
Royse, S. W., St. Andrew's Chambers, Albert Square, Manchester
Ruffle, Jno., Portway House, Plashet Road, Plaistow, E.
Rumble, C., Belmont Works, Battersea, London, S.W.
Rüntz, John, Linton Lodge, Lordship Road, Stoke Newington, N.
Rupp, Wm., 117, Pearl Street, New York, U.S.A.
Ruscoe, Jno., Albion Works, Henry Street, Hyde, near Manchester
Rushton, H. F., 30, Juvenal Street, Liverpool
Russell, Jno., Anchor Brewery, Britten Street, Chelsea, London, S.W.
Russell, Dr. W. J., St. Bartholomew's Hospital, London, E.C.
Ryan, T., Castle Hill House, Flint, N. Wales
Ryder, C. E., c/o Messrs. Elkington, Newhall Street, Birmingham
Ryland, Howard P., The Cedars, Gravelly Hill, Birmingham

S

Sadler, A. E., Sandhall, Ulverston, Lancashire
Sadler, S. A., Middlesbrough-on-Tees
Sadtler, Samuel P., University of Pennsylvania, Philadelphia, Pa., U.S.A.
Sainsbury, E., Briton Ferry Chemical Works, Glamorganshire
Saint, W. Johnson, Hörmann Strasse 5, Schwabing, München, Bavaria
Salamon, A. G., 1, Fenchurch Avenue, London, E.C.
Salamon, Jno., The Willows, Wennington, near Romford, Essex
Samuel, W. Cobden, 203, Norwood Road, Herne Hill, London, S.E.
Samuelson, Sir Bernard, Bart, M.P., 56, Prince's Gate, London, S.W.
Sandon, R., 118, Leighton Road, Kentish Town, London, N.W.
Sanderson, T. C., 21, Glengall Grove, Old Kent Road, London, S.E.
Sanford, P. G., Blandford Lodge, Streatham, S.W.
Sansone, A., Vauxhall Chemical Works; and 8, Bignor Street, Cheetham Hill, Manchester
Saul, C. H., 76, Mosley Street, Manchester
Savage, W. W., 109, St. James's Street, Brighton
Savary, W. J. H., 39, Lombard Street, London, E.C.
Schad, Julius, 14, Charlotte Street, Manchester
Schäppi, Dr. H., Badische Anilin und Soda Fabrik, Ludwigshafen-am-Rhine, Germany
Schellhaas, H., 54, Navigation Road, Northwich
Scheurer-Kestner, Dr. A., 57, Rue de Babylone, Paris, France
Schindler, Martin F., Zürich, Switzerland
Schloesser, R., 14, Charlotte Street, Manchester
Schofield, C., Whalley Range, Manchester
Schofield, C. J., Clayton, Manchester
Schofield, E., Scout Bottom, Newchurch, near Manchester
Scholefield, H. E., 52, Edge Lane, Liverpool
Schorlemmer, Dr. C., The Owens College, Manchester
Schott, A., 26, Princess Street, Manchester
Schreiber, F. T., Halliwell Bleachworks, near Bolton
Schroeder, C., 55, Bloom Street, Manchester
Schunck, Dr. E., Kersal, near Manchester
Scorgil, J., College of Science, Poona, India
Scott, A., High Calton, Edinburgh
Scott, F., Rhodes Works, Middleton, near Manchester
Scott, G. H., Hague Bar, New Mills, near Stockport
Scott, Wm., 9, Ardgowan Street West, Greenock, N.B.
Scott, W. T., Crown Chemical Works, Marsh Gate Lane, Stratford, London, E.
Scudder, F., 26, Devonshire Street, Ardwick, Manchester
Seaward, G. A., St. George's Brewery, Commercial Road, London, E.
Segner, P., 26, Princess Street, Manchester
Sellars, J., Fairfield, near Manchester
Sellon, J. S., 78, Hatton Garden, London, E.C.
Sellon, S.
Semet, Louis, 217, Chaussée de Vleurgat, and 19, Rue du Prince Albert, Brussels
Senier, Dr. A., Chemisches Laboratorium, 35, Georgenstrasse, Berlin, N.W.
Senier, H., Romola Terrace, Tulse Hill, London, S.E.
Serré, C. A., 55, Fulton Street, New York, U.S.A.
Sevin, C., 155, Fenchurch Street, London, E.C.
Sexton, A. Humboldt, 7, Sefton Terrace, Rutherglen, Glasgow
Seymour, J. R. W., Northcroft Farm, Inkpen, near Hungerford, Berks.
Shackel, W., Three Mills Distillery, Bromley-by-Bow, E.
Shackleton, C. J., Sydney Villa, Mill Hill, Derby; and Phœnix Chemical Works, Ironbridge, Salop
Shadwell, J. E. L., Meadowbank, Melksham, Wilts.
Shapleigh, W., c/o Graham Blandy, 16, Broad Street, New York, U.S.A.
Sharp, Henry, Loseley Hurst, Bournemouth; and Poole
Sharp, James, The Towers, Low Moor, near Bradford, Yorks.
Sharples, Stephen P., 13, Broad Street, Boston, Mass., U.S.A.
Shaw, D., Clayton, near Manchester
Shaw, F. W., Heapey Bleachworks, near Chorley, Lancashire
Shaw, Geo., 37, Temple Street, Birmingham
Shaw, Jno., Bradley Mills, Halifax
Shaw, R., West Bank Chemical Works, Widnes
Shaw, Walter, Sherdley Glass Works, St. Helens
Shearer, A., Messrs. Boake & Co., Stratford, London, E.
Shenstone, W. A., Clifton College, Bristol
Sherlock, T., New Market Place, St. Helens
Shimidzu, Tetsukichi, c/o T. Hirano, 11, Ginza Shichome, Tokyo, Japan

Shimosè, Masachika, Insatsu Kyoku, Tokyo, Japan
Shipstone, Jas., jun., Woodthorpe Lodge, Sherwood, Nottingham
Siddall, F. P., Averley Villa, Station Road, New Barnett, Herts.
Sieber, C. H., Whitworth, near Rochdale
Siebold, L., Carr Bank, Walmersley, near Bury
Sill, T. T., Wallsend Chemical Co., Newcastle-on-Tyne
Sillar, W. Cameron, The Native Guano Co., Limited, 29, New Bridge Street, Blackfriars, E.C.
Silva, Prof. R. D., 26, Rue de la Harpe, Paris
Simon, H., 20, Mount Street, Manchester
Simpson, J., 8A, Rumford Place, Liverpool
Simpson, R., Grecian Terrace, Harrington, Cumberland
Simpson, W. S., 95, Darenth Road, Stamford Hill, N.
Sims, T. H., Mayfield Printworks, Manchester
Singleton, Jos., 41, Corporation Street, Manchester
Sisson, G., jun., Washington Chemical Co., Washington, County Durham
Skaife, Wilfred T., 630, Sherbrooke Street, Montreal, Canada
Slade, H. E., Streatham Common, London, S.W.
Slater, H. H., Clifton Villa, Brading, Isle of Wight
Smaile, J. I., Messrs Gibbs & Co., Iquique, Chili
Small, Evan W., Cavendish Crescent North, The Park, Nottingham
Smetham, A., 18, Brunswick Street, Liverpool
Smiles, Jas., 3, Brandon Terrace, Edinburgh
Smith, Alfred, Bank Lane Chemical Works, Clayton, Manchester
Smith, Anthony, Dublin Vitriol Works, Ballybough Bridge, Dublin
Smith, A. E., Widnes
Smith, A. J., Elswick Ordnance Works, Newcastle-on-Tyne
Smith, Ernest, 114, West Street, Glasgow
Smith, C. A., The Laboratory, 8, Loftus Street, Sydney, New South Wales
Smith, Edgar F., Wittenberg College, Springfield, Ohio, U.S.A.
Smith, E. T., 35, Ampthill Square, Hampstead Road, London, N.W.
Smith, Fred., West Parade, Sutton-on-Hull
Smith, G., Polmont Station, Scotland
Smith, Geo. F., Cromwell Lodge, Putney Hill, S.W.
Smith, Henry, 11, Malvern Road, Dalston, London, E.
Smith, H. R., 1, Aubert Park, Highbury, London, N.
Smith, J. Johnstone, Miramichi, Port Glasgow, N.B.
Smith, J., Ash Grove House, Radcliffe, Manchester
Smith, Dr. J. H., 1, Bute Terrace, Low Fell, Gateshead-on-Tyne
Smith, J. W., West Street, Paddock, Huddersfield
Smith, M. H., Messrs, Hopkin & Williams, Waterside, Wandsworth, S.W.
Smith, Richard, Metallurgical Laboratory, Royal School of Mines, South Kensington, S.W.
Smith, R. W., The Grange, Kirkburton, near Huddersfield
Smith, S., 35, Ampthill Square, Hampstead Road, London, N.W.
Smith, Thos., Heriot Hill House, Edinburgh
Smith, Watson, The Owens College, Manchester
Smith, Wilfred, 114, West Street, Glasgow
Smith, W., 10, Corn Street, Bristol
Smithells, A., Yorkshire College, Leeds
Smithers, F. O., Dashwood House, 9, New Broad Street, London, E.C.
Smithson, J., Park Printworks, Halifax
Snelling, E., 5, Spital Square, Bishopsgate Street, London, E.
Soames, J. K., Thames Soap and Candle Works, Greenwich, S.E.
Solvay, Ernest, 19, Rue du Prince Albert, Brussels
Solvay, Alfred, Boitsfort, Belgium
Sommer, Dr. G. Shack, 323, Vauxhall Road, Liverpool
Sommer, Adolf, West Berkeley Alameda Co., California, U.S.A.
Southall, A., Richmond Hill Road, Edgbaston
Sowerby, W. M., 8, Clervaux Terrace, Jarrow-on-Tyne
Soward, A. W., 18, Scylla Road, The Rye, Peckham, S.E.
Spalding, E. S., South Darenth, Kent
Spence, D., Alum Works, Manchester
Spence, F., Alum Works, Manchester
Spence, J. W., 63, West Regent Street, Glasgow
Spencer, Hugh T., Park House, St. Helens
Spencer, Jno., Globe Tube Works, Wednesbury
Spencer, Jas., 11, Old Ashfield, Bradford
Spencer, J. W., Newburn, Newcastle-on-Tyne
Spiegel, Dr. Adolf, Messel, Darmstadt, Germany
Spiller, J., 2, St. Mary's Road, Canonbury, London, N.
Spiller, A., 2, St. Mary's Road, Canonbury, London, N.
Sprengel, Dr. H., Saville Club, 107, Piccadilly, London, W.
Squire, E. L., Coalbrookdale, Shropshire
Squire, P. W., 413, Oxford Street, London, W.
Squire, Dr. W. S., Clarendon House, St. John's Wood Park, N.W.
Stacey, H. G., 300, High Holborn, London, W.C.
Stacey, S. L., 300, High Holborn, London. W.C.
Stahl, Dr. K. F., Johnstown Chemical Works, Johnstown, Cambria Co., Pa., U.S.A.
Stanford, E. C. C., Glenwood, Dalmuir, N.B.
Stanley, C. L., Sandygate House, Wath-upon-Dearne, Yorkshire
Stanning, Jno., Broadfield, Leyland, near Preston
Stapleton, Jos., 3, Lower Sackville Street, Dublin
Staples, H. J., Spondon, Derby
Staples, Sir Nath. A., Bart., Lissan, Cookstown, Ireland
Stark, J. F., 33, Sisters Avenue, Clapham Common, London, S.W.
Starling, J. H., The Avenue, Erith, Kent
Staub, Dr. A., care of Brunner, Mond & Co., Northwich, Cheshire
Staveley, W. W., Baghill, Pontefract
Stead, J. E., 5, Zetland Road, Middlesbrough-on-Tees
Stead, W. H., 23, Boundary Street, Liverpool
Stebbins, J. H., 117, Pearl Street, New York, U.S.A.
Steedman, R. H., North British Chemical Co., Clyde Bank, near Glasgow
Steel, J. M., 85, Gracechurch Street, London, E.C.
Steele, M., Newton Hall, Frodsham, Cheshire
Steel, R. Elliott, Spring Cliffe House, Heaton Road, Bradford, Yorkshire
Steel, Thos., Nansori Sugar Mill, Rewa River, Viti Levu, Fiji
Steiger, Alph., 16, Mincing Lane, London, E.C.
Stephens, Chas., Avenue House, Finchley, N.
Steuart, D. V., Eagle Chemical Works, Clayton, near Manchester
Stenart, D. R., Broxburn, near Edinburgh, N.B.
Stevens, Wm., The Native Guano Co., Ld., 29, New Bridge Street, Blackfriars, E.C.
Stevens, W. J., Marsh Soapworks, Bristol
Stevenson, J., Broxburn, N.B.
Stevenson, Jas., 23, West Nile Street, Glasgow; and The Bromfields, Largs, N.B.
Stevenson, A. S., Tynemouth; and Ach na Cloich, Oban, N.B.
Stevenson, H. E., 2, Bromfield Gardens, Onslow Road, Richmond, Surrey
Stevenson, J. C., M.P., South Shields
Stevenson, Dr. T., Guy's Hospital, London, S.E.
Stevenson, W., Standard Works, 95A, Southwark Street, London, S.E.
Stewart, A. Y., 212, Camden Road, London, N.W.
Stewart, S., Caledonian Railway Stores Department, St. Rollox, Glasgow
Stewart, David, Birdston Farm, Kirkintilloch, N.B.
Stiker, Flavius P., 639, Ellicott Street, Buffalo, N.Y., U.S.A.
Stillwell, C. M., 55, Fulton Street, New York, U.S.A.
Stirk, Jos., 126, Station Street, Burton-on-Trent
Stoddart, F. Wallis, Western Counties Laboratory, Bristol
Stoddart, J. E., 60, Robertson Street, Glasgow
Stoer, J., 6, Hanover Quay, Dublin
Stoker, G. N., The Laboratory, Somerset House, London, W.C.
Stone, E. D., 19, Lever Street, Piccadilly, Manchester
Stone, F. B., 75, Plumstead Road, Plumstead, Kent

Stopes, H., Kenwyn, Cintra Park, Upper Norwood, S.E.
Storer, D., Sydney Street, Glasgow
Storey, H. L., Underfell, Lancaster
Storey, J. H., Haverbreaks, Lancaster.
Strangman, J. Pim, Sarno, Salerno, Italy
Strype, W. G., The Murrough, Wicklow, Ireland
Stuart, C. E., 29, Mosley Street, Newcastle-on-Tyne
Stuart, T. W., Newton Villas, Hebburn-on-Tyne
Studer, Dr. A., 10, Marsden Street, Manchester
Suilliot, H., 21, Rue Ste Croix de la Bretonnerie, Paris
Sumner, R. M., 50A, Lord Street, Liverpool
Sutherland, D. A., Burntisland Oil Co., Burntisland, N.B.
Sutherland, R. M., Lime Wharf Chemical Works, Falkirk, N.B.
Sutherland, Jno., 16, Flinders Lane North, Melbourne, Victoria, Australia
Sutton, F., London Street, Norwich
Sutton, F. Napier, 57, Gordon Square, London, W.C.
Swan, J. C., 1, Dean Street, Newcastle-on-Tyne
Swan, J. W., Lauriston, Bromley, Kent
Swinburne, Geo., c/o J. Coates & Co., Planet Chambers, 8, Collins Street East, Melbourne, Australia
Syddall, R. J., Roseleigh House, Chadkirk, near Stockport
Sykes, E., 27, Nursery Street, Pendleton, near Manchester
Sykes, Dr. B. C., St. John's House, Cleckheaton, Yorkshire
Syme, W. B., c/o Young's Paraffin Oil Co., Addiewell, West Calder, N.B.
Symes, Dr. C., 14, Hardman Street, Liverpool

T

Takamatsu, T., Tokyo University, Japan
Takamine, J., Noshomusho, Tokyo, Japan
Tanner, A. E., High Cross, Tottenham, N.
Tanner, B., Ferndale Villa, Disraeli Road, Forest Gate, Essex
Tate, A. N., Hackins Hey, Liverpool
Tate, E., Sugar Refinery, Silvertown, London, E.
Tate, F. H., Holland Bank Chemical Works, Church, near Accrington
Tate, H., jun., Allerton Beeches, Allerton, near Liverpool
Tate, W., 43, Norwood Grove, Liverpool
Tatlock, J., 100, Sauchiehall Street, Glasgow
Tatlock, R. R., 138, Bath Street, Glasgow
Tatters, J. G., Dean House, South Shields
Taubman, R., 33, Southampton Row, London, W.C.
Taylor, Andrew, 11, Sutton Place, Edinburgh
Taylor, C., Friars Field Villas, Uttoxeter New Road, Derby
Taylor, G. Crossland, Thornton Hough, near Neston, Cheshire
Taylor, Jno., The Belgrave Pharmacy, Torquay, Devon
Taylor, J.
Taylor, Jas., Osgathorpe Crescent, Sheffield
Taylor, H. E., 11, Langdale Road, Greenwich, S.E.
Taylor, R. L., 29, Peru Street, Higher Broughton, Manchester
Taylor, W. J., c/o Prentice Bros., Chemical Works, Stowmarket, Suffolk
Teed, Dr. F. L., 8, Victoria Chambers, Westminster, London, S.W.
Tennant, Sir Chas., Bart., 35, Grosvenor Square, S.W.; and Glen, Peebleshire, N.B.
Tennant, Jas., Dartmouth Lodge, Saltwell, Gateshead-on-Tyne
Terry, Hubert L., 13, Duke Street, Greenheys, Manchester
Tervet, R., Forth House, Fisher Row, Musselburgh, N.B.
Thatcher, C. F., Gwydyr House, 559, Old Kent Road, London, S.E.
Thew, Walter H., 47, Castle Street, Liverpool
Thom, John, Birkacre, Chorley, Lancashire
Thomas, C., Broad Plain Soapworks, Bristol
Thomas, H. E., Hyde Lodge, Redland, Bristol
Thomas, J., Brook House, Wooburn, near Beaconsfield
Thomas, J. W., The Laboratory Wharf, Cardiff; and Pen-y-lan, near Cardiff
Thomas, R. Schofield, 70, Charlotte Street, Birmingham
Thomas, S. M., 143, Cannon Street, London, E.C.
Thompson, Chas., St. Ninian's House, Leighton Crescent, Brecknock Road, N.W.
Thompson, Claude M., University College, Cardiff
Thompson, G. E., Birkdale, South Road, Smethwick, Birmingham
Thompson, W., jun., Larkfield, Earlstown, Lancashire
Thompson, W. G., Tonge Springs Works, Middleton, near Manchester
Thompson, W. P., 6, Lord Street, Liverpool
Thompson, G. Carruthers, 39, Kersland Terrace, Hillhead, Glasgow
Thomson, John, Institution for Deaf and Dumb, Queen's Park, Glasgow
Thomson, J. M., King's College, London, W.C.
Thomson, J. S., Uphall Oil Works, Uphall, N.B.
Thomson, R., City Analyst's Laboratory, 138, Bath Street, Glasgow
Thomson, Robt. T., 138, Bath Street, Glasgow
Thomson, W., Royal Institution, Manchester
Thorne, E. E. H., c/o H. E. Thorne, Bridgetown, Barbadoes
Thorne, Dr. L. T., 52, University College of Wales, Aberystwith
Thorneycroft, Wallace, 447, Sauchiehall Street, Glasgow
Thorp, T. W., Messrs. Crossman & Co., Mile End Road, London, E.
Thorp, W., 39, Sandringham Road, Kingsland, London, E.
Thorpe, Dr. T. E., Royal Normal School of Science, South Kensington, S.W.
Tibbitts, J. H., Astoria, Long Island, New York, U.S.A.
Tichborne, C. R. C., 15, North Great George Street, Dublin
Tickner, G., Castle Brewery, Guildford
Tidy, Dr. C. M., 3, Mandeville Place, Manchester Square, London
Tighe, Patrick, Lake House, East Jarrow
Tilden, Dr. W. A., Mason Science College, Birmingham
Timmins, A., Stanley Villas, Runcorn
Timmis, T. S., Widnes
Todd, A. M., Nottawa, St. Joseph Co., Mich., U.S.A.
Tomlinson, G. G., Rainham Ferry Vitriol Co., Rainham, Essex
Toms, F. W., States Analyst's Office, St. Heliers, Jersey
Tonks, E., Packwood, Knowle, near Birmingham
Tothill, W. W., Messrs. Reckitt & Son, Limited, Hull
Towers, J. W., Grosvenor Buildings, Victoria Road, Widnes
Towns, J., Hall's Wharf, Victoria Docks, London, E.
Townsend, H. H., Avenue House, Cotham Park, Bristol
Townsend, Jos., 19, Crawford Street, Port Dundas, Glasgow
Trachsel, E. F., c/o W. C. Moore, 9, Old Jewry Chambers, London, E.C.
Trechmann, C. O., 10, Cliff Terrace, Hartlepool
Trench, G., Standard House, Faversham, Kent; and the Cotton Powder Co., Limited, Faversham
Trewby, G. C., The Gas Light and Coke Co., Horseferry Road, Westminster, S.W.
Trewby, Herbert, Langford Lodge, New Park Road, Clapham Park, S.W.
Tribe, P. C. M., Oswego, New York, U.S.A.
Trimble, H., 632, Marshall Street, Philadelphia, U.S.A.
Trimnell, C. H., Elmhurst, New Malden, Surrey
Trobridge, A., 6, Willow Avenue, Sandon Road, Edgbaston, Birmingham
Truby, Charles, 53, High Street, Manchester
Truman, E. B., 31, Derby Road, Nottingham
Tsukiyama, S., Imperial Paper Mills, oji, Tokyo, Japan
Tuer, Arthur H., 28, Church Street, Standish, near Wigan
Tunbridge, A. A.
Tunbridge, George, 7, The Crescent, King Street, Leicester
Türgensen, Dr. R., Oberröblingen a/ See, bei Halle, Germany
Turnbull, Wm., 14, Wilberforce Terrace, Gateshead-on-Tyne

Turnbull, W. S., Place of Bonhill, Renton, Dumbartonshire
Turner, F. T., 17, Copeland Street, Stoke-on-Trent
Turner, Thos., Mason College, Birmingham
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U

Umney, C., 50, Southwark Street, London, S.E.
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W

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Y

Yardley, H. B., 17, Clarendon Villas, Charlton, Kent
Yates, F., 64, Park Street, Southwark, London, S.E.
Yates, R., 64, Park Street, Southwark, London, S.E.
Yglesias, M., 2, Tokenhouse Buildings, London, E.C.
Yoshida, Hikorokuro, Imperial University, Hongo, Tokyo, Japan
Young, A. C., 64, Tyrwhitt Road, St. John's, S.E.
Young, Brougham, Home Lyn, Woodberry Down, London, N.
Young, C. Francis, New Islington Chemical Works, Baker Street, New Islington, Manchester
Young, Jno., 22, Belhaven Terrace, Kelvinside, Glasgow, N.B.
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Young, W. C., 22, Windsor Road, Forest Gate, E.

Z

Zimmermann, A., 21, Mincing Lane, London, E.C.
Zinkeisen, W., c/o Frau Heléne Fischer, Rappstrasse No. 3, Tübingen, Germany.

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NOTICES.

Notice is hereby given that the next Annual General Meeting will be held in Manchester in the month of July, 1887, instead of in Glasgow as originally arranged; the Annual General Meeting in Glasgow being postponed until 1888.

This change originated in a generally-expressed desire, resulting in a special invitation from the Manchester Section, supported by the cordial acquiescence of the Glasgow Section. It will enable members to visit both the Jubilee Exhibition in Manchester, and the Glasgow Exhibition of 1888.

Full particulars as to the Manchester Meeting will appear in a subsequent issue.

The supply of copies of the Journal for January, 1882, and January, 1883, being now exhausted, the Secretary would be glad to receive communications from members possessing extra copies of those numbers, in good condition, with a view to purchase.

Should sufficient applications for complete sets be received, the numbers will be reprinted.

Authors of communications read before the Society or any of its Local Sections are requested to take notice that, under Bye-Law 43, they cannot receive the prescribed 50 copies of their communications unless they comply with the condition laid down in that Bye-Law—viz., that they give notice of their desire to receive such copies upon their manuscript before sending it to the Editor. Mention should also be made as to whether the Discussion is to be included in the reprint.

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Jno. Bell, Millburn, Renfrew, N.B., dyer.

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C. W. Lowe, Summerfield House, Reddish, near Stockport, chemical student.

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S. Tsukiyama, Imperial Paper Mills, Oji, Tokyo, Japan, chemist.

Dr. R. Turgenseo, Oberroblingen a See, bei Halle, Germany.

Cornelius Walton, 63, Queen Victoria Street, London, E.C., engineer.

S. J. White, 3329, Powelton Avenue, Philadelphia, Pa., U.S.A., chemical student.

W. Collingwood Williams, 86, Grove Street, Liverpool, analyst.

Deaths.

Col. Sir Francis Bolton, 19, Grosvenor Gardens, London, S.W.—at Bournemouth, January 5.

M. G. Crossman, Berwick-on-Tweed.

Emile Leroy, Directeur de la Soudière, Cie. de St. Gobain, Chauny, Aisne, France—December 19.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

Chairman: David Howard.

Committee:

Sir F. A. Abel.
H. E. Armstrong.
W. Lant Carpenter.
W. Crowder.
C. Graham.
S. Hall.
A. K. Huntington.
R. Messel.
R. E. R. Newlands.
B. Redwood.
T. Royle.
John Spiller.
G. C. Trewby.
J. Williams.

Hon. Local Sec. and Treasurer: Thos. Tyrer,
Garden Wharf, Church Road, Battersea, S.W.

The meetings of the London Section will be held on the first Monday in each month.

SESSION 1886—87.

Prospective Arrangements.

Feb. 7.—Mr. W. Jago, "On Fermentation in its relation to Bread Making."
,, Mr. J. Mactear, "A New Method of Elevating Liquids, especially applicable to Acids."
,, Mr. C. Napier Hake, "Notes on the Stassfurth Industries."
,, Mr. Wingham, "English-grown Tobacco."
March 7.—Messrs. Cross and Bevan, "Mr. Hermite's Method of Electrolytic Bleaching."
,, Mr. J. Mactear, "The Castner Process for Production of Sodium."
April 4.—Triennial Election of Sectional Officers and Committee.

Notices of Meetings and Papers will be found in the Scientific Journals.

Notices of papers and communications to be made to the Local Secretary.

ON KINETITE.

BY WATSON SMITH, F.C.S., F.I.C.,

Lecturer in Chemical Technology in the Victoria University, etc.

THERE is no doubt, I think, that any new blasting explosive for which it can be truly claimed that it is so easy to prepare and mix, and withal so safe, that its principal constituents might be readily and safely transported to the place where they are wanted, and the composition there made up,—or, that if first made and then carried as a whole to its destination, there is not the slightest peril from exudation of dangerous liquid matters, or, in fact, danger of any kind of mechanical separation; moreover, that supposing by violent percussion at any point, some of the explosive lying about be detonated at that point, the detonation confines itself to the said fragment immediately struck, and does not spread to the surrounding substance—then, other things being equal, such new explosive is, I conceive, well worthy of as large a share of confidence as can be given to such matters. This certainly becomes the case if we can say of it that practically in open spaces it can scarcely be called an explosive, and is thus harmless; that it does not even burn very readily or quickly in contact with a flame, and that it remains unchanged on keeping, whether in hot or cold weather. But most of these advantages were claimed. and so far as my experience has gone, rightly claimed, for certain members of precisely the class of explosives to which kinetite, the subject of my paper, belongs, so far back as 1873, in a remarkable paper read before the Chemical Society by Dr. Hermann Sprengel. This paper was termed by Sir Frederick Abel, in his presidential address before our Society in 1883, "one of the most interesting, original, and suggestive of comparatively recent contributions to the literature of explosives," and I may now add that it seems to me it has proved sufficiently suggestive to the inventors of *Kinetite* to have enabled them by the addition of a certain improvement to make what I cannot help regarding as the safest blasting explosive in existence. Of Dr. Sprengel's paper (*J. Chem. Soc.* 1873, pages 805 and 806), Sir Frederick Abel in his address (this Journal, vol. ii. pages 312 and 313) gave an abstract, which I beg herewith to reproduce, since it so felicitously condenses into a very brief space so much that was important in that and previous papers:—

"In a memoir contributed to the Chemical Society in 1873, Dr. Hermann Sprengel sets forth the reasoning whereby he was led in 1871 and subsequently to make a series of experiments demonstrating that mixtures of strong nitric acid (sp. gr. 1·5) with solid or liquid hydrocarbons, such as naphthalene, phenol, or benzene, or with other very readily oxidisable liquids, such as carbon bisulphide, may be detonated, and that potassium chlorate may be also applied in the same way in conjunction with such substances, so that cylinders of compressed chlorate might be converted at any time into explosive cartridges by saturating them with the sulphide or with a liquid hydrocarbon. He pointed out that one obstacle to the practical application of mixtures of nitric acid and hydrocarbons—namely, the heat developed upon producing the mixture, due to the nitrification which ensues (and very prone to establish violent oxidation and even ignition)—may be removed by employing the *nitro-products* instead of the original hydrocarbons. Thus, while the addition of strong nitric acid to phenol would inflame it, the employment of trinitro phenol would actually give rise to a very considerable depression of temperature on mixing with nitric acid. And again, the employment of nitrobenzene would be attended only by a trifling elevation of temperature, while cold would be produced by using dinitrobenzene. Sprengel urged that the facts brought forward by him were susceptible of important application, because powerful explosive cartridges or charges might at any time be rapidly prepared from two ingredients which, kept separately, are non-explosive."

I shall now try to show that the so-called kinetite is virtually one of what Dr. Sprengel terms his "safety explosives" (see this Journal, 1886, page 200), and by a modification and improvement wrought by Messrs. T. Petry, O. Fallenstein, and H. Lisch, of Düren, the safety is somewhat further enhanced by a greater convenience of form safely conferred upon the nitrobenzene used, that liquid being converted into a jelly that can easily be packed, carried, or stored with safety, and without danger of exudation. Let us first see what kinetite exactly is. Messrs. Petry, Fallenstein and Lisch (Ger. Pat. 31,786, June 18, 1884) prepare this explosive by dissolving guncotton, or other nitrocellulose, in the nitro-compound of an aromatic hydrocarbon,—for example, nitrobenzene,—and then they knead into the resulting jelly, potassium chlorate, nitrate, ammonium nitrate, and similar compounds, and finally add to the whole mass and incorporate with it three per cent. of antimony pentasulphide. It is proposed that from this explosive, as with dynamite, cartridges enveloped in paper cases should be formed. These kinetite cartridges have been manufactured by the firm of Petry & Fallenstein, of Duren, since 1884. Some coal-mining experiments were tried with these cartridges in 1884 near Stolberg, and a full account is given in the *Berg und Hüttenmännischen Zeitung* for 1885, page 65.

The results of these experiments, tabulated as follows:— show that kinetite, as regards consumption and cost, did not altogether compare very favourably with gunpowder and dynamite, but in the displacement of material in the working of seams, it appears to slightly better advantage even than dynamite. In the article on these experiments—*Dingl. Polyt. J.* **256**, 409 (*i.e.*, in 1884)—it is very truly added that first experiments of this kind do not warrant the drawing of conclusions, and that "it is probable the correct method of using kinetite has not been found out":—

		Consumption in kilos. for one metre.	Costs per metre.	Metres thrown up in seam working.
In field-work with	Gunpowder (70 per cent.)	6·85	4·57	0·046
	Dynamite	3·54	7·70	0·051
	Kinetite	4·30	9·82	0·053
In shaft-sinking with	Dynamite	5·20	13·63	0·0129
	Kinetite	8·27	22·36	0·0135

(Presumably the metres above referred to are cubic metres.)

"The kinetite used in the experiments referred to was made of gun-cotton (probably dinitro-cellulose) and nitrobenzene made into a jelly, in which potassium chlorate and nitrate were kneaded, and to which some antimony pentasulphide was added It is stated that kinetite in spite of this latter addition is nevertheless difficult to explode, and can only be brought to this by very strong detonating caps. It is, however, waterproof, and cannot be frozen. It requires a good solid tamping, a circumstance which becomes important in actual working, and dangerous with detonating caps. Experiments in which stoppers of gypsum or hay were used seemed to answer well. The only obstacle to the use of kinetite is said to be the circumstance that its production is dearer than that of blasting-gelatin or dynamite."

It must be remembered, however, that this was written (1884) when benzene commanded a market price of some five to six shillings per gallon; now the price is 1s. 4d. to 1s. 6d. per gallon. The preparation of kinetite has been patented in this country as a communication from Messrs. Petry & Fallenstein to Thomas Wilkins, of Peckham, Surrey (Eng. Pat. 10,986, August 6, 1884).

In this patent the advantages claimed for kinetite are that "whilst it is stronger than ordinary gunpowder (explosive force five or six times that of ordinary powder), it is far less dangerous than dynamite, and being very easily mixed, and that mixing being unattended with danger, the ingredients (none of which are *per se* explosive, except the small percentage of gun-cotton) may be transported to the place where an explosive is required and there mixed. Moreover the compound of gun-cotton and nitrobenzene is a non-explosive gelatinous mass; hence the gun-cotton can be dissolved before transport to form the jelly, and all danger to the public from the carriage of explosives for mining purposes suppressed."

The explosive itself is a plastic mass varying in consistence according to the mixture adopted, and the proportions recommended as giving the best results are the following:—

	Per cent.
Nitrobenzene (or similar nitro-compounds)	16 to 21
Gun-cotton (or other form of nitro-cellulose) ..	¾ to 1
Alkaline chlorates and nitrates	75 to 82¼
Sulphur, as antimony pentasulphide (or other sulphide)	1 to 3
	100 100

The above are the English patentee's own words. Now let us hear the results obtained by German authorities not interested in anything but the actual truth and their own personal reputation.

In the first place, here is the translation I have made of the original of a stamped testimonial from the Bürgermeister of the locality where the works of Messrs. Petry & Fallenstein stands:—

Herewith it is testified that in the Blasting Explosive Works for Kinetite manufacture, owned by Messrs. Petry & Fallenstein, licensed in August 26, 1884, no accident or mishap of any kind has occurred.

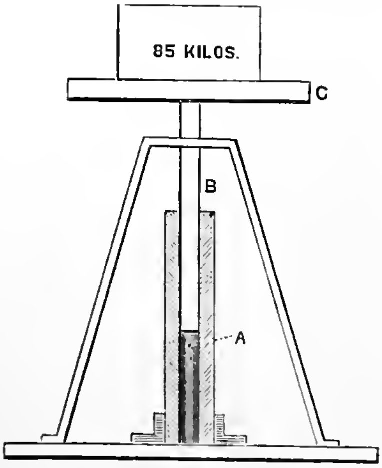
K. K., Bürgermeisterei Amt.

Rolsdorf, June 27, 1885.

Next follows a translation of a report, manuscript copy of which has been sent me. This report deals with the question as to the SENSITIVENESS of kinetite, and runs as follows:—

At the request of General Director Landsberg of Aachen, in presence of Director Blum and also Mining Director Dunkel of the Coal Mine Diepenlinchen, near Stolberg, the following experiments were tried—

The iron tube A shown in the adjoining cut serves for the reception of the cartridge, and the iron ramrod B is furnished with a plate C for carrying the weight, whereby the pressure required in ramming a bore-hole can be given: A was loaded with a cartridge of kinetite, the ramrod B adjusted, and its plate C laden with an 85kilo. weight.



Then the plate C, and with it the ramrod B, was set rotating in order to produce friction. The cartridge in the tube was now exposed to a violent concussive friction by allowing a weight of 21kilos. to fall repeatedly from a height of one metre upon the ramrod. Neither by this means nor in the foregoing cases did either ignition or explosion of the kinetite result. By the blows of the ramrod, however, the latter was so firmly imbedded in the kinetite that it was possible to lift the whole apparatus up by the ramrod without getting the latter loose. At last the tube was unscrewed out of the apparatus, when it was found that the kinetite was pressed extremely hard on the bottom. It was ignited and burned slowly without the slightest appearance of explosion.

The General Director Landsberg declared himself completely satisfied, by the result of these trials, as to the safety of kinetite as a blasting explosive.

I have also received copy of another manuscript report from Germany, containing the report of other experiments of which I will give a condensed account.

FIG. 1.

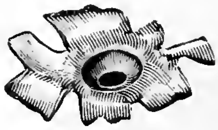


FIG. 3.—View from above of piece of Cylinder.

FIG. 2.—Side View.

On April 2, 1885, before the Königl. Bergrath Wagner, in presence of Bergassessors Müller and Kropp, Professor Schulz, with Messrs. Till, Baumann, Zimmermann and Hillonblink, engineers and managers, the following trials were made. A fire was kindled on a hearth over which was an arch in which a hole had been made admitting a funnel. It was so contrived that cartridges, etc., could be arranged in the space between the funnel and an iron cap which covered the funnel. This cap could be raised by a string, and in so doing, the cartridges and other matters in the space between funnel and cap were precipitated through the funnel and upon the grate or hearth. The kinetite cartridges from Petry & Fallenstein's works weighed 80grms. each. The results were briefly as follows:—

(1.) Two kinetite cartridges cut into four equal parts and distributed in the funnel. *No explosion.*

(2.) A kinetite cartridge tightly wrapped in a thick paper covering 74cm. long, in order to exert pressure. *No explosion.*

(3.) Two kinetite cartridges pressed together in a strong bedding-mould. *No explosion.*

(4.) Three percussion caps (such as are used for dynamite) were completely enveloped in a kinetite cartridge, and strongly bound up in paper. *Only explosion of the detonating caps and combustion of the cartridge.*

Thrown upon a burning fire it thus appears that kinetite cartridges cannot produce an explosion.

The Royal Mining Councillor Wagner testifies, under his seal, that the results of these experiments precisely coincide with those he had himself obtained in similar trials.

I have obtained also a translation of the Report of the Royal Technical and Administrative Military Committee in Vienna on a sample of so-called

"Petrofracteur," submitted in order to procure licence for manufacturing. Petrofracteur generally resembles kinetite in composition, but differs specially in that it contains no guncotton, which renders the nitrobenzene of the jelly more difficult of volatilisation.

Petrofracteur consists of a mixture of the following substances in the following proportions:—10 per cent. nitrobenzene, 67 per cent. potassium chlorate, 20 per cent. potassium nitrate, and three per cent. antimony pentasulphide. With the powder test of Nebatius it was found impossible to explode the triturated sample with double-filled sporting caps, and hence petrofracteur is unsuitable for gunnery purposes.

With an adaptation of the Brisanz-meter, using lead cylinders and an adjustable ballistic pendulum, 17grms. of petrofracteur gave a pendulum propulsion of 1·98°, 2·43°, 1·88°; average = 2·11°, as against 8·76 of 70 per cent. Kieselguhr dynamite, and a compression of the lead cylinders, each 20mm. long, of 1·00, 1·500, 1·10; average = 1·20 kilogram-meters, as against 11·9 kilogram-meters of 70 per cent. dynamite.

Detonated in the open, petrofracteur is therefore far less effective than 70 per cent. dynamite. Exposed in the open air for eight days it lost 9·73 per cent. of its weight, due to the volatilisation of the nitrobenzene, and an impervious casing is recommended. In damp air it loses nitrobenzene, but absorbs moisture. Heated to 70° C. for a lengthened period, after 2—3 days all nitrobenzene is lost, but no further decomposition was observable. Heated in a closed "eprouvette" to 70° C. the nitrobenzene evaporated, and the preparation after two days became deep black by the change of the antimony pentasulphide into the lower black sulphide and sulphur. Neither explosion, ignition, nor tumultuous decomposition takes place. The substance is not affected by temperatures near or below zero. Slowly heating from 70° upwards causes no explosion. At 340° it commences to melt and then decomposes, leaving a white residue. The fusion and decomposition are accompanied with pulling and spitting on suddenly heating to 500°, and combustion takes place. A coating of 1mm. thick between steel surfaces of 1·34sq.c.m. area, the preparation only exploded by blows of 4 kilogram-meters and upwards upon the first blow, below this down to 3·5 kilogram-meters only partially, and below the latter not at all, whilst 70 per cent. Kieselguhr dynamite explodes with 1·5 kilogram-meters.

The Committee considers petrofracteur less dangerous than Kieselguhr dynamite, with respect to personal and public safety, as regards its manufacture, storage, packing, conveyance generally, and particularly railway conveyance, also in respect to its sale and use no objections whatever stand in its way.

On comparison of this report with the foregoing on kinetite, it is observable that petrofracteur is the more sensitive of the two, and not a little so. I am sure, moreover, that kinetite suddenly heated to 500° would not break into combustion. On referring to the constituents of both explosives, generally so similar, and to the proportions adopted, I am led to the conclusion that the difference referred to is due to the larger proportion of antimony pentasulphide combined with the greater inequality of the mixture with liquid nitrobenzene, and also to what we may call the superior wetting power of the nitrobenzene—*i.e.*, its closer physical contact with the solid constituents of the "petrofracteur" mixture, whereas in kinetite the nitrobenzene-guncotton jelly envelops each grain of saline matter with a waterproof and airproof skin, which does not, I believe, creep into pores or minute crevices, but roughly envelops each minute grain. Thus, I believe what the kinetite slightly gains in a kind of theoretical way by the addition of its small $\frac{3}{4}$ to 1 per cent. of gun-cotton, in explosive power, it very largely gains in the physical condition into which it and the nitrobenzene are thrown, as a jelly, and in the whole physical condition so largely out of proportion to the minute quantity of nitrocellulose required, conferred thus upon the entire mass.

You may now naturally inquire: "Since the manufacture of kinetite has been patented in this country by Wilkins, it is to be presumed efforts have been made to obtain a licence for the manufacture?" This is so: nevertheless no success has attended these efforts, the company desiring to commence the manufacture failing to convince the Secretary of State of the sufficient safety of the explosive in question; but being desirous of obtaining further tests, proofs, etc., it then invited further and more searching trials, and for this purpose exhaustive experiments and reports have been made separately and independently by Prof. Stahlschmidt of the Polytechnic Schools in Aachen, by Prof. Lunge, of Zürich, by Professor J. Campbell Brown, of Liverpool, and by myself. Prof. Campbell Brown and I worked together with regard to one point—viz., experiments as to the effect of a glancing blow, wood on wood. Before saying anything as to the experiments thus more recently tried, I must refer to the Government report, which is adverse to kinetite.

In the recently published Blue Book, the Tenth Annual Report of Her Majesty's Inspectors of Explosives—viz., that for the year 1885, pages 30 and 31, the following report appears as to kinetite:—

> Kinetite consists of nitrobenzene thickened or gelatinised by the addition of some collodion cotton incorporated with finely-ground chlorate of potassium and precipitated sulphide of antimony. Nitrobenzene is not present in any of the explosives at present licensed, and kinetite constitutes in some measure a new departure. In some respects, such as the very high temperature required for its ignition and the great difficulty, practically the impossibility, to explode it when unconfined by the application of heat, kinetite possesses considerable advantages, but it suffered under two fatal defects. In the first place it proved to be extremely sensitive to combined friction and percussion, and in the second place it gave indication of a certain want of chemical stability, which, under favourable conditions, might lead to spontaneous ignition or explosion. In regard to the latter point, I [the chemical adviser of the Government] have quite recently received information fully bearing out the correctness of my conclusion: cases of spontaneous ignition of kinetite have not only been actually observed to occur in the laboratory, but in one case, at least, the contents of a magazine containing kinetite were burnt, owing to the spontaneous ignition of the explosives. In the latter case it had been observed that the kinetite had become strongly acid, and arrangements were at once made for its destruction, but the kinetite took fire spontaneously before these arrangements could be carried into effect.
>
> In connection with the rejection of Turpin's explosives, of etnite and of kinetite, all of which contain chlorate of potassium, I should like to offer the following remarks: Chlorate of potassium, on account of the readiness with which it lends itself to the production of powerful explosives, offers a great temptation to inventors of new explosives, and many attempts have been made to put it to practical use, but so far with very limited success only. This is chiefly owing to two causes. In the first place chlorate of potassium is a very unstable compound—it is one of those compounds during the decomposition of which heat is evolved, or energy is produced during decomposition, instead of, as is usually the case, being absorbed, and all such compounds are unstable—and is liable to suffer decomposition under a variety of circumstances, and under, comparatively speaking, slight causes, chemical and mechanical. All chlorate mixtures are liable to what is termed spontaneous ignition or explosion in the presence of a variety of materials, more particularly of such as are acid or are liable to generate acid; and all chlorate mixtures are readily exploded by percussion, but more particularly by combined friction and percussion, such as a glancing

blow, which might easily, and would often, occur in charging a hole. In the second place, there is some evidence to show that this sensitiveness to percussion and friction increases by keeping, more especially if the explosive is exposed to the action of moist and dry air alternately. If inventors would only keep these characteristics of chlorate mixtures in mind they would frequently save themselves serious disappointment.

With respect to the question of stability, Professor Stahlschmidt, in letters addressed to Messrs. Petry & Fallenstein, of which I have translation-copies, makes statements of which I give the following extracts:—

> Neither chlorate of potash, nor saltpetre, nor pentanitrocellulose, nor nitrobenzene, are bodies which either by themselves or in mixture undergo alteration. I have still in my possession a cartridge remaining over from the tests, which has in no wise changed its characteristics, but, on the contrary, retains all the features presented in a perfectly fresh state.

The letter is dated June 14, 1885, and the sample was given to Dr. Stahlschmidt on Dec. 20, 1884. Another letter to Messrs. Petry & Fallenstein, bearing date of Aug. 1, 1885, runs as follows:—

> With respect to the explosiveness of your kinetite by a sliding blow, or a glancing blow, I beg to say that exhaustive trials which I have carried out prove that only very small particles of the explosive compound can be made to explode by this action; in fact, only such particles as are immediately struck. All the rest remained unconsumed, and in part strewn about. Any danger, therefore, of a more extensive explosion taking place is *completely* excluded.

Now, to my mind, only one cause of acidity developing in kinetite is conceivable—viz., the impurity of some of the raw materials, which conceivably might contain a little acid—*e.g.*, the guncotton, the nitrobenzene, and the antimony-pentasulphide. In the latter case, the acidity could scarcely be said to develop; but if not carefully made, the antimony-pentasulphide might of course contain some free sulphur, and this might commence an action. Nevertheless, the proportion of the sulphide used is very small (about 2 per cent.). I cannot but think, in view of the experiments and reports from Germany, as well as those I have tried, that the cases of spontaneous ignition must have arisen from extraordinary causes of impurity, or acids present in the materials, and such mishaps are as liable to arise in many other licensed explosives.

Since kinetite made with the addition of antimony-pentasulphide was rejected by the Secretary of State, the attempt was made to meet his views by removing the sulphide from the mixture; in short, kinetite was made of nitrobenzene jelly and potassium chlorate, with or without the addition of some nitre (6 per cent.). But, thus made, we at once recognise in kinetite a modified form of Sprengel's "rack-a-rock"; still, it no doubt is a modified form, and I believe the physical change induced in the nitrobenzene by dissolving in it so small a quantity of nitrocellulose, forms a distinctly new departure. The experiments made by Lunge, Campbell Brown and myself, were with this modified kinetite. Nevertheless, after our experiments were concluded, the "Potentite" Company, Limited, the company desirous of working Wilkins' patent (the communication from Petry & Fallenstein), received a letter from the Home Office, once more denying the desired licence. The letter ran as follows, and was addressed to Mr. Macan, the London representative of the company:—

WHITEHALL, February 25, 1886.

SIR,—I am directed by the Secretary of State to inform you, with reference to previous correspondence, that the sample of the explosive kinetite submitted by you for examination, although a trifle less sensitive than the sample previously submitted, and rejected, when tested by a glancing blow, is, nevertheless, far too sensitive under this test to admit of its being licensed for general use. I am to state that it has been found that the explosive may be fired without much difficulty by a slight glancing blow from a wooden broomstick, or small mallet, even when placed on a new, or rather soft deal floor, and that, in these circumstances, the Secretary of State has no choice but to refuse to license it.—I am, Sir, your obedient Servant, PEMBERTON.

If I was asked, "What then would be the effect of detonating the portion struck by a mallet or broomstick on a wooden floor, supposing that floor entirely covered with, say a quarter-of-an-inch deep of kinetite? Would it not be an awful explosion?" By no means so; and from an intimate experience with laboratory specimens of kinetite, extending over a year-and-a-half, I can affirm my willingness to allow myself to be placed in such a room, and, if merely furnished with a bucket or two of water, I will undertake to detonate on iron, with an iron hammer, some of the kinetite which shall be in direct contact with all the rest on the floor (to detonate with wood on wood is far too troublesome, and I have often exhausted myself with violent glancing blows ere I could get satisfactory detonations). Nitrobenzene is considerably heavier than water, and so an effusion of water would soon extinguish it on burning, and all that the detonation of the portion struck in a room like that named could do, would be to inflame the oil in the surrounding kinetite; and yet in none of the trials I have made or seen made have I ever seen kinetite set on fire by the detonation of a part of it. A striking experiment performed at Melling, near Liverpool, in the presence of Prof. Campbell Brown and myself, and to be subsequently described, will justify, I believe, what may at first seem to look like a suicidal proposition on my part.

I will now give the report of Prof. Lunge on experiments he made with kinetite free from sulphides, and which he himself prepared from the gelatin supplied to him by Messrs. Petry & Fallenstein:—

[TRANSLATION COPY.]

ZÜRICH, 1st October, 1885.

REPORT UPON THE KINETITE OF PETRY & FALLENSTEIN, OF DUREN.

I have been requested by the above firm to report upon the chemical stability of their patented explosive, called kinetite; as also upon its sensitiveness against shock and blow. To this end, the said firm placed at my disposal a quantity of gelatine, composed of 5 parts of nitrocellulose and 100 parts of nitrobenzol, and with this I myself prepared the explosive compound, according to the directions of the patent, by mixing 22 parts of this gelatine with a compound of 72 parts of chlorate of potash, and 6 parts of nitrate of potash, both finely powdered and intimately kneaded together, until a homogeneous mass was obtained, in which each salt particle was coated or covered by the nitrobenzol gelatine. The mass thus acquired a consistency of about that of damp garden mould, and obtained also a certain although low grade of plasticity.

With kinetite thus prepared, I have carried out the following experiments:—

I.—BEHAVIOUR UNDER SHOCK OR BLOW.

1. A small quantity of kinetite was spread out upon cardboard, and laid upon an iron anvil. Violent blows with a hammer were then dealt upon it, without, however, producing any explosion. The same conditions obtained with wood.

2. Some kinetite was next placed upon a thin sheet of copper-plate, and laid together with it on the anvil.

Here, too, on being struck violently with a hammer, no explosions resulted. The kinetite was merely flattened out, and stuck firmly to the under (striking) surface of the hammer.

3. Kinetite, laid directly upon the iron anvil, exploded on being struck with the hammer, but only in so far as it came immediately between the two iron (steel) surfaces. All the rest was merely compressed, or scattered about. So, for instance, a portion of kinetite remained sticking to the surface of the hammer head unchanged, and was finally brought to explosion by a somewhat altered direction given to the blow.

Inference.

Kinetite only explodes, even by violent blows and shocks, when iron impinges direct on iron. Between iron and copper it cannot be brought to explode; and equally so between iron or cardboard or wood.

[*] Kinetite, therefore, is as little sensitive to shock or blow as any other known well-behaved explosive.

II.—BEHAVIOUR UNDER IGNITION.

Even larger quantities (*i.e.*, as in the case of my experiments, several grammes) of kinetite may be ignited, either by a burning body, or by a red-hot iron, without any appearances of explosion taking place. The compound burns quietly with a strong illumination and sooty flame, and leaves a hard, salt residue.

III.—BEHAVIOUR WHEN HEATED.

1. A few grammes of kinetite were heated in an air bath during a lengthened period to 120° C. (248° F.).

Subjected to this process, the nitrobenzol gradually evaporated. The salty residue showed no explosive qualities.

2. A few grammes of kinetite were directly heated in an enamelled iron dish, over a moderately large gas flame (Bunsen burner). The nitrobenzol evaporated very quickly and completely, but quietly, in the form of a brownish-yellow vapour. A residue of salts remained, which later on was brought to a state of fusion, without, however, obtaining any appearances of explosion.

3. A few grammes were placed in the same dish, but over a very powerful gas-flame, so that a very high temperature was very quickly reached. In about 30 seconds the substance ignited and burned quietly away, leaving a residue of molten salts. The ignition occurred evidently in this instance, by reason of the fact that the temperature was rapidly raised to the point of inflammability before evaporation of the nitrobenzol had taken place.

4. In order to test if, from any cause of separation between the gelatine and the salt molecules, a greater degree of danger would arise, I heated in a water bath a few grammes of the gelatine (*i.e.*, of the compound of 100 nitrobenzole and 5 nitrocellulose) by itself only. As an open dish was used, the temperature did not rise above 80° C. (166° F.). At this temperature, however, it did not by any means reach the point of fusion, but, on the contrary, retained almost the same salve-like condition which it has under ordinary temperatures. It may therefore be confidently assumed that no separation (disincorporation) of the explosive compound from any sweating out of the gelatine—consequent, say, upon the heat of summer weather—can take place. It may also be remarked that the gelatine thus heated in a water bath, on being ignited, burnt quietly away without a trace of explosive characteristics. For itself alone it also evinces, when struck by iron upon iron, much weaker explosive characteristics than kinetite.

Any disincorporation of the compound would therefore *diminish* the danger of carriage and storage. Quite the opposite of ordinary dynamite, which on account of the sweating out of nitro-glycerine in liquid form, increases its dangerousness to an enormous extent.

Inference.

In reference to its behaviour under heating and ignition, kinetite is considerably less dangerous, in respect of carriage and storage, than any other explosive known to me in my general experience hitherto.

IV.—ITS BEHAVIOUR ON PROLONGED STORAGE.

Experiments in respect to this I could not carry out, as a lengthened period of time would be necessary. I consider, however, such experiments quite purposeless. No expert would for a moment entertain the thought that from any degree of prolonged storage, to whatever length of time extended, any such change in the ingredients composing kinetite could take place, which could in any sense make its manipulation in the slightest degree more dangerous.

If the storage vessels are not tight, nitrobenzol will evaporate. If water is permitted to associate with it, the salts will be washed out. In either case the residue will always be *less explosive.*

If stored in vessels impervious to air and water, it is beyond question that any reaction can take place which could increase the danger of explosion, such as is the case with imperfectly purified nitroglycerine, or with dynamite manufactured therefrom.

On the basis of the above facts, and on the basis of the experience which I have had in experimenting, by order of the Swiss Government and Swiss Railways, upon the explosives chiefly used, I give it as my opinion that the explosive called kinetite, manufactured by Petry & Fallenstein, belongs to the least dangerous of all explosives in reference to carriage, manipulation, and storage; and that any possibility of increase of danger, from change of character by storage, or by transport, is entirely excluded.

(Signed) DR. LUNGE,
Professor of Tech. Chemistry
at the Eidgenossischen Polytechnikum,
Zurich.

Prof. J. Campbell Brown's report now follows, and this was written in complete ignorance of Dr. Lunge's experiments, results, or report:—

UNIVERSITY COLLEGE,
LIVERPOOL, 5th Dec., 1885.

I have examined and made experiments with a sample of kinetite received from the Potentite Company, Lim., in November last, and with other samples made by myself, and beg to report as follows:—

1. When submitted to blows upon an iron anvil with an iron hammer, it explodes when struck with sufficient force, but not very easily; and only that portion immediately struck explodes, the surrounding portions, if any, remaining unaltered.

2. When placed upon copper, zinc, and other metals, and struck with an iron hammer, it exploded with greater difficulty and no more completely.

3. It exploded entirely only when placed between two iron plates and struck with a sufficiently heavy hammer.

4. When placed upon wood and struck either directly by the hammer or with the intervention of an iron plate, it only flattened out and did not explode.

5. When placed upon iron, wood, stone, and concrete successively, and struck by a slanting blow of an iron hammer, it behaved in the same way as when struck directly. When struck by a slanting blow of a wooden mallet it did not explode.[†]

6. When placed upon iron, wood, stone, and concrete successively, and struck by a slanting blow of a heavily-shod heel, a small portion only, or sometimes none, exploded, leaving the rest flattened only.

7. When heated in an open dish until half dry, and treated in the same way, it exploded in a similar way—perhaps a little more easily when hot; but when all the nitrobeezene had been evaporated away it did not explode under any kind of blow.

8. When a large quantity is set on fire by any burning substance, or a hot bar, it does not explode, but burns

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[*] Dr. Lunge here, of course, refers only to direct blows, and not glancing or sliding blows.

[†] More recent experiments by Dr. J. Campbell Brown showed that when fairly beaten into the wood, and continued slanting blows administered till in fact the friction produces warmth, slight detonations could at length be caused, confining themselves, however, to the points and portions struck.—W. S.

quietly away with a smoky flame, leaving a saline mass which contains a little potassium chloride, but chiefly potassium chlorate and nitrate. In one experiment I found as much as half the potassium chlorate reduced to chloride; but in no case was nearly all the chlorate reduced. The residue is non explosive.

9. An ounce of kinetite surrounding one of Geo. Eggerstorff's sextuple detonators and placed on a boulder in the open, did not appear to me to explode when the detonator was fired by a fuse, but was so scattered that no complete evidence as to what became of it could be obtained; the experiment was therefore repeated in the same way, but under an inverted empty barrel. In this case the kinetite was only partly exploded, lifting the head of the barrel, and was partly but imperfectly burnt, there being soot inside the barrel and a strong smell of nitrobenzol on all the grass surrounding the stone on which the kinetite had been placed, and the stone was uninjured.

Judging from all these results, I entertain no doubt whatever that kinetite is a much safer kind of explosive than dynamite and its allies, whether in manufacture, storage, or in use.

J. Campbell Brown, D.Sc.,
Professor of Chemistry in University College, Liverpool, and Victoria University.

As regards my own experiments, I was invited to specially test and report on the chemical stability of kinetite made without antimony pentasulphide, and subsequently with Prof. J. Campbell Brown to witness and to try some field experiments on a larger scale at the Potentite Company's Works and in a neighbouring quarry at Melling, near Liverpool.

Report on the Chemical Stability, etc., of the New Explosive known as "Kinetite."

Oct. 26, 1885.

I. A quantity of kinetite was prepared by me according to the directions furnished, but I took *pure* nitrobenzene instead of the commercial article usually employed. I dissolved 1 part of gun-cotton, the product of the Potentite Company, Melling, by Liverpool, in 20 parts of pure nitrobenzene, prepared specially for me by Mr. C. Dreyfus of the Clayton Aniline Company, near Manchester. I warmed the nitrobenzene in the process of solution, and found that heat causes the gun-cotton to go very quickly into solution. To ascertain if any danger exists in this part of the process by which, with mechanical agitation, no application of heat would be necessary, I heated the mixture to nearly 120° Centigrade (248° F.). The only effect was fuming of the nitrobenzene. Hence, to promote solution of the gun-cotton, warming of the mixture with a closed steam coil would be perfectly and absolutely safe.

My jelly produced as above I now mixed intimately in a porcelain mortar with well-dried potassium chlorate and nitrate, in the following proportions: 22 parts of the aforesaid jelly, 72 parts of chlorate of potassium, and 6 parts nitrate of potassium.

II. I first found that the explosive in portions, each about the size of a pea, was detonated by smart blows with an iron-headed hammer on a cast-iron plate, giving explosions like pistol shots.

III. Similar pieces of explosive (about the consistency of putty) when placed on the iron plate and fired with a lighted match, simply burned with a smoky, luminous flame, quite harmlessly, and left behind a residue of a white saline character. This residue consisted almost entirely of the unaltered potassium chlorate, for it deflagrated powerfully on heating with the blow-pipe flame or charcoal. It is then easy to burn away the nitrobenzene, and probably the gun-cotton, quite harmlessly from the explosive, without sensibly altering the potassium chlorate. I say "without sensibly altering," for, on closely observing the burning mass, I perceived no symptoms of fusing of the residue of chlorate as it was left.

IV. A thin wrought-iron plate was now heated stongly, but not more than to a black heat, and a piece of the explosive was now put on this plate. It commenced to smoke strongly, and continued to do so till the nitrobenzene was volatilised, when intumescence of the chlorate set in with evolution of oxygen gas, as is usual with chlorate of potash when heated—but no sign of *anything approaching* to explosive violence was *at any time* manifested. Neither in III. nor here in IV. does the presence of the gun-cotton manifest itself by any phenomenon in the least degree.

V. Further portions of the explosive were placed in watch-glasses and exposed to temperatures of about 96° to 100° C., and about 70° C. respectively. In from 24 to 30 hours it was found that all nitrobenzene had volatilised, not even the least odour remaining, and residues were left which consisted of chlorate of potassium with the minute quantity of gun-cotton originally added in the form of jelly.

VI. The dry, odourless saline residues obtained by the evaporation of the nitrobenzene were now placed on the cast-iron plate and violently struck with the iron-headed hammer, but without any result in the shape of detonation.

On charcoal with the blow-pipe flame, the chlorate deflagrated and burned along with the gun-cotton in it, but not in the least differently from chlorate of potassium deflagrated alone under the same conditions.

Similar portions of saline residues left as above stated were subjected to the following tests:—

(*a*) Portion placed on a strongly-heated iron plate, quietly fused, evolved oxygen gas just as chlorate of potassium usually does.

(*b*) Another portion refused to ignite, deflagrate, or explode on attempting to fire with the flame of a match.

VII.* A portion kept in a warm room (16° C.) in stoppered bottle for three weeks, was not changed in the least, nor was another portion similarly kept for two months. In fact, in the chemical nature of things, it is quite impossible any spontaneous change should take place.

VIII. Another portion exposed in a watch-glass at about 30° C. for several days, was at the end of about 3½ days found dry, and to consist of a simple mixture of chlorate with the small quantity of gun-cotton of the jelly. The jelly itself I have found perfectly stable, and also that on exposure it does not suffer loss by evaporation of the nitrobenzene like the kinetite, though, of course, such evaporation does take place.

Altogether, I consider the kinetite is *a most safe mixture*, as I believe my experiments amply prove.

IX. The employment of nitrobenzene well washed from *all free acid*, and gun-cotton also free from *acidity*, are precautions which, being very easy of attainment, I see no difficulty or danger at all in the production of kinetite on a large scale, perfectly safe to keep.

X. I have made some kinetite with pure nitrotoluene, and this I find more difficult to detonate than that made with pure nitrobenzene—*i.e.*, a harder blow must be administered. Consequently the use of a commercial benzene containing also toluene, and the resulting employment of a mixture of nitrobenzene and nitrotoluene, offers no risk of danger whatever, but being detonated, even with more difficulty than a kinetite made with pure nitrobenzene, it is, on the contrary, safer.

Watson Smith, F.C.S., F.I.C.,
Lecturer in Chemical Technology in the Victoria University.

Report on a Series of Comparative Experiments made 12th November, 1885, with "Kinetite," "Potentite," and Nobel's Dynamite, at the Works of the Potentite Company, Melling, near Liverpool, in company with Professor J. Campbell Brown, Mr. F. W. Macan, and several Members of the Firm and Officials.

November 20, 1885.

The following experiments were tried with the object

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* *January* 2, 1887.—A portion of this same sample, and also some of a larger sample prepared from commercial products, and kept since October, 1885, and brought under all normal conditions of exposure, are now perfectly unchanged.

of comparing the explosive effects of the above-named preparations.

Cylinders of solid lead each 2ft. long and 6in. in diameter, were bored with holes down the centre, the bore of each of which is $\frac{15}{16}$ of an inch in diameter, and 18in. in depth. The cartridges were lowered into this tube by the fuse terminated by a detonator inserted in the cartridge, and whilst the end of the fuse projected, the tamping was done with water—*i.e.*, water was poured into the hole until full. The cylinder having been sunk in the earth until only about 4in. projected, the fuse was lighted, and after the explosion the earth was removed and then the tube, when a bulbous swelling was found upon it in the vicinity, more or less, of the cartridge. The volumes of such bulbs could easily be measured by measuring the water capable of filling the cylinders in which the explosions had taken place.

A 1. Two cartridges of potentite (a mixture of nitre and gun-cotton), each weighing 1½oz., were now exploded in a lead cylinder sunk in the earth.

The side of the cylinder was blown out and a rent made, a bulbous bulging out of the lead all round the place where the cartridges were, appearing.

A 2. Two cartridges of potentite, as before, exploded.

Bulging again as before, but no rent; still the bulb contained several cracks and small ruptures.

B 1. Two cartridges of kinetite, of 1½oz. each, exploded as in A 1, and 2. Explosion sharper than in A 1 and 2. But though bulged in a very even bulbous form, not any rupture had taken place.

B 2. Kinetite paste used this time, and not cartridges, the weight employed being the same as in B 1. Sharp report and red flash. Bulb very evenly bulbous in shape.

C. Some kinetite paste was now placed on a granite stone connected with detonator and fuse, and fired. From the sound it was judged that only the detonator exploded. At any rate, all was blown away, and no positive proof remained that the kinetite was not exploded. To get such proof—

C 1. Again some kinetite paste was placed with detonator and fuse on the stone, the fuse lighted, and an empty cask placed over the whole, so as to enclose it. On exploding, the head of the cask was blown out, but the rest of the structure remained unhurt.

On examining the grass, a dark circular line was observed just inside the circle described by the rim of the cask, and this was found to be moist with and to smell strongly of nitrobenzene. Thus it is proved that even with a detonator, when fired in the open, or even in a space so much enclosed, either no explosion or only a very partial one ensues.

C 2. A cartridge of potentite fired on the same stone with a detonator and fuse, just as the kinetite was fired (under an inverted cask), was exploded and blew the cask to pieces.

Comparison of Kinetite and Dynamite (Nobel's Cartridges).

I. Lead cylinders, bored precisely as before, were used. One cartridge of Nobel's dynamite (2¼oz.) was exploded. No flash perceived; the cylinder was bulged locally, but unevenly somewhat as in Fig. 1 (*see p. 4*).

II. One cartridge of kinetite (2¼oz.) exploded. Sharp explosion, much sharper than I. No flash perceived, and cylinder bulged apparently to about double the volume of that in I. with the dynamite. The bulge was remarkably even, however.

III. Two cartridges of kinetite (2¼oz.) exploded. Sharp explosion as in II., but louder. Very regular bulge, of larger size than in II., but an almost perfect bulb. No rupture.

IV. Two cartridges of dynamite (2¼oz. each). Flash, and deep hollow detonation or explosion; earth thrown up, and with it the upper half of the lead cylinder, about 6ft. into the air. This part of the lead cylinder had assumed a form like that in Figs. 2 and 3 (*see p. 4*). A hole was found in the ground where the upper part of the cylinder was, and the lower part remained embedded. The hole measured about 2½ft. in diameter.

V. Another explosion, with a similar charge of dynamite as in IV., gave a result singularly like that of IV. in every respect.

VI. Explosion with another double charge of kinetite (two cartridges of 2¼oz. each) produced a result very like that of III.—viz., a singularly even bulge as if a bulb had been blown upon the tube by an experienced glass-blower, but this time there was a rupture, a hole being blown in the side measuring about 3in. by 1¼in.

Thus it appears that a certain degree of reliance could be placed on a rough calculation of the explosive effect of a charge of kinetite, single or if doubled, but no such calculation could be made with regard to dynamite. For, a small charge of dynamite doing less work than a similarly small one of kinetite, actually did when doubled immeasurably more than double the work of the doubled charge of kinetite, and did it after a somewhat eccentric and destructive fashion. The localised character of the violence of the dynamite explosion was well marked.

As regards any attempt at explanation of the at first sight abnormal results of these latter experiments, one theory suggests itself as possibly the most likely.

It was noticed in each case when a rupture was effected in the lead, that the general results indicated a considerably greater destructive action than when no rupture took place.

In experiment I., where no rupture with the single charge of dynamite took place, it is observed how uneven the bulge of the lead was, though not a large bulge by any means. This indicates the certain rupture of the lead with an explosion of *dynamite the equal of which*, generally speaking, with kinetite would not rupture the lead, because being equally exerted in all directions, an even bulge is produced. The uneven character of the bulge caused by the dynamite also throws some light on the extraordinary and eccentric concentration of violence, so to say, with which dynamite acts upon certain points, in given directions, so as to cause what are called destructive *local* action.

The Action of Kinetite in Blasting Rock.

An experiment was tried in a quarry of sandstone near the Potentite Company's Works, and instead of a cartridge simply a piece of kinetite moulded in the hands was used; this was inserted in the bore hole just as a cartridge would be, in it being inserted also the detonator with fuse. The tamping was not carried out at all, the fuse being simply lighted. An explosion followed, which did admirable work in clearing out a large mass of rock, and in large pieces, and generally manifesting an equal all-round action, which must be of the greatest economic value in blasting in either quarries or coal mines. The testimony of the workman in charge was highly in favour of the kinetite as regards the loosening of large pieces, as compared with that of dynamite. A particularly valuable quality of kinetite was shown in the next experiment. A bore hole had been made in the rock at the bottom of a pool of water, and into this a piece of kinetite paste, first moulded in the hand, was inserted by a workman, who bared his arm and reached down to the bottom of the pool for the purpose. Into the middle of the kinetite the detonator was inserted, the end and a few inches of the fuse projecting above the water. On lighting the fuse, at length an explosion followed, showing the waterproof character of the explosive. Nitrobenzene being insoluble in water, protects the particles of otherwise soluble chlorate of potassium, so that the whole remains insoluble and unwetted in the water.

The fact that in so many cases, probably most, cartridges of kinetite are not needed, and that kinetite may be handled in moulding with safety, as it is not noxious like dynamite,* producing the violent headaches following

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* I am aware that vapours of nitrobenzene in closed spaces act to some extent as a poison, but the conversion into the jelly prevents the vapourisation to a great extent, and hence the poisonous effect, which again is very far below that of nitroglycerin, even supposing work in closed rooms, of which there is no need.—W. S.

contact with that article, is a strong argument in its favour, both on economic as well as sanitary grounds.

WATSON SMITH, F.C.S., F.I.C.,
Lecturer in Chemical Technology in the Victoria University.

As an expression of opinion, the immense preponderance of all the evidence compels me to say, with Professor Lunge, that "the explosive called kinetite belongs to the least dangerous of all explosives in reference to carriage, manipulation and storage."

As regards the use of kinetite in coal mines, I have heard a report from Germany, the reference to which I can unfortunately not find again, that it behaves exceedingly well, especially in detaching or loosening very large masses and making but little smalls and dust. This is a matter of immense importance in coal mining.

In conclusion, permit me to say that I have not the slightest interest in kinetite beyond my reputation as a representative of chemical technology, and my duty as regards my experiments and report, which, again, the company charged me to make in their interests, with the most unbiased intent to elicit the full truth, and I must confess that in those interests, those of my country, and with every due care to my own reputation, I cannot but see great advantages in the manufacture and use as a blasting explosive of this offspring, as I cannot but regard it, of Dr. Sprengel's researches, and I should, therefore, class kinetite as *par excellence* "a safety explosive." If I can find evidence, or have it placed before me, to the contrary, it will be my duty, and I shall in fact hasten to renounce that position.

EXPERIMENTS.

After reading his paper, Mr. Watson Smith performed several experiments with a view to proving the safety attending both the manufacture and use of kinetite. (1.) He dissolved 5 of nitrocellulose in 100 of nitrobenzene, and heated the mixture even to ebullition over a flame (nitrobenzene boils at 205° C.). (2.) Some kinetite (made in November, 1885) was put on a strongly heated iron plate over the gas flame, nitrobenzene was rapidly volatilised, but no combustion ensued, until the flame was directly applied to the explosive, when the latter burned away steadily and somewhat slowly. (3.) Some kinetite was placed on an iron block, and was struck heavily with a hammer. Several explosions of those portions which actually came between the two iron surfaces occurred. (4.) Some kinetite was placed on a sheet of lead, which, again, was placed on the iron. Heavy blows were struck at this, with no result. On a second attempt a minute portion was exploded. The same experiment was repeated a third time, with no result. (5.) Some kinetite was laid on wood, and struck with a wooden mallet so as to produce a sliding or glancing blow. Repeated attempts to explode the kinetite in this way were made, but with no success. Some portions of the explosive adhered to the mallet, and were subsequently burnt off at the gas flame.

DISCUSSION.

The CHAIRMAN said Mr. Watson Smith had given a very interesting paper on this new substance. It was most remarkable to see how Dr. Sprengel's inventions had borne fruit. It seemed hardly possible now for an inventor to do more than develop one or another of Dr. Sprengel's ideas on the subject—in fact, all that remained for one to invent in respect of this class of explosives were variations in composition and in name. It seemed to him that the most interesting property of kinetite was its power of regular explosion. In this respect it appeared to be superior to dynamite, for if the latter were used in coal mining or in quarrying, its excessively destructive local action was always a great disadvantage. This new explosive, however, gave results more resembling those of gunpowder, and it would therefore appear to be a very valuable addition to our stock of blasting agents. Of course there might be reasons why the use of kinetite would be unadvisable; but, looking at the experiments they had seen performed, it did not appear to him to be a very dangerous body.

Dr. DUPRÉ observed that, if he, as the adviser of the Home Office in matters relating to explosives, might compare small things to great, he would suggest that the various gentlemen, whose reports had been read to the meeting, were "in a position of greater freedom and less responsibility," and everyone present would understand that he had to be cautious as to what he said. He had often, in teaching, compared these explosives to horses. Everyone was aware that a horse knew what sort of a rider was on him. He would do what a good rider wished him to do. But put a bad rider on him, and he would be nowhere. Similarly, it would seem that explosives knew when they were in the hands of a man who understood them. They then would do what was expected of them, but in the hands of an inexperienced individual, of course the individual would be nowhere. When kinetite was first introduced, Dr. Stahlschmidt had written him (the speaker) a letter urging him to recommend it as a perfectly safe and perfectly stable body. In fact, as in the case of every inventor of a safety explosive, the thing he had invented was absolutely inexplosive, except at the very moment when one had got it in the hole and wished to explode it. One might do what one liked with it—shoot at it, put it between two express trains, take it up a precipice and tumble it down—the explosive would never do harm unless one wished it. In his hands kinetite had proved to be neither stable nor otherwise safe. Kinetite was one of a well-known class of explosives, of which, as a rule, only the portion actually struck exploded. Sometimes one might strike them with a hammer without exploding them, at other times the slightest touch would set them off *en masse*. One might shoot at tons of dynamite when frozen without exploding it; in fact, at such a time it was scarcely to be exploded by a detonator. But the result would be very different in summer. There was an instance in which a poor man had lost his hand by merely taking a dynamite cartridge in his hand and striking it with a small hammer. It had become a proverbial saying in his laboratory, when the impossible happened, "It only explodes when iron strikes iron direct." And so the man with greater freedom and less responsibility thinks, "I have never succeeded in making it go off, and therefore it is safe." But it was well known that most serious accidents had happened through a comparatively slight touch of a hammer on such bodies. They ought not, theoretically, to have gone off, but, unfortunately, they had done so, and scattered people to atoms. There was one respect in which some of these explosives had an advantage; their constituents could be kept separate and mixed only at the moment when they were required. That was very admirable, in some cases, but it required much practical experience to decide when it was desirable. But, desirable or not, it could not be done in this country without an Act of Parliament. That was a point inventors should bear in mind. If they could get the power from Parliament, well and good; but at present no such power existed. To return to the question of the kinetite experiments. In the laboratory of the manufacturers two or three cartridges went off spontaneously—they ought not to have done so, but they did. Several hundredweights of the same suspicious composition were then in the magazine at the factory, and arrangements were made for their destruction. Accordingly, next day they went to remove them, but when they arrived they found that the kinetite had anticipated their action, and had burnt away. Fortunately it had not exploded. Sometimes these bodies did simply burn away; at others they exploded. But, supposing it were proved that kinetite would never explode under such circumstances, what would have happened if a ton of gun-cotton had been in the same magazine? Would the gun-cotton have remained unexploded? He imagined that even Mr. Watson Smith would not have liked to pass the night in the magazine containing these hundredweights of kinetite; and if he had done so, it was to be feared that the Section would not have had the pleasure of hearing him read the paper they had just listened to. Professor Lunge had said in his report that he had not found it possible to explode kinetite on wood. But he (the speaker) had found that in his hands it would go off on wood, on iron, on stone, on almost anything. Could it be that kinetite was unusually sensitive in his hands? And that was the great danger of all chlorate explosives. They were admirable; they were beautiful; but they had the very ugly knack of doing the wrong thing at the wrong time. If great caution were used, they were, as a rule, safe to keep; and kinetite itself was usually safe from explosion by fire. So one might often set fire to gun-cotton by the hundredweight or by the ton, and it would merely burn off; at other times it would explode. He had seen a hundredweight of dynamite burn off quite comfortably; at another time two or three pounds of it set on fire violently exploded—why, he did not know. These facts showed how careful those who were responsible for the lives of others should be. They could not be too cautious with respect to new explosives, whenever there was the shadow of a doubt about their safety. It was all very well for Mr. Watson Smith to show them the experiments he had made, but he (the speaker) might hint that he would have got an explosion more easily if he had struck his slanting blows *across* the grain of the wood instead of *with* the grain. Everyone who had the slightest experience of explosives knew that even gunpowder would occasionally go off if incautiously rammed down a hole. It ought not to, but it did. And how much more readily might such a thing happen with kinetite? Men of experience would know that gun-cotton might be struck at ordinary temperatures and it would not communicate a flame; but if it were struck at 100° F. the whole mass would probably go off. There was another considerable danger in these chlorate explosives which was at present little understood—viz., sensitiveness to atmospheric changes. If made of pure materials and carefully kept, they would last well. But if some of the same matter were exposed alternately to cold, damp, and to warm dry atmospheres, it would be found to be covered with crystals of chlorate of potassium, in which condition it was sometimes remarkably sensitive. With respect to the experiments mentioned by the author, he (the speaker) would be greatly obliged to any one who would show him any instruments by means of which the force of combined friction and concussion could be measured. He had never yet succeeded in measuring such force accurately. There was thus no exact measure of the sensitiveness of these explosives, but there was strong evidence that on being exposed alternately to moisture and warmth they became much more sensitive, and would occasionally go off with a very slight blow. He could say much more on the subject, but he was under considerable restriction as to freedom of speech. He would conclude by assuring the meeting that all these questions were considered by the authorities fairly and carefully, with the full knowledge that on their decision depended not only the introduction of improvements in an important branch of manufacture, but the lives of hundreds of their fellows.

Mr. W. Dalrymple-Borland said he had worked for a long time with explosives, and felt quite sure that chlorate mixtures were all more or less uncertain in action, both in manufacture and storage. There were one or two points upon which he would be glad of further information. First, as to the density of kinetite. Everyone knew that the density of an explosive was a matter of great importance. For instance, blasting gelatine had a great advantage over dynamite because of its greater density. For the same reason dynamite had the advantage of gun-cotton. He would therefore be glad to know the specific gravity of kinetite. Then as to the initial impulse required for explosion. From what had been said of its non-sensitiveness he should think it required a large impulse. That would be important. As to the experiments made to show the relative forces exerted, he could not but think that those cylinder tests, as carried out, were wholly unreliable and practically worthless. Under no circumstances could they give more than approximate results. There was one point in respect of this new body which had not been touched upon—viz., the gases of explosion. In these days of high explosives yielding gases practically innocuous—water, carbonic acid, etc.—any new explosive would stand a poor chance if its gases of explosion were noxious. Now, chlorates were well known to yield as a rule gases containing more or less chlorine; at any rate they were liable to do so. He would be glad to know whether this had been found to be the case with kinetite. He considered sulphide of antimony a most dangerous thing to use. If its employment had been abandoned, well and good, but he was not clear on that point. As to the experiment made by Mr. Smith to show the harmlessness of mixing gun-cotton with nitrobenzene, of course no new property had been imported to the gun-cotton thereby. It was observable that nitrous fumes were given off during the heating; but the gun-cotton being in very small quantity would not make itself felt to much extent. The anvil experiments shown were very interesting; but he did not think they showed kinetite to be safer than dynamite, or gun-cotton, or even gunpowder.

Mr. E. F. Herroun said that most of the remarks he had intended to make had been anticipated by the last speaker. It was a well-known fact that gun-cotton, as made for the preparation of potentite, was not sensitive to concussion. It might be remembered that in order to induce the Lancashire and Yorkshire Railway Co. to allow the carriage of potentite over their line, the makers ran some trucks over some potentite cartridges placed on the rails without damage. He had conducted many experiments of the kind they had seen, and had found that the explosion of the portion actually compressed was often not communicated to the loose portions. But he regarded such experiments as of little value, since the various accidents which had occurred with potentite and tonite (bodies which were comparatively safe) had demonstrated that the detonation of such bodies in a confined space might be very serious. He would suggest that the fact of the kinetite, or a large proportion of it, not being exploded by a blow indicated an imperfect action of its constituents due to their not being uniformly blended. Although a detonator had failed to cause complete explosion in some kinetite placed on an open boulder, still it was possible that a slight detonation, produced by the friction of a rammer in a bore-hole, might cause the explosion of the whole. He quite agreed with the last speaker in his remarks on the lead cylinder tests. No analysis of the products of combustion having been made, there was no evidence whether the kinetite had exerted all its energy or not.

Mr. John Spiller wished to inquire what was the nature of the detonator used for firing these cartridges, because the experiments of the late Edwin Brown had shown that much depended on this point. One could not but recognise the high value of Dr. Sprengel's experiments, which had initiated this and other contributions to the science of explosives. In the body placed before them that evening there would appear to be a very great excess of oxidising materials. If, as Mr. Smith had suggested, the antimony pentasulphide was to be kept out altogether, there would remain gun-cotton, chlorate of potash, and nitrobenzene—bodies all containing so much oxygen that one would expect it to be greatly in excess, or likely to become so when, by exposure, some of the nitrobenzene had vapourised. But his purpose was chiefly to inquire what sort of fuse had been used for detonating these cartridges.

Mr. E. Kennard Mitting wished to ask, in reference to the experiments in lead cylinders, whether any steps were taken to ensure that the earth was uniformly homogeneous round each cylinder. If not, that would account to some extent for the different results obtained by the firing of various cartridges.

The Chairman having called upon

Mr. Watson Smith to reply, he said he must at once bow to Dr. Dupré's much superior and wider knowledge of explosives. His own experience had extended over one year and a-half, and had all been laid before the meeting that night. Still, having heard what Dr. Dupré had to say on the subject, he could not help thinking that there was *at least* as much to be said for kinetite as for dynamite. They had heard much of the mysteries and misdeeds of dynamite and of the *possibility* of danger from kinetite. He could, of course, only judge by his own experience, and from that he judged kinetite to be stable and constant. If there were acid present in the nitrobenzene (sulphuric acid, for instance) he could understand that reaction would occur between it and the chlorate of potash; but that could easily be obviated by the addition of a small quantity of aniline.[*] Similarly, the presence of sulphide of antimony might possibly account for the heating which had developed in certain cases; but it was proposed to abandon the use of that constituent in England. This explosive was manufactured in Germany, and no mishaps had occurred; and he could not but regard most of the accidents and dangers they had heard of as being due to ignorance. A workman might have his hand blown off; but if he (the speaker) had to deal with kinetite, he took care not to put his hand in peril. He understood kinetite, but the workman in question evidently did not understand dynamite. He was not aware that Stahlschmidt invented kinetite, but had always understood that explosive was the invention of Petry & Fallenstein, of Düren. Mr. Smith had not determined the density of kinetite: but it might be roughly judged from the densities of its constituents—nitrobenzene, to begin with, being about 1·2. The ground in which the lead cylinder tests were made was of a clayey nature and was tolerably homogeneous. All the cylinders were embedded in the same kind of soil, close together, and the pressure on each would be about equal. He thought the bulges made in the cylinders showed the direction of the force exerted, and that an even bulge must be taken as indicating an equal development of force all round, while an extremely uneven sphere would show a greater development in the direction of the greatest bulge. As to the gases of explosion, he had not determined them; but he had never observed the slightest smell of chlorine in them. He would propose that the gun-cotton should be put into the nitrobenzene as soon as possible, and should never remain in stock; it should, moreover, be well tested for acid before being dissolved. When Dr. Lunge tested kinetite on wood, he had probably used direct blows only; but he (the speaker) had used glancing blows. It was quite true that both potentite and kinetite needed a large initial impulse to explode them; but then if one wanted safety one must be prepared to sacrifice something for it. One could not expect great sensitiveness, easy explosion, and safety at the same time. He was not a special advocate for potentite or tonite: those bodies were simply experimented on for the sake of comparison, the experiments being made in the Potentite Company's works. The detonators employed in the experiments described were Eggerstorff's sextuple detonators. He must confess himself ignorant of their composition; but they were very powerful, and on one occasion already referred to, one of them, although failing to detonate the kinetite in the open, had produced quite an explosion on its own account.

SOME NOTES ON GRINDING AND SEPARATING HARD SUBSTANCES.

BY T. W. B. MUMFORD.

Some four years since, the firm of manufacturers with whom I am connected, saw their way to do a largely increased trade in artificial fertilisers, but were limited to the quantity they could produce by the capacity of their machinery for grinding phosphatic materials. The opportunity I speak of came when there was a scarcity all round of the particular article required, and consequently profits were better than usual. This made us doubly anxious to secure the business; the only question was, How to do it?

Our margin of engine power was not very great, certainly not sufficient to drive millstones enough to produce what was required, and I therefore cast about for some other machine to help in the matter. I may say that every system which I investigated I considered unsuitable, either from the power required to work it, or from what, in my opinion, was equally important—the principle on which the various machines were constructed—whereby the probable wear and tear or gradually-diminishing efficiency of the apparatus would increase the cost of producing the article we wanted to make; so that what, under ordinary circumstances, was a very profitable margin between the cost of production and the selling price, would have been seriously diminished, if it did not disappear altogether.

I had long held the opinion that grinding phosphates by the aid of millstones was both primitive and expensive, but inasmuch as every manufacturer possessed machinery of that description, and it represented so many pounds sterling in his books as plant, it became a matter of some difficulty for me to get very much encouragement or information as to what had been done in other directions. There is of course this great advantage with millstones, they begin and finish the material ready for use, whereas other machines require some assistance in separating the fine from the coarser particles which they grind. It is not my intention this evening to inflict upon you

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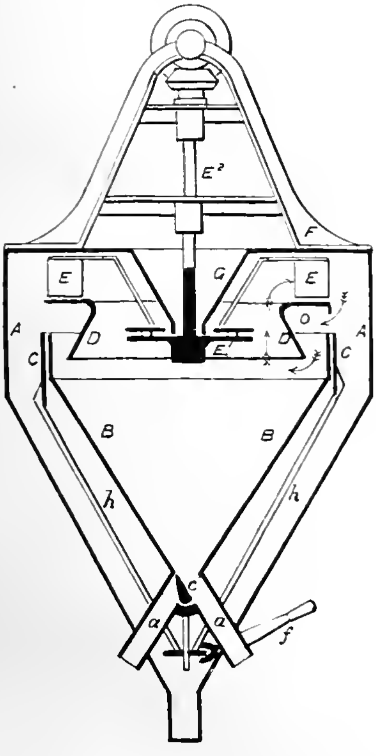
[*] This proposal was made by Dr. Sprengel in his paper read before the Chemical Society in 1873, and hence I claim nothing new for it.—W. S.

an account of my experiences in perfecting a grinding machine to help us out of our difficulties: suffice it to say that, having the good fortune to have as my chief engineer a thoroughly good all-round man, we were enabled to construct on our own principle a system of roller mills which not only met all our requirements for the time being, but which have been at work continuously ever since, and with the most satisfactory results.

With roller mills, as with every other machine outside millstones, the material after being crushed required to be graded. I found it was one thing to crush or grind the phosphate, but quite another matter to get an uniformly fine grade, which would fulfil the two essentials of profitable manufacture—viz., minimum insolubility of the mixed phosphates and sulphuric acid, with maximum condition of the finished article. We—and I daresay many other manufacturers are in the same fix—had not a large space at our disposal, and so were prohibited from erecting the ordinary exhaust apparatus with stive or dust chambers: we had therefore to fall back upon sieves, and here my troubles commenced. We tried every form—circular, hexagonal, and flat; iron gauze,

FIG 1



steel gauze, copper gauze, brass gauze, perforated plates, etc., etc., but all to no purpose; none proved satisfactory. Either a small hole would wear in the sieve, and, before the man in charge had discovered it, sufficient coarse material had got through to upset my calculations for insoluble phosphate; or, the material being slightly damp, the sieves became clogged, and we had to stop to brush them. Moreover I found that with woven wire the weaver was confined to a certain gauge of material, and that the finer the mesh required the thinner was it necessary for the wire to be; whilst the finer I found it necessary to grind the material the greater tendency was there for the sieves to become blocked, and the more necessity was there for them to be kept in a constant state of vibration, or to be brushed, and hence when most was required in this direction, the substance on which the operation had to be performed was far less capable of withstanding what it was necessary to do to keep the interstices free. The question was, What was to be done? Here we were with a splendid machine for grinding our materials, but it was impossible to shut our eyes to the fact that with the most perfect system of sieves we could devise or obtain, they would wear out, and moreover that we were at the mercy of our workpeople, who by inattention might, and did, bring about results which were the very opposite of what we desired.

My colleague, Mr. Moodie, after we had from time to time discussed this weak point in our armour, conceived the idea of the machine to which I wish to draw your attention, and of which I have a model on the table before me.

The diagram to which I will now refer will explain the principle on which the apparatus is constructed.

Section of Separator.

A, outer casing of sheet iron, circular in form, into which the fine dust is thrown, terminating in a spout at the bottom for delivering into bags, casks, on to creepers, etc., etc., as may be desired. B, inner casing into which the coarse particles fall, and can be delivered to the right or left through the branch pipes *a*, *a*, by moving the valve *c*. C, a movable band encircling the top of the case B, which acts as a damper for closing the opening between the cases A and B, and is worked by the lever *f*, and the rods *h*, *h*. D, hood against which the material is thrown. E, E, blades of fan connected by arms to the disc E^1, rotating on the fan spindle E^2. F, standard for carrying the spindle and driving gear, which may be bevel wheels or pulleys. G, feed cone into which the material is fed.

Mode of Operation.

The material to be treated is fed into the cone G, and, falling on to the rotating disc E^1, is thrown in a thin stream all round towards the fixed hood D. The current induced by the fan passes upwards and carries with it the fine particles, which are thrown into the outer case A; the current of air, separating itself from the fine particles by centrifugal force, returns through the opening O in the direction of the arrows, the same air being used over and over again. The coaser particles which are too heavy to be lifted by the current of air fall into the casing B, from whence they return by the branch pipes *a*, *a*, to the grinding machine to be further reduced.

The degree of fineness of the finished material can be regulated by the speed of the fan, also by the partial closing of the aperture O, by means of the damper C, which intercepts the current of air.

Different forms of hood D also alter the quality of the finished material.

I may add that I have found by using this separator in conjunction with millstones that I have been able to increase the quantity of finished material 60—70 per cent. continuously, and this without any additional wear and tear of the stones, or increase in the power taken to drive them, the reason being that the runner is raised as high as possible consistent with its still grinding the material between it and the bedstone. The material, coarse and fine together, after passing the stones is fed into the separator, the fine passing out by one spout, and being caught in bags, etc., in the usual way, whilst that which is not ground sufficiently fine is returned to the eye of the stones to be further reduced. I am working one 5ft. separator to every two pairs of millstones, and this arrangement leaves plenty of margin for materials which are much more easily ground than phosphates, and where the quantity of fine which two pairs of 4ft. 6in. stones will produce is in excess of what we are able to get from phosphate of lime.

Figs. 2 and 3 show this arrangement :—

A is the separator; B, B, millstones; C, elevator; *a*, *a*, spouts from millstones to elevator; *b*, spout from elevator to separator; *c*, *c*, return spouts for the coarse particles to millstones; *d*, spout for delivering finished material into bags, etc.

The machines have no wearing parts which come in contact with the material or which can get out of order: they are driven at a slow speed for machines of this sort. A finished material of any degree of fineness can be separated by it, and ones miller cannot by inattention vary the grade of the ground material. The separator also takes up very little room, and can be adapted to any system of crushing or grinding machinery.

In conclusion, permit me to say that by the aid of these machines we are able to keep our insoluble phosphate in our supers below 1 per cent., and at the same time the condition of the manufactured article is all that can be desired.

FIG 2

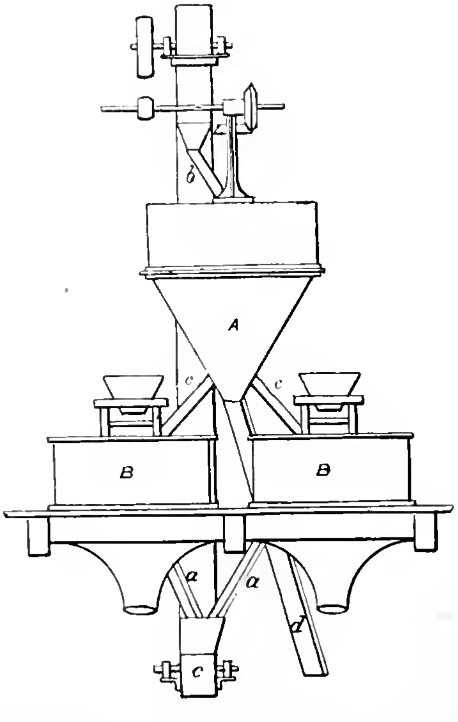
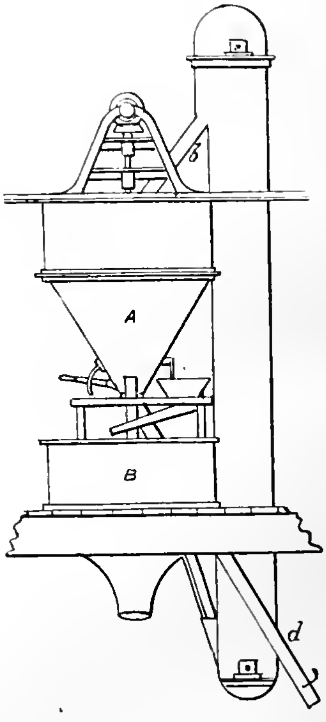


FIG 3



ERRATUM.—In the December number (1886), page 634, Mr. Evershed's part in discussion, for "*Messrs. Kynaston and Rideal*" *read* "Messrs. Kinnicutt and Nef."

Liverpool Section.

Chairman: Prof. J. Campbell Brown.

Vice-Chairman: Dr. F. Hurter.

Committee:

J. Affleck.
E. G. Ballard.
Ernest Bibby.
H. Brunner.
J. C. Gamble.
D. Herman.
J. W. Kynaston.
E. K. Muspratt.
Jas. Simpson.
A. Norman Tate.
A. Watt.

Local Sec. and Treasurer: W. P. Thompson, 6, Lord Street, Liverpool.

Meetings will be held at University College Laboratory, Brownlow Street, on Feb. 2, March 2, April 6 (Annual Meeting), and May 4, and the following papers have been promised:—

Prof. George Archbold, "On the Manufacture of Starch."
Mr. V. C. Driffield, "On Boiler Management."
Mr. C. Longuet Higgins, "On the Manufacture of Potassium Chlorate by means of Magnesia."
Mr. J. W. Macdonald, "On the Manufacture of Arrowroot in St. Vincent, West Indies; its Uses and Adulterants."

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

A Meeting was held in the Chemical Theatre of the University College, Brownlow Street, on Wednesday evening, December 1, 1886.

PROFESSOR CAMPBELL BROWN PRESIDING.

DISCUSSION ON DR. HURTER'S PAPER ON PYROMETERS (THIS JOURNAL, 1886, 634).

MR. E. K. MUSPRATT said that the Siemens electrical pyrometer gave accurate results, at first, up to 800° C., but in a very short time it got out of order, and had to be discarded. He wished to know whether the instrument exhibited by Dr. Hurter could not be made less fragile. It was quite clear that up to 900° F. very excellent results were given, and the zero was not altered by constant use. If used in a works its fragility was very detrimental to its permanent use.

Dr. HAMBURGER said that he could only confirm Dr. Hurter's statement as to the inaccurate results obtained by the pyrometers which were usually employed in chemical works. The Steinle and Hartung graphite pyrometer gave at first very good results up to about 500° C., but if the instrument had once been quickly cooled, its indications were unreliable, and it must be adjusted very often. The Schäffer and Budenberg pyrometer also required frequent adjustment. The only trustworthy instrument was Fischer's calorimeter, but it must be carefully handled, and could not be left in the hands of workmen. He would also like to point out that in the September number of this Journal, p. 491, there was an article by Seger, who made extensive investigations on the fusibility of ceramic glazes. As a result he was able to arrange a scale of glazing mixtures, the fusibility of which, during regular intervals, served as an indication for the temperature. But, of course, this scale could only be employed for very high temperatures, such as prevailed in the pottery oven and so forth.

The Chairman (Dr. J. Campbell Brown) said he thought that the glass could be replaced by porcelain, but that platinum would hardly answer the purpose for many reasons. Platinum would be more apt to be influenced by outside pressure than either glass or porcelain.

Dr. Hurter said that with regard to the fragility of the instrument, he had certainly placed before them an instrument which looked exceedingly fragile. It was especially designed for taking the temperature of superheated steam in a part of their works, hence the reason for its peculiar shape. As to the amount of error which Mr. Carey mentioned, it was very considerable, amounting to 200° in 2000. With regard to making the pyrometer of different material, it was difficult to join a platinum or porcelain bulb to the mercurial gauge and air tight enough to stand the variations of temperature. Messrs. Heisch and Folkard proposed to make the bulb of platinum or porcelain, but how they were going to fix these bulbs he was at a loss to say. At a white heat, platinum and most metals become porous, so that gases transfuse through them, and he, therefore, was afraid that platinum would not answer the purpose. Porcelain might answer if a satisfactory joint could be made between the mercurial gauge and the porcelain bulb. Platinum, also, was too expensive. He was unable to give any information regarding Murrie's pyrometer, as he had not received any accurate description of it.

The Chairman, after stating that he had placed on the table a few specimens illustrating the manufacture of Saccharine, called upon Dr. Shack-Sommer to read his paper on the Manufacture of Sugar.

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SUGAR REFINING.

BY DR. GUSTAF SCHACK-SOMMER.

Before attempting an account of the work of sugar refining, we must ascertain what the difficulties to be contended with are, and of what their nature consists. Now the object of the process is of course to remove the impurities from the raw sugar; and we find that these impurities are of two kinds—(*a*) mechanical, (*b*) chemical.

(*a*) The mechanical impurities consist of sand, remnants of the plants from which the raw sugar has been extracted, and other insoluble matters. These can be completely removed by careful filtration. This process may be accomplished either with *filter bags* or with *filter presses*. When filter bags are used the sugar is simply melted in hot water and passed through the bags by its own weight. This is necessarily a comparatively slow process. But a more expeditious method of filtration is that of driving the liquor through filter presses. In this case the sugar solution not containing solid impurities enough to enable it to saturate the pores of the filtering medium, and so to cause it to pass through slowly and become completely clarified in process, it becomes necessary to add something to it to improve the medium of filtration. For this purpose, it is customary to add such diverse substances as ground charcoal, sawdust, lignite, blood, albumen; or various chemicals, for example, lime, sucrate of lime, alum and its salts, and tannic acid. The first three substances named of course remain in the press without further aid from the refiner; the blood and albumen coagulate through the heat of the process, and are also, therefore, kept back; but the other substances require to be precipitated by the further addition of chemicals before going into the filter press.

(*b*) Secondly, we have to deal with the chemical impurities, and these are the most troublesome. They consist, first and foremost, of colouring matter; secondly, of those impurities which prevent crystallisation; and thirdly, of those which may destroy the crystallisable matter.

The colouring matter, of course, consists principally of vegetable substances which have not been separated from the sugar in the preparation of the raw. But, besides this, it is found that a considerable portion of the sugar itself has, owing to unskilful treatment, been turned into caramel, and this must also be removed before the colour can be improved. For this purpose, either animal charcoal or some artificial substance sharing its properties must be used. The only other method of decolorisation which need be mentioned is by using sulphurous acid over a filtering medium of gravel.

The impurities which prevent crystallisation are inverted sugar, foreign bodies of the albumen class, gums, and inorganic salts and bases: and their adverse action appears to be due to the fact that they intervene between the particles of sugar at the moment of crystallisation, and prevent its taking place. The correctness of this theory is proved by the fact that when these impurities are removed by the osmose process, crystallisation occurs freely. Raw cane sugar contains chiefly albumenic impurities, and the inorganic salts in it are not so difficult to deal with as those contained in raw sugar obtained from beet.

From experience, the refiner makes a rule-of-thumb calculation that the available hard sugar to be turned out from a given sample of raw cane is equal to the amount of the pure sugar contained therein, less three times the amount of salts and the amount of grape, or uncrystallisable sugar. From my own experiment I have found that the available in the raw sugar used during a whole year, and the hard sugar turned out during the same period, were practically the same. Pol. 84·25, avail. 72·15. Total cane sugar turned out in hard crystal, etc., but not taking into account what was boiled into tanks, 72 per cent. (cane in 77·5 per cent.).

The salts contained in raw beet are more injurious, and in consequence of this the refiner has to take his available hard sugar obtainable from beet to be equal to the amount of pure sugar it contains, minus five times the salt; but in this case the result can be only a purely arbitrary figure, because the sugar-liquor extracted from beet grown on soil near the sea, or in places where nitrate of soda is used as manure, are almost uncrystallisable. The salts of potash and the alkali hydrates appear to be most inimical to crystallisation, and these salts are also found to some extent in low-class cane—*e.g.*, Jaggery, 4·9 per cent.; Ilo Ilo, 5·8 per cent.; Egyptian, 6·30 per cent., 5·3 per cent., 0·8 per cent. And, moreover, the salts of potash are generally found to amount to two-fifths of the total salts present.

Mr. Duncan, of London, has for many years successfully used an alum process for getting rid of these salts. He first precipitates the potash in the form of alum, and then neutralises the residual liquor by the addition of lime. One part of potash requires, for conversion into alum, about 9·5 parts of sulphate of alumina, out of which 2·5 parts are required to convert the potash into a sulphate, and the remaining 7 combine with the sulphate of potash and form alum—

$$\left.\begin{matrix}4SO_2\\K_2\end{matrix}\right\}O_8+24aq.$$

$$\text{or, } K_2(SO_4)4+24aq.$$

	Beet Syrup.	After treatment, and before Char.	After Char.
Sugar	60·18	40·51	41·60
Ash	3·61	1·33	0·47
Water, etc.	36·21	58·13	57 93
	100·00	100·00	100·00

The alum is then separated from the sugar-liquor by the addition of lime-water until it only gives a dull red tinge to blue litmus paper, after which the liquor is pumped into the blow-up pans, and goes through the regular process of sugar refining. Another method of using chemicals in refining which is sometimes practised is as follows:—Five to ten per cent. of calcium sucrate is added to a pure sugar-liquor, and the mixture is treated with carbonic-acid gas until it is almost decomposed, when it becomes calcium hydrate, sucric acid, and carbonic acid chemically combined,* or more correctly, sucrate-hydrocarbonate of lime. This compound is mixed with the raw sugar-liquor which they desire to purify, and then the process of decomposing it with carbonic acid is completed. A very spongy precipitate is thus formed, which carries with it most of the colouring matter and other impurities. The inventors, Messrs. Boivin and Loiseau, of Paris, claim for their process that by its use not only is the yield of sugar increased and its quality improved, but that also less charcoal is required and less molasses turned out. With regard to this last point, however, it should be mentioned that the molasses obtained under this method is quite unfit for any purpose except distilling. A firm who use this process showed a sample of their molasses at a recent exhibition labelled "Syrup containing all the impurities." I think that statement is decidedly misleading, for most of the original impurities contained in the raw sugar were thrown down in the precipitate; and what makes their syrup unsaleable for consumption is impurities—that is, chemicals put in by themselves in the process. The process can only be advantageously employed for raw sugars containing a small percentage of inverted sugar, as, if there is much uncrystallisable present, it will combine with the lime, and becomes glucate of calcium, a substance which forms a sticky mass, and which, owing to its great solubility, cannot be got rid of throughout the whole process, and by its presence prevents a large proportion of the sugar from crystallising out. The most generally used medium of chemical purification, however, is animal charcoal. The substance is composed chiefly of carbon in a minutely-divided state, deposited on a groundwork of phosphate of calcium. For this reason it has a great power (probably entirely physical) of retaining most of the soluble substances as well as the colouring matters.

Raw Sugar from Java. Pol. 97·6.	Raw Liquor.	Liquor filt'r'd through Char.	Char Washings.
Crystallisable sugar	45·00	46·60	43·00
Uncrystallisable sugar	1·00	·30	1·80
Organic substances besides sugar	1·40	·00	1·35
Ash	·20	·10	·25
Moisture	52·40	53·00	53·60
	100·00	100·00	100·00

Raw Sugar from Manilla (so-called "Taal"). Pol. 74.	Raw Liquor.	Liquor filt'r'd through Char.	Char Washings.
Crystallisable sugar	35·40	41·20	36·00
Uncrystallisable sugar	9·40	6·40	7·80
Organic substances besides sugar	·00	·00	2·10
Ash	1·20	·40	·80
Moisture	51·00	52·00	53·30
	100·00	100·00	100·00

The analysis on preceding column, taken from the working of our sugar-house, shows the absorbent power of char, for the impurities contained in solution of sugar (gauge 24° B. at 63·5° F.).

I attribute the organic substances in the char washings of the taal to decomposed sugar.

The absorbent powers of char increase at high temperature. The finer the grain of the char, the more powerful its action. Certain inorganic salts—*e.g.*, carbonate of lime, and several substances of the albumen class—seem to be permanently retained by the char; but others, such as inorganic bases, combined with organic acids, and most of the inorganic salts, and gummy substances seem to be only temporarily retained, and are removable by the addition of thinner liquors, or by washing with hot water.

If the refiner could use just the amount of char necessary to absorb the colouring matter and the salts which he desires to have removed, and could then let the sugar-liquor drain off, he would reap the full advantage from the char; but as he cannot afford to waste the sugar adhering to the particles of char, he has to wash it out with hot water, and then these thin liquors contain nearly all the impurities which the raw sugar originally contained.

The absorbent power of char ceases sooner for salts and other impurities than for colouring matters. In connection with this we may note that a thin scale is often formed in the pans in which these thin liquors are evaporated, and it has been found on analysis to contain—

Lime	25·87
Magnesia	0·40
Peroxide of Iron	0·28
Alumina	0·88
Oxide of Copper	3·50
Oxide of Lead	0·17
Potash	9·70
Soda	0·42
Sulphuric Acid	41·00
Phosphoric Acid	0·19
Carbonic Acid	4·30
Insoluble Siliceous Matters	3·75
Combined Water	7·84
Organic Matter, Loss, etc.	1·70
	100·00

Several substitutes for char—for instance, a carbonised mixture of 100 parts of pipe-clay, 20 of tar, and 500 parts of coal-dust—have been brought forward, which may, in their fresh state, have the same effect as charcoal, but they lose their power more quickly on reburning. But why English manufactured charcoal is so much better than foreign make I have not been able to find out. Here is a field for research for chemists, and I hope someone will read us a paper on char soon, that we may ventilate this very interesting subject.

Before the char is used, it is necessary to wash carefully all the salts out of it. The first water con-

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* See Lock, Wigner, and Harland's excellent treatise on "Sugar Growing and Refining."

tained 464·4 grains of salts per gallon. After eight hours' washing with boiling water, the wash-water still contained 99·3 grains of salts per gallon ; after eleven hours, 39·3 grains of salts per gallon : after fourteen hours, 23·8 grains of salts per gallon ; after seventeen hours, 9·20 grains of salts per gallon ; and after twenty hours, 2·8 grains of salts per gallon.

The impurities which destroy the crystallisable sugar are principally acids. The organic acids, although themselves not very powerful, may liberate the acid in the salts, and then play havoc with the crystallisable sugar.

The lime or lime salts contained in the charcoal or the substances put into the pan, when the sugar is melted, are the only possible remedies for this evil. The sugar refiner, during his whole manipulation of the material, is constantly adding to the impurities it contains. To begin with, he dissolves the sugar in water, although he knows that in time a sugar solution will be decomposed into ulmic acid and water. A Java sugar having got wet on the journey altered very much, as the analysis shows :—

	Moisture.	Other Organic Substances.	Ash.	Invert Sugar.	Pol.	Avail.
Sound Java Sugar......	0·2	0·1	0·4	0·8	98·5	96·5
Washed Java	5·2	2·7	0·2	8·1	83·8	75·1

Then he heats the solution, knowing full well that heat is favourable to the inversion of sugar. In fact, Souteiron has shown, experimentally, that a solution of pure crystals of pol. 71·0 after two hours' heating polarised only 68, after four hours 58, after eight hours only 38, and so on. This shows how necessary it is for the refiner to guard against high temperature during his processes. He should never get higher than 60—65° Celsius, say 140—150° F. The same chemist proved, by repeating the experiment with a solution covered with oil and attaining the same result, that this waste was not due to the action of the air.

This inversion is not due to the sudden application of heat, but is brought about by the action of long-continued raised temperature, and, therefore, the more quickly he can accomplish the process of refining, the less liability to loss of crystallisable sugar is incurred. To give an example from practice, it has been found that in working raw of a polarisation of 84·25 for a considerable period there was a loss of cane amounting to 12·25 per cent. on the raw melted, which was equivalent to 14·60 per cent. on the crystallisable melted. Of this loss half would go in molasses turned out, but the other half of the lost crystallisable must be attributed to inversion. Not only must heat and water be guarded against, if we wish to keep down this tendency to inversion, but sunlight must also be avoided, as it has a similar power of inverting cane sugar, as the following experiment of Maumené shows :—

He took two similar glass tubes filled with pure cane solution, and kept them from the 12th of May to the 20th of October—one he exposed, the other was in complete darkness—both were kept at the same temperature. At the end of this period he found that half of the first solution had become inverted, whereas the other remained in its original condition.

It may be well here to mention another cause of inversion, which, however, does not come under the control of the British refiner. It is the practice of some planters to cut the canes more quickly than their mills are able to crush them, and for this reason the canes often have to lie several days, after they have been cut, before they reach the mills. During this period fermentation sets in, and in the result the raw sugar derived from them contains an unduly large proportion of inverted sugar.

From the prominence we have given inverted sugar, it will be seen this is one of the worst difficulties with which the sugar refiner must contend, and it will, therefore, be well to give some account of it, though it is a substance of which comparatively little is known. It cannot be classified by its crystallisation, nor by its constant qualities, for it is a mixture of restless particles of saccharine matter, which are always changing the position of their molecules. Inverted sugar can remain without crystallising for months, until suddenly, without apparent cause, it deposits crystals which turn the polarised light to the right, and are, therefore, called Dextrose. Uncrystallisable, on the contrary, turns the polarised light to the left, and is known as Levulose. These two are present in irregular proportions in inverted sugar, and the process of inversion is believed to take place by one molecule of cane sugar combining with two molecules of water, and forming a mixture of dextrose and levulose :—

$$C_{12}H_{22}O_{11} + H_2O = \underset{\text{Dextrose.}}{C_6H_{12}O_6} + \underset{\text{Levulose.}}{C_6H_{12}O_6}$$

Dextrose crystallises in the form of twin crystals of the triclinic system. The presence of inverted sugar always depreciates the value of the raw, but I also have strong suspicion that the cloudiness of golden syrup (refined molasses), which is the great trouble of some refiners, since it renders their residual product unsaleable, is due to the dextrose crystallising out after a more or less considerable time has elapsed since the manufacture has been completed.

Dextrose, indeed, is troublesome, not only in its simple form, but also in its combinations with organic and inorganic bases. Inverted sugar and lime in combination form a very easily decomposed salt, which, if exposed to the sunlight for a few minutes, turns from white to a dark brown, approaching black, and in that state is proof against further decomposition by carbonic acid.

These properties of inverted sugar render it impossible for the refiner of cane sugar to profit by the new methods of refining more universally practised on the Continent for extracting the crystallisable sugar from molasses, by the means of compounds of lime strontianite and baryta. I need only refer to such processes as those of Manoury and Scheibler, which, though excellent for beet, are impracticable with cane sugar. Though I may mention here that the French Government has prohibited manufacturers at Aubervilliers and Wallers from using the last ingredient on account of symptoms of poisoning, which showed themselves not only amongst the workmen employed in the manufactories, but also amongst the animals and vegetables for miles round the works. A. M. V. Gayon has proposed to destroy the inverted sugar by means of a fungus called Mucor, having made the discovery that fermentation with that fungus will only attack the inverted sugar in molasses, and leaves the cane sugar intact. In this process the solution must be first boiled so as to prevent all other fermentation, then it is impregnated with the mucor circinelloides, and whilst the fermentation is proceeding, any air which is admitted has to be either filtered through cotton wool or passed through red-hot pipes, so as to prevent the possibility of the approach of any other germs. The liquid itself must be maintained at a temperature of 35—40° C. during the process, but afterwards may be gradually lowered to 20° C. to avoid evaporation of the alcohol. After the fermentation is over the alcohol is distilled off, and the sugar is secured by the usual methods of crystallisation.

It has often been remarked that beet-root sugar has less sweetening power than cane sugar. This could be accounted for by the fact that there are substances —*e.g.*, Peligot's discovery, Saccharin—which have the power of turning the polarised light more than cane sugar, and have many of its properties as well, but have no taste whatever. Peligot's Saccharin—which should not be confused with Fahlberg's Saccharine, to which I will refer later on—is produced by the action of hydrate of calcium on inverted sugar, a product which is very apt to be generated by the method in which beet-root sugar is made on the Continent.

I am also unable to give any definite reason why fruit preserved with beet-root sugar, or refined sugar made from beet root, will not keep. The only explanation to be offered for this is that the salts, which are never totally eradicated from beet-root sugar, favour fermentation.

Now it will be seen, from all we have said, that the sugar refiner has to overcome many difficulties, and to overcome them all at the same time. Thus, if he does not use sufficient heat in his process, he prolongs his operation and favours fermentation. If, on the other hand, he uses too much heat, he caramelises the saccharine matters. Again, if he does not get rid of the foreign bodies and the acids, the sugar will not crystallise, yet he injures the raw material in the process of destroying them.

It now becomes necessary for the sugar refiner to convert his pure sugar liquor into a solid substance in a saleable form.

This is done in modern refineries by first boiling the liquor in vacuum pans, and then separating the formed sugar crystals from the syrup, by means of centrifugal hydro-extractors. When viewing the present rapid and inexpensive methods of accomplishing these ends, it is almost impossible to conceive that only a very few years ago sugar refiners were content to separate their hard sugar from the syrup by the slow process of drainage, which not only caused great loss by the time which was wasted and the room which was required to accommodate the moulds for several days' melt, but also caused the sugar to become very hard and insoluble, and this evil was intensified by the practice of "sucking" air through the sugar, so as to dry it after the drainage had run through. This comparative insolubility is another reason why Titlers are now so little used, as, though old habit was with difficulty broken, customers have at length begun to find that ready-made cubes not only are a saving of labour to the purchaser by relieving him from the trouble of chopping his sugar, before using it, but they may consist of sugar quite as pure as the old loaf sugar, and are much more soluble than it ever could be.

It is strange that though all these objections to moulds were well known at the time, refiners persisted in using the old process long after the invention of the centrifugal hydro-extractor; and I well remember, when I was a student, that this fact suggested to my professor a long dissertation on the struggle by which real economy has to overcome old fashions. Similar fashions still hold their sway in our trade, for in many parts of Lancashire and Yorkshire there is a great demand for immense crystals which owe their size to the great temperature at which they are boiled, though it is well known that this high temperature renders them very insoluble. Not only can fancy prices be obtained for these large crystals of pure sugar, but, especially in the South of England, grocery Demeraras, which are merely a highly crystallised raw cane sugar, are much sought after, as there is a very unfounded belief that they contain more sweetening properties than white crystals of pure sugar.

Grocers frequently complain that refiners sell them water instead of sugar. Now it is a fact that pure crystal sugars contain less than 0·5 per cent. of moisture, and it is to the presence of this modicum of water that the sparkle, which is so much sought after, is due. And the very people who cry out so loudly about "wet" crystals are the first to reject absolutely dry sugar on account of its dulness and want of sparkle.

A paper on sugar refining at the present time would be very incomplete without a reference to the alleged discovery of "Professor" Friend; I refer of course to electric sugar refining. When it is borne in mind how many different kinds of foreign bodies are wont to be present in the raw material, and how easily the pure sugar is injured and even destroyed in the process of eradicating them, it will be understood what an immense stride that gentleman claims to have made when he says that he can almost instantly refine sugar at a merely nominal cost and with a merely nominal loss in the process.

He claims first, to quote the words of his own pamphlet, that the process will refine any grade of sugar, and that raw sugars of the lowest grades are as easily, cheaply, and effectually refined as raw sugars of the highest grades. Secondly, that the whole saccharine matters in the raw sugar, including the invert, within the merest trifle is returned in refined sugars of the highest grades similar to those exhibited, and he claims that the invention is an entirely new process of refining sugars. It is dry throughout, dispensing altogether with boiling and the use of bone-black; no syrup whatever is produced, but the whole product is hard sugar of nearly, if not quite, absolute pure sugar—viz., 100 per cent. of pure sugar, as per analysis. A principal feature of the process is the use of electricity, concerning which the inventor claims that he has discovered a new method of producing it at a nominal cost. Knowing definitely nothing more than this about Professor Friend's process, one can of course only speculate as to how this problem is to be worked out, bearing in mind all the difficulties with which the sugar refiner is surrounded. To begin with, it is stated that the process is an entirely dry one, and I have the Professor's own authority for the statement that at all events he did not use "more than perhaps a bucket full of water" in the whole course of his great demonstration, when on the 14th July, 1885, he produced 40 barrels filled with refined sugar of 12 different sizes, ranging from cubes of nearly an inch cube down to powder. Now, as I am not aware that one can bring about crystallisation of sugar without first passing the substance through the stage of solution in some liquid, I can only suppose that when the Professor speaks of his process as a dry process, he means us to understand either that he does not dissolve his sugar in water, but uses some other solvent for the purpose, or that he fuses it by heat. The first alternative is the most likely one, as it would be almost impossible to keep sugar in a sufficiently high temperature to fuse it, without at the same time turning it to caramel, for even at 160° C., the fusing point of sugar, it decomposes very rapidly. The peculiar agglomeration of crystals which form the sample of refined which he has produced, even favour the first theory. But in spite of this I should personally be inclined to believe that this solvent had been applied after the refining process had been completed, for all the individual crystals of electric sugar belonged to the monocline form of crystallisation, that form which sugar invariably takes.

For the second place I must refer to the statement regarding the application of electricity to the purification of sugar. Now up to this time there has been a general agreement amongst scientific men to the effect that sugar is a poor conductor of electricity, and that it is totally unaffected by the action of the electric fluid. But Professor Friend is not the only person who claims the invention of a process of sugar refining by electricity, for last year, in *Dingler's Journal*, cclvii. p. 298, we find it stated that some people in Lyons claim to have obtained sugar by the following method :—They boiled 100kilos. of potatoes in 5 cubic metres of water containing 5kilos. of sulphuric acid and a trace of nitric acid. They passed through this an electric current of 11 ampères. The electrodes were of antimonial lead, and the flow of the current was continually changed. After two hours it was tested and all the starch had disappeared, and then first the acid and then the saccharine matter was precipitated with lime, and from the precipitate the latter freed by carbonic acid when it had been evaporated and crystallised. The result of this experiment was analysed and found to contain

Water	6·95
Ash	3·67
Grape	1·00
Cane	88·38
	100·00

I could never verify this startling announcement, and Professor Scheibler, of Berlin, whom I consulted about it, told me it was a misapprehension, and Professor Landolt, at the general meeting of the Rubenzucker Industrie, in July, 1885, made a statement to the effect that no progess had been made up to that date in making use of electricity in the process of sugar refining. I had a letter a few days ago from Mr. Gill, of London, who investigated the invention personally and found there was no truth in it whatever.

There is one method in which it may be possible to use electricity in sugar refining, but I do not think it has ever been attempted in practice. That is, to create ozone by passing electricity through oxygen and then decolorising the sugar with the product. Patents have been taken out by several persons for the use of electricity in sugar refining, but they all propose to purify the liquor from the salts by decomposing them into their constituent parts ; and under the working of each patent there is an increase of uncrystallisable in the process. I need only mention the excellent experiments made in the sugar house of MM. Dudok, Devitt & Co., at Amsterdam, which were quite unsatisfactory in their results. As regards the patents of Mr. Louis Henri Despeissis, of Paris, taken out 30th August, 1883, and of Joseph Goiz, of Berlin, taken out 27th November, 1883, they have not proved of any practical advantage, and neither have been adopted.

I have now given all the information which can throw any light on the probability of the electric process being practicable, and I think you will agree that the practical difficulties of sugar refining prevent any likelihood of electricity being advantageously employed in the process. I do not for a moment pretend that it is an impossibility to make cane sugar from invert, in fact I believe that some day it will be rendered practicable to do so ; but when that is done I think the inventor will be able to use other and cheaper sources for his raw material than either the sugar cane or the beet-root, and here I do not mean crystals of invert sugar, such as Mr. Behr, of New York, has produced, but I mean crystals of cane sugar to be produced from the invert sugar.

Before I close this paper I would like to mention that saccharine, which is one of the products of coal tar treated in the manner described on a former occasion in this Society, would seem to a chemical mind to be poisonous, or at least prejudicial to health, but experiments made by medical men, first on animals and afterwards on human beings, have proved that it shows no evil effects. In fact it passes through the body without decomposition, as a cherry-stone would do. The whole amount administered to a person can be afterwards recovered from his secretions. Now, of course, to sufferers from diabetes mellitus and gouty persons saccharine may be a boon, as it will allow them to enjoy the sweetness of sugar and similar carbohydrates without their, to them, injurious effects. But sugar planters and refiners need not be afraid of this substance, for it has only the power of conveying the sweet taste of sugar to the palate. It is absolutely without the nutritious properties of sugar.

Experiments on dogs have shown that a diet of sugar, combined with a modicum of fat in order to ensure the complete assimilation of the sugar, will be sufficient to keep up the vital forces for a long period, that in fact sugar contains all the nutritious elements necessary for sustaining life.

There are many substances which, on entering the stomach, are converted by the process of digestion, first into sugar and afterwards into fat, and it is found that children and persons with weak digestion are much benefited by a diet containing a quantity of sugar, as the preliminary process of digestion is avoided, and the sugar becomes fat almost immediately upon its reception into the body.

Moreover, there is another digestive property of sugar, which is also common to salt. This is the power of exciting the salivary glands which makes it possible for many other substances, of themselves indigestible, to be eaten without danger, because it causes them to be thoroughly impregnated with saliva before they are swallowed, and thus easy of digestion, a property which is not possessed by the coal-tar sugar.

A company with a capital of £100,000 is now established at Madgeburg, to manufacture this substance on a large scale, but I cannot believe that it will ever find its way into the grocer's shop ; it is much more probable that it will remain on the druggist's shelves, where, doubtless, it will be found very useful for medicinal purposes.

In spite of my conviction that neither of these much-talked-of competitors are dangerous to the sugar refiner, I think it will be seen from the few remarks that I have given you, that the sugar refiner has sufficient real difficulties to contend with in his business to render it very necessary for him to bring all the resources of his experience and all the knowledge of chemistry he can command to his aid, if he attempts to compete with the bounty-fed productions of the Continent and the United States.

DISCUSSION.

The Chairman said that they had had a most interesting and instructive paper from Mr. Shack-Sommer, and that there was a great deal of room for remarks and discussion. He believed there was present a representative of the Electric Sugar Co., and had pleasure in calling upon

Mr. Robertson, who said the reader of the paper had mentioned that he did not understand what Professor Friend claimed as his process. This being so, his criticisms of what he did not (admittedly) understand could not be of great value. He might have been mistaken, as owing to the reverberation in the room he had not quite caught every word of the reader.

He had been requested to attend the meeting, as being perhaps the heaviest English investor in the Electric Sugar Company. He had been to New York to see and learn all he could about what was claimed for this new invention. He attended what was called a demonstration at Professor Friend's house, at which time nine barrels of raw sugar were given him to refine, and after two hours and a half he was shown what was said to be the result—eight different sizes of refined sugar, some of which was now shown. Professor Friend would allow no one to see how he refined the sugar, nor his machinery either, and was keeping the process secret. He was fully convinced that Professor Friend had done, and could do, all that he claimed. He had invested moderately before going out to New York, but after attending the demonstration alluded to, and becoming acquainted with Professor Friend and his family, he had more than doubled his investment, and had induced other members of his family to do likewise; but this did not prove anything beyond his own faith in the invention. He had never heard a single expert in sugar deny that the product was a new one; the process being a new one unknown to anyone but the inventor. He could not say how it was done, but thought it only reasonable to give Professor Friend credit for what he claimed, seeing that no one had yet produced the same character of refined sugar as that shown. He was so confident of the *bonâ fides* of the inventor and all he claimed, that if he could afford it he would double his holdings in the company. He had pleasure in placing before the members several specimens of sugar refined by Professor Friend.

Mr. E. Carey would like to ask Dr. Shack-Sommer one question. He understood him to say, as a kind of general statement, that crystallisation could only be induced from a state of either solution or fusion. He might have misunderstood the remark, but would observe that there were many instances in nature of crystallisation without solution or fusion, as, for example, the crystallisation of wrought iron when exposed to continued vibration. The iron gradually became crystalline and brittle instead of being fibrous and tough.

Mr. Muspratt said he would be glad if Dr. Shack-Sommer could give them some further information as to the way in which the poisoning referred to in his paper had taken place. As he understood that when baryta salts were used in the way described in the paper, an insoluble precipitate was formed, it seemed difficult to understand how the use of these salts could affect the surrounding people in any way. The poisoning must have been serious to cause the Government to interfere in the matter.

Dr. Schack-Sommer said that his information was derived from Scheibler's *Zeitschrift für Rübenzucker Industrie*, vol. xvii. No. 13, p. 167, where it is stated that the works of Mr. Lebandy, at Aubervilliers and Wallers, had been closed by order of the Government on account of sickness amongst the workmen, manifesting itself, in the first instance, by the falling off of their hair, as well as the destruction of all animal and vegetable life for a considerable distance round, the poisoning of the neighbouring streams, and the pollution of the atmosphere, which was noticeable for miles round. He had no particulars as to how it took place.

Mr. Henry Brunner said that he thought the reason why beet sugar was not as sweet as cane sugar was due in some measure to the presence of the salts contained in the syrups or molasses adhering to the sugar.

Mr. J. W. Macdonald said he thought that the poisoning caused by the use of baryta, was due to the small particles flying about, owing to the handling and slacking of the caustic baryta. This could be considerably obviated by care in the construction of the works, keeping the baryta department by itself, and having it closed in as much as possible. This would only affect the workmen in the baryta department, and would be no worse than in other industries where compounds of baryta, lead, arsenic, and such like substances were manufactured or used. The baryta could not affect the consumers of the sugar, for it was completely precipitated by carbonic acid gas, and the carbonate of baryta filtered off. Even should a trace of baryta compounds remain in the molasses, it would not appear in loaf and crystal sugars, which were washed free of molasses. He quite agreed with Dr. Shack-Sommer's remarks on the so-called electric sugar process of Prof. Friend. He thought the professor's claims preposterous, and the public should know what those in the sugar industry thought of the process. Prof. Friend claimed to have discovered a means of separating the sugar from the innumerable organic and inorganic impurities contained in raw sugars. He also claimed to have converted the glucose into crystallisable sugar, and to separate it along with the sugar. Any of these results would be most remarkable, if obtained in a wet process; but the process was also said to be a *dry* one. Now, sand and other insoluble matter could not be separated from sugar crystals by a dry process. You must have solution and filtration. Prof. Friend did not tell them what became of the potash salts and other soluble impurities which at present formed molasses. All that he showed was sugar and such like substances as sand, fibre, and the various substances at present removed in the refineries by *filtration*. Very similar sugar to the "electric" sugar could be made by gently crushing loaf sugar, and separating it into various sizes by a set of different sieves. If the process were so very valuable, the Americans would very soon subscribe the necessary capital. As to the sweetening property of cane sugar, he thought the flavour contained in raw cane sugars helped to make the taste of those sugars so pleasant. He believed that pure sugar made from cane or beet had the same sweetness, and that if each were introduced into the mouth under the same conditions, it would be found that the effect on the palate was the same. By *pure* sugar he meant loaf sugar, cube sugar, crystallised sugar, and granulated sugar, all of which contain practically 100 per cent. of actual sugar. If *yellow sugars*, however, or "*pieces*," containing syrup, were being tasted, those made from beet would not taste as sweet as those made from cane, because of the salts contained in the syrup. The salts in beet syrup were more abundant and also more nauseous, weight for weight, and, therefore, neutralised a greater quantity of the actual sugar (or sweetness) present in the sample. He had made some *pure* crystallised sugar (testing 100 per cent.) both from raw cane and raw beet sugar. These crystals were made under exactly the same conditions. Equal weights of each were then dissolved in equal volumes of water. These equal solutions were then tasted by different persons, care being taken to introduce into the mouth equal quantities of these solutions. The general opinion was that no difference in sweetness could be distinguished. Equal quantities of the original crystals were also tried in the mouth; they also produced apparently the same sweetness.

Mr. W. P. Thompson said that although he was not a believer in the electric sugar, he did not think it was out of the bounds of possibility that Prof. Friend might have discovered some method of subliming sugar in combination with some solvent or other chemical, so as to form a sublimable composition, then to precipitate the sugar from that compound by means of electricity, or other means, so as to form crystals.

Dr. Hamburger stated that Dr. Sommer had not mentioned a new process for the purification of sugar solutions, which had been patented by two Austrians (Englert and Becker). The details of the process were not present to his mind, but he knew that the purification was brought about by the action of the alumina compound of Schützenberger's hydromonothionic acid. On boiling, the latter was decomposed into alumina and hydromonothionic acid, which destroyed the colouring matter present. He remembered having read that the process had been introduced into several Austrian works, where it was worked with perfect success.

Mr. Norman Tate, referring to the preservative properties of sugar, thought that sufficient attention had not been given to the inorganic salts in the two kinds of sugar. He could not help thinking that the difference in the amount of sulphates, phosphates, etc., would frequently have some very considerable influence in the use of one sugar as compared with the other, as a preservative agent. He also thought the reference to the presence of mucor made by Mr. Schack-Sommer, was worthy the close attention of sugar manufacturers. Further biological investigations on the effects of the presence of mucor and other organisms would, he thought, result in great advantage to sugar refiners.

Dr. Hamburger asked whether the potassium salts could be separated from molasses, or whether the molasses would be fermented first?

Dr. Schack-Sommer replied that the alum process had been used by Mr. Newlands, of Messrs. Duncan's, to get the potash salts, and the chemicals were obtained as by-products.

Dr. Hamburger asked whether those salts were precipitated?

Dr. Schack-Sommer replied that they were.

The Chairman, before calling upon Dr. Shack-Sommer to reply, said with regard to electric sugar, they were very glad to see present so able a representative of the inventor's interest, because they had had put before them the whole and sole evidence that had been adduced in favour of the inventor's claim, which was that a gentleman took a number of bags of raw sugar from one room into another, and after a certain time had brought certain bags, bottles or specimens of refined sugar from that second room, there being no evident connection between the one and the other. They were given to understand that the assertion was made by him that the refined sugar came from the unrefined; but there was not the slightest particle of proof to support the statement. In the absence of that evidence manufacturers entirely declined to believe in it. There was a very proper tendency to disbelieve everything that is absolutely secret—spirit rapping, for instance; and until some indication was given of the connection between the raw and the refined product of that process, they could not expect reasonable people to give it credence. He did not *say* that the process was not true, but there was no piece of evidence produced that would cause people to invest money in it; and he could only express a hope that the gentlemen who had so generously and boldly risked their money, might get it back again some time. With regard to the use of ozone, he had seen a gentleman interested in that subject perform a large experiment, the only result of which was that the sugar was a little darkened rather than lightened.

Dr. Schack-Sommer said, in reply, that he would first inform Mr. Robertson that he had not come there that evening to attack the Electric Sugar Refining Co., or any other company. His purpose was only to investigate, from a scientific point of view, the probabilities of the alleged invention of Prof. Friend, and he believed he had proved to all present, save Mr. Robertson, that according to all scientific rules yet known, this "wonderful" discovery was entirely inexplicable. As regarded Mr. Thompson's suggestion that probably the process was performed by sublimation, the plain answer was that sugar and its compounds do not sublime: but he quite agreed with Mr. Thompson that crystallisation could take place from vapours, considering that in the gaseous state the atoms of a substance were merely the atoms of it in the liquid state, considerably expanded. As to the poisoning in the neighbourhood of baryta works, he did not think it impossible, as from his own experience in the manufacture of white lead he found by chemical reaction that traces of the lead salt were perceptible at great distances. If acetate of lead could do this, he did not see why baryta salts should not go further than was imagined. As to beet sugar, he knew a wholesale grocer who by smell alone was invariably able to tell if a sample of pure white sugar polarising 100, submitted to him, had been derived from beet or cane. The only explanation he could afford Mr. Tate as to the salts was the one he had already given.

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Meeting held Wednesday, January 5, 1887.

DR. HURTER IN THE CHAIR.

The Chairman said that before calling on the Secretary to read the first paper, he would ask if any member had a communication to make?

Mr. J. W. Macdonald said that as the question of the different sweetness of cane and beet sugars was brought up at the last meeting, he had brought samples of refined sugars made exactly in the same way from raw beet and cane sugars. He would place these on the table for the members to examine. It was a pity that the report of the last meeting of this Section was not yet published, so that they could have read the remarks with reference to the sweetness of beet and cane sugar, before they came to this meeting. He had also brought samples of *raw* cane and beet sugars, which contained exactly the same saccharine strength, so that the members could be able to judge of the sugars before and after refining. They would see that the raw beet was very nauseous, and that the raw cane was sweet and pleasant, but that there was no difference between the pure refined articles from each. Many persons said that beet sugar was not as sweet as cane, but he would qualify that by saying "raw" beet sugar.

Dr. Hurter said that perhaps some of the members would endeavour to find out by taste which sample was from beet and which from cane sugar.

After due examination most of the members—in the proportion of about 4 to 1—thought that the sample made from cane sugar had been made from beet.

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NOTE ON MAHWA FLOWERS, AS A SOURCE OF SUGAR.

BY H. S. ELWORTHY, F.C.S.

Some months ago an article appeared in one of the English morning papers in regard to the manufacture of sugar from the flowers of the Mahwa tree. The article in question gave a very sensational account of the capabilities of the tree, and its sugar-producing powers, placing the amount of sugar at 50 per cent. on the dried flowers. Figures were also given to show the large amount yielded by each tree, and the number of trees which could be grown on an acre of ground. It was made out quite to the satisfaction of the writer that the sugar cane had met with a far more formidable rival than the beet.

Thinking it worth while to investigate the matter, and having facilities for obtaining the flowers in any desired quantity, I tested 4 samples from as many different places, with the following result :—

	Sucrose.	Invert Sugar.	Dextro Glucose.	Total Sugar.
No. 1.—From Hyderabad . ..	17·1	40·0	—	57·1
,, 2.— ,, Jubulpore..	4·6	41·4	—	46·0
,, 3.— ,, Guzrat	9·6	45·3	—	54·9
,, 4.— ,, Mirzapore	6·7	—	43·6	50·3

The above analyses will show that the Mahwa is totally unfitted for the manufacture of crystallisable sugar, although possibly available as a source of brewer's sugar. The spirit made by a direct fermentation of the flowers contains an exceptionally large proportion of fusel oil, and has a very strong unpleasant flavour. It would, therefore, require very careful purification. This tree, *Bassia Latifolia* (Roxb.) is indigenous to the forests of Central India, and is largely cultivated in many other parts of the country. It forms a valuable source of food to the poorer classes in the district where it abounds, and considerable quantities of native spirit are made from it. It is not generally fermented alone, but is mixed with about one-third of molasses. As previously stated, it contains a large quantity of fusel oil, one sample examined by me having no less than 3 per cent. of this dangerous ingredient. The price of the dried flowers ranges from about 2 rupees 8 annas to 3 rupees per maund of 82⅖lbs.

Some time ago considerable quantities of the flowers were shipped to France, but for what purpose I am unable to say, and I believe the shipments have been stopped.

There was also a kind of brandy made from the flowers by a European in the Punjab, some years ago, but this has also been stopped.

DISCUSSION.

Mr. A. Watt said it seemed to him, from the analyses given, that the flowers were totally unsuited for the manufacture of sugar, owing to the small proportion of sucrose contained in them. He thought they might suit "Professor Friend," as the glucose was just as useful for his purpose as the sucrose.

The Chairman, in reply to a question of Mr. N. Tate, said he thought that the percentages given in the paper were from the dry flowers. The sugar trade appeared to him to be like the alkali trade, a new ghost turning up every day to frighten manufacturers. He thought the paper would do good in dispelling wrong impressions.

Manchester Section.

Chairman : Sir H. E. Roscoe, M.P.

Vice-Chairman : I. Levinstein.

Committee :

Dr. Bowman.
R. F. Carpenter.
C. Estcourt.
H. Grimshaw.
Peter Hart.
Dr. Gerland.
C. Schorlemmer.
Dr. Schunck.
Dr. Watson.
Wm. Thomson.
L. Siebold.
Dr. Hewitt.

Local Secretary :
J. Carter-Bell, Bankfield, The Cliff, Higher Broughton, Manchester.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Chemical Club Rooms, Victoria Buildings, Tuesday, January 4, 1887.

ON VALENTA'S TEST FOR OILS.

BY GEORGE H. HURST, F.C.S.

In *Dingl. Polyt. J.* **252**, 296, E. Valenta brought before the notice of chemists a new test for oils; this consisted in mixing equal volumes of the oil and glacial acetic acid of 1·0562 sp. gr., heating the mixture until solution occur, and then introducing a thermometer into the mixture and allowing it to cool slowly, and noting the point at which a turbidity begins to make its appearance in the tube. An abstract of this notice appears in the *Chem. Soc. J.* Abstracts, 1884, p. 1079; see also *J. Soc. Chem. Ind.* 1884, 642. In this paper Valenta states that olive and castor oils are soluble in glacial acid at ordinary temperatures, while rape oils are only imperfectly soluble, and other oils only dissolve in glacial acid when heated. The statement in regard to olive is not borne out by figures quoted in a table given with the paper.

More recently this test was brought before the notice of the members of the Manchester Section of the Society of Chemical Industry, in January last, by Mr. Alfred H. Allen, of Sheffield, and reported in the Journal for February, 1886.

I have at odd intervals made a few experiments with this test, but without any very satisfactory results; recently, however, I have had an opportunity of examining a large number of samples of various oils with this test, and as the results I obtained differed from those obtained by Valenta and Allen, I thought it might be of interest to the members of this Section to bring them before you.

In the original paper, beyond stating that equal volumes of oil and acid are used, Valenta mentions no specific quantities to be taken; Allen recommends using 3cc. of each. My experiments were made as follows: 5cc. of oil were poured into a test tube, and 5cc. of glacial acetic acid, sp. gr. 1·0562, were added. A thermometer was then inserted into the mixture and the whole heated until a clear solution was obtained. The mass was then allowed to cool slowly, and the temperature, when the mixture became turbid, was noted.

My results are given in Table I., and as far as comparison is possible, the corresponding figures of Valenta and Allen.

It will be observed from the figures given that Allen invariably gives lower turbidity temperatures than Valenta, and that my temperatures are lower than either of those observers.

There is also another important difference between us; both Valenta and Allen state that rape oils are not soluble, even at the boiling point of acetic acid. Now, I was always able to dissolve these oils.

From the figures given it will be seen that rape and colza oils have a high turbidity temperature; linseed oil is comparatively low in the list; while castor oil and oleic acid dissolve easily at the ordinary temperature. Olive oil is intermediate between rape and linseed, and it is notable that tallow oil has a lower turbidity temperature than the corresponding lard oil. This test will be found useful in detecting rape oil in admixture with other oils.

From the differences in the turbidity temperatures of the same oils obtained by Valenta, Allen, and myself, it seems to me that we might infer that a considerable amount of personality enters into this test, a great deal depending on the manner in which this test is carried out. I have obtained various figures even with the same samples of oil and acid. To

TABLE I.

Oil.	Specific Gravity at 15·5° C. Water at 15·5° C. 1·00.	Temperature of Turbidity, ° C. Observers.		
		Hurst.	Valenta.	Allen.
1. Ground Nut Oil (African)	·9165	92	112	—
2. " (French)	·9175	72	—	87
3. Rape Oil (Hull Refined)	·9145	88		
4. " (Stettin)	·9168	86	Insoluble.	Insoluble.
5. "	·9132	85		
6. " (Black Sea)	—	73		
7. Colza Oil	·9162	99	Insoluble.	Insoluble.
8. " (Stettin)	·9131	97		
9. " (French)	—	91		
10. "	—	94		
11. "	·9132	82		
12. Neatsfoot Oil	·9116	85	—	102
13. "	·9161	65	—	—
14. Lard Oil	·916	76	—	—
15. " (Summer)	·9141	69	—	—
16. " (American)	·915	73	—	—
17. Olive Oil (Malaga)	·916	76	111	(Ellwood—108)
18. "	—	71	—	—
19. "	—	65	—	—
20. " (Mogador)	·9122	62	—	—
21. " (Zante)	·9138	47	85	—
22. " (Gallipoli)	·9151	28	—	—
23. Cotton-seed Oil	—	53	110	90
24. "	·9222	63	—	—
25. Linseed Oil (Bombay)	·9313	41	—	57—73
26. " (Russian)	·9315	41	—	(Ellwood—67)
27. " (Baltic) 1.	·9325	36	—	—
28. " " 2.	—	36	—	—
29. " (Boiled)	·915	36	—	—
30. Whale Oil (Norwegian) 1.	·918	71	—	86
31. " " 2.	·9177	53	—	38
32. " (Arctic)	·9235	65	—	—
33. "	—	48	—	—
34. Shark Oil	·8675	95	—	105
35. Cod Oil	·9235	65	—	—
36. Seal Oil (Arctic)	·9225	34	—	72
37. Sperm Oil "	—	85	—	—
38. " (Bottlenose)	·8783	81	—	102
39. "	—	74	—	98—103
40. "	·8781	74	—	—
41. " (White Whale)	·8866	60	—	—
42. Castor Oil	·963	Soluble.	Soluble.	Soluble.
43. Thickened Rape Oil 1.	·967	15	—	52
44. " " 2.	—	15	—	—
45. Palm-nut Oil	Does not become turbid at 13°.	—	48	32
46. Cocoa-nut Oil		—	40	7·5
47. Tallow Oil (Cold-pressed)	—	47	—	—
48. Ox Oil	—	48	—	—
49. Rosin Oil	·981	41	—	—
50. Oleic Acid	—	Mixes in all proportions.	—	27

obtain good results it is necessary to have a *dry* test tube: the presence of a *small* quantity of water increases the turbidity temperature, or in the case of rape and colza oils prevents their being dissolved.

This seems to show that while the test is useful in many cases, it must always be carried out in one particular manner, and as a comparative test in the same manner as Maumené's test is used.

On reference to Table I. it will be noticed that even samples of the same kind of oil differ among themselves sometimes to a great extent, as, for instance, the olive oils from 76 to 28.

TABLE II.

SHOWING INFLUENCE OF FREE ACID ON THE TURBIDITY TEMPERATURE.

OIL.	Turbidity Temperature 0° C.	Percentage of Free Acid calculated as Oleic Acid.
Colza Oil	99	3·56
,, ,,	82	1·23
Castor Oil, seconds	Ordinary	3·34
Ground Nut Oil, African	92	4·01
,, ,, French	72	2·67
Neatsfoot Oil	85	5·57
,, ,, English	65	1·55
Lard Oil	76	2·005
,, Summer	69	2·45
Ox Oil	48	8·02
Cotton-seed Oil	53	·49
,, ,,	63	·98
Sperm Oil, Arctic	85	1·17
,, Bottlenose	84	2·225
,,	74	1·96
,, White Whale	60	3·125
Norwegian Whale Oil, 1	71	2·67
,, ,, 2	53	7·57
Whale Oil, Arctic	65	4·01
Rape Oil, Hull refined	88	5·71
,,	85	4·56
,, Black Sea	73	2·45
Olive Oil, Malaga	76	5·34
,, Mogador	62	7·35
,, Zante	17	11·03
,, Gallipoli	28	22·06

On thinking over what may be the reason of this difference, I felt inclined to adopt a suggestion of Mr. Allen's, that difference in the amount of free acid that oils would contain would lead to differences in the turbidity temperatures of such oils.

Now, seeing that oleic and acetic acids are miscible at the ordinary temperatures in all proportions, I thought that it would be safe to infer that the greater the proportion of free fatty acid an oil contained, the lower the turbidity temperature would be; to see whether this inference was correct, I determined the amounts of free acid present in the oils, and the results are given in Table II. But the evidence is nearly as much against as for this inference.

I therefore made a number of direct experiments. I took 5cc. of cotton oil (because this contained the least amount of free acid of all the oils examined) and mixed it with varying quantities of oleic acid, and determined the turbidity temperatures of these mixtures; the results are appended:—

	Turbidity Temperature.
5cc. cotton oil ½cc. oleic acid	18°
5cc. cotton oil 1cc. oleic acid	37
5cc. cotton oil 1½cc. oleic acid	28
5cc. cotton oil 2cc. oleic acid	20
5cc. cotton oil 2½cc. oleic acid	15

From which it will be seen that the turbidity temperature decreases with increase of oleic acid, and that when the proportion of acid in the oil gets to 33 per cent. it is practically soluble at the ordinary temperature of the air.

I am strongly inclined to think that the inference as to the effect of acid in oil on this test noted above is correct.

In connection with my experiments I made a few to see what influence varying the quantities and proportions of oil and acid would have on the results.

I found, first, that so long as the proportions of oil and acid remained the same it did not matter how much of each was taken. If the proportions were altered I found the results affected as follows: Increase of oil decreased the temperature of turbidity, while increase of the acid increased the temperature. Table III. shows some of the results obtained in this way.

Mineral oils are only partially soluble in acetic acid at 50° C., while rosin oil is completely soluble; thus this test can be used to distinguish these oils, but it cannot be used quantitatively.

When a mineral oil and a fat oil are mixed together, the mixture containing about 10 per cent. of mineral oil and treated with acetic acid, the oil is completely dissolved, the presence of the fat seeming to bring about the solution of the mineral oil; if the proportion of mineral oil be much greater than this, then complete solution does not occur.

Since writing the above paper Mr. Ellwood has published (*Pharmaceutical Journal*, 3, xvii. 519) some results of his in the use of this test, in which he corroborates some of my remarks. He gives the following figures:—

Olive oil	101° C.
Almond oil	108° C.
Linseed oil	67° C.

DISCUSSION.

Mr. Thomson desired to know what was the nature of this turbidity, and also if all the oil would separate out at the ordinary temperature of the atmosphere; further, which test Mr. Hurst considered the better—the acetic acid or the ordinary sulphuric acid test? Had Mr. Hurst determined the amounts of different oils dissolved by the acetic acid at the ordinary temperatures?

Mr. McNair said he might suggest that some of the discrepancies arose from the manner in which the experiments were carried out, for the thermometer did not give the true temperature of the liquid. A thermometer with a large bulb would cool more slowly than one with a small one, and would therefore give too high a temperature. He would suggest that the tube containing the mixture of oil and acid should be immersed in a large volume of heated liquid, which would then cool down slowly and give the true temperature.

Mr. Hurst: In reply to Mr. Thomson's question as to turbidity, he should regard it simply as a deposition of the oil from the acid. He had allowed the mixture of oil and acid to stand for some time, and then found that they gradually separated into layers, the oil above and the acid below. It seemed to him that the solubility depended upon the temperature, and hence there was a difference in turbidity and temperature with different oils according to their degree of solubility in the acids. With regard to the comparison between this test and Maumené's, he considered Maumené's the best. As to the manner in which these experiments had been carried out, he had tried the experiments in the form given by Mr. McNair, and had found no advantage over the method described. The results were much the same.

TABLE III.

Five Parts of Oil.		Mixed with Parts of Acetic Acid.									
		1	2	3	4	5	6	7	8	9	10
Russian Linseed Oil................	Turbidity Temperatures.	Not at 15°	27	43	50	50	49	48	47	46·5	46
Colza Oil, Stettin		Not at 15°	60	83	95	100	102·5	104	105	106	106
Lard Oil, American		Not at 15°	35	62	72	76	79	79	80	79	78

Errata.—On page 612 of this Journal, December number, 1886, second column, line 11 from top, *for* "head" *read* "bead." Page 643 of the same, line 25 from bottom of second column, *for* "sulphate and sulphide" *read* "sulphite and sulphide." In Mr. Fawsitt's paper, p. 638, second column, fifth line, *for* "22° C." *read* "−22° C."

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CLAUS'S PROCESS FOR THE PURIFICATION OF COAL-GAS BY AMMONIA.

BY C. W. WATTS.

The process which I have to describe has for its object the complete purification of coal-gas in closed vessels. It is founded on the processes invented some years ago by F. C. Hills, which had the same object in view, but have not succeeded completely, although a portion of the process has been in use for a considerable time at the Old Kent Road works of the South Metropolitan Gas Company.

The material which we use for purifying the gas is ammonia, which is employed in the form of gas. As all the impurities of coal-gas are, with the exception of ammonia itself, of an acid character, they are removed in combination with ammonia, dissolved in water. For the purpose of description the process may be divided into three parts, and I will first briefly describe the apparatus employed in the different stages of the process.

For the purification of the gas a series of six scrubbers is employed; they are shown on the plan at A, A_1—A_5.

Five of the scrubbers are 4ft. square and 20ft. high, the sixth (a subsequent addition) is circular, 5ft. diameter and 30ft. high. The total scrubbing space is about 2000 cubic feet, which allows 8 cubic feet space for each 1000 cubic feet of gas purified per diem, reckoned on the maximum make.

All the scrubbers are filled with broken gannister brick, in pieces about 2in. in diameter, and are provided with tumbling boxes for distributing the liquor.

At the foot of each scrubber is a pump, by which the liquor from each scrubber is sent into another. The last scrubber, A_5, is supplied with cold spent liquor from the still, in quantity regulated according to the amount of gas passing through the system; this liquor is pumped from one scrubber to another through the entire series, gradually taking up the impurities from the gas, until it is finally removed from A, saturated with these impurities, and ready for the next stage of the process.

The second stage of the process is that known as Hill's process, and consists in the decomposition by heat of the carbonate and sulphide of ammonia contained in the scrubber liquor, the carbonic acid and sulphuretted hydrogen being expelled, while the ammonia is retained in the liquor.

The plant consists of three parts:—1st, the apparatus in which the actual heating takes place; 2nd, a scrubber, which we call a carbonating tower, in which the gases from the heated liquor are washed with the cold scrubber liquor on its way to the heating tower; and 3rd, a small catch scrubber for completing the absorption of the ammonia which accompanies the carbonic acid and sulphuretted hydrogen.

In the experimental plant at Windsor Street the heating apparatus and the carbonating tower are each divided into two portions, but they really form one apparatus, and will be so described. The catch tower B and the carbonating towers B_1 and B_2, are constructed and worked just like the scrubbers; they are 2ft. square and 18ft. high.

The heating is effected in the two towers marked

B_3 and B_4. These are also 2ft. square and 18ft. high; each is fitted with thirty cast-iron trays 22in. square and 3in. deep, in each of which is a flat coil of ¾in. steam pipe supplied with steam from a main pipe between the two towers. The scrubber liquor, after passing through the carbonating towers B_1 and B_2, is pumped to the top of B_3 and overflows from tray to tray to the bottom, where it is pumped to B_4 and passes in the same way through this, the temperature gradually rising and more and more of the carbonic acid being driven off, until at the end the liquor consists principally of caustic ammonia, and is ready for the next process.

This is carried out in two towers marked C and C_1, similar in all respects to the carbonating towers, and forming, as they do, a single piece of apparatus. A third tower C_2, in connection with them, acts as a condenser for the hot gases from C_1.

The purified liquor from B_4, which is already at a temperature of 195° F., is pumped into C_1 and thence to C. At the bottom of C free steam is introduced (as a matter of practice the exhaust steam from the engine is used).

It is at this point that the portion of the gas which is purified in our plant is drawn off.

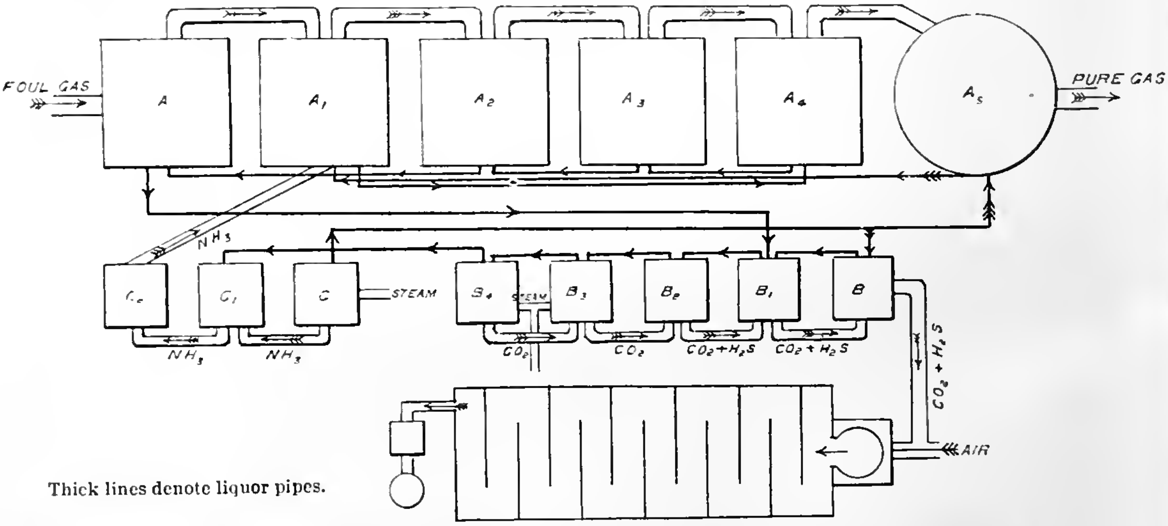
The gas entering the scrubbers contains the following removable impurities:—Ammonia, sulphuretted hydrogen, carbonic acid, and carbon bisulphide, and, in addition, hydrocyanic acid and oxygen, which, though they can hardly be called impurities, are absorbed in the scrubbers, and play an important part in the process.

The quantities of these substances are, as might be expected, somewhat variable, as will be seen from the following table:—

Ammonia	0·4 to 0·5	per cent.	by volume.
Sulphuretted hydrogen ..	1·0 to 1·8	,,	,,
Carbonic acid	1·5 to 2·8	,,	,,
Hydrocyanic acid	0·1 —	,,	,,
Oxygen..................	0·0 to 0·8	,,	,,

The volume of the carbon bisulphide is extremely small, only forming two or three hundredths per cent. of the crude gas.

The carbonic acid and sulphuretted hydrogen generally amount to about four per cent. of the crude gas.



Thick lines denote liquor pipes.

A minute quantity of caustic soda solution is mixed with the liquor in the still for the purpose of decomposing the fixed salts of ammonia. The liquor, on arriving at the bottom of C, is completely free from ammonia, and, after cooling, is pumped to a tank placed over scrubber A, and is used again for washing the gas.

The whole series of operations is perfectly continuous; the only materials used for the purification of the gas are ammonia and water, which are brought together in the scrubbers to combine with and absorb the impurities of the gas, and are then, after being freed from these impurities by heat, separated from each other by distillation, to be again brought together in the scrubber, and so on.

We will now consider more in detail the changes undergone by the gas and liquor in the various stages of the process.

PURIFICATION OF THE GAS.

The crude gas made in the retorts passes first through the condensers and a Livesey washer, the latter being supplied with liquor from the condensers. In these it deposits the tar and the excess of water, and the condensed water absorbs about two-thirds of the ammonia in combination with carbonic acid and sulphuretted hydrogen.

We find that, under ordinary conditious, the liquor produced in the scrubbers consists, empirically, of normal carbonate and hydrosulphide of ammonia; consequently, to effect complete purification, we must supply to the gas a quantity of ammonia equal to twice the volume of the carbonic acid + once the volume of the sulphuretted hydrogen, or, deducting the ammonia already contained in the gas, about 6·5 per cent. by volume of the foul gas, or nearly 30lb. of ammonia for the gas produced from one ton of coal.

We have found it most advantageous to work with a liquor containing about four per cent. of ammonia, of which about three-fourths is causticised in the subsequent heating process and rendered available for purification. It follows that about 100 gallons of this liquor are required for the purification of the gas from one ton of coal. This quantity will, of course, vary with the amount of impurity, and also with the temperature, a smaller quantity being required in winter, and a rather larger quantity in warm weather.

I shall have to describe two modifications of the process; the first and more simple effects the removal of the carbonic acid, sulphuretted hydrogen and ammonia, with only a partial reduction of the carbon bisulphide, while by the second this impurity can be reduced to any degree that may be desired.

In the first method the spent liquor for washing the gas is introduced into the last scrubber; after passing through this it is pumped to the next scrubber, and so on straight through the series.

The foul gas enters at the bottom of scrubber A and passes straight through in the opposite direction to the liquor.

The ammonia for purification enters the system at the outlet of scrubber A and passes with the coal-gas through the connecting pipe to the bottom of A_1, the two being thus thoroughly mixed.

The foul gas entering A meets in its upward passage with the liquor produced in the next scrubber A_1. This liquor contains about five per cent. of ammonia, of which about three per cent. is combined with sulphuretted hydrogen (as monosulphide), and about one per cent. with carbonic acid, which accompanies the ammonia from the still.

As the ammonia from the still is necessarily somewhat warm, this liquor is at a temperature of 100—110° F., and when it comes into contact with the gas in A, some of the free ammonia and ammonium sulphide are volatilised and return to A_1, the effect being to always keep a stock of ammonia in the intermediate scrubbers, which is amply sufficient to deal with any temporary variations in the quantity of the gas or the amount of impurity contained in it.

In scrubber A, the whole of the carbonic acid is generally absorbed, but none of the sulphuretted hydrogen; indeed, the gas leaving the scrubber is richer in this impurity than the original gas, the additional quantity having been volatilised from the liquor.

At exceptionally low temperatures, and also with weaker liquor than is usually employed, the reverse is the case, the sulphuretted hydrogen, owing to its greater solubility in water, being absorbed first, while the carbonic acid passes forward. As before mentioned, the ammonia for purification enters at the outlet of the first scrubber, and passes together with the partially purified gas into the second scrubber A_1. In our first experiments, the ammonia was introduced with the foul gas into the first scrubber, but it was found that, owing to the great solubility of ammonia, the liquor produced contained a large proportion of free ammonia, which was in consequence wasted for purposes of purification. By introducing the ammonia into the second scrubber, and washing the foul gas with the liquor so produced, it is completely saturated with acid impurities. The gas entering A_1, thus contains about 10 per cent. of ammonia, two per cent. of sulphuretted hydrogen, and the small quantity of carbonic acid which accompanies the ammonia from the still. In its passage through this scrubber it is deprived of all the carbonic acid, and a large proportion of the ammonia and sulphuretted hydrogen.

In the next scrubber nearly all the remaining sulphuretted hydrogen is absorbed, and the remaining scrubbers complete the absorption of the ammonia.

In this process only five scrubbers are employed, and are worked so that the liquor from the last one, A_4, contained nothing but traces of ammonia, and that from A_3 contained from one to two per cent. of ammonia, and a trace only of sulphuretted hydrogen.

A typical set of liquors would be as follows:—

	A_4.	A_3.	A_2.	A_3.	A.
Total Ammonia	0·1	1·5	3·5	5·0	4·0
Sulphuretted Hydrogen	—	0·1	1·5	2·0	1·5
Ammonia as Carbonate	—	—	—	1·0	3·0

The foul gas always contains some oxygen, derived from air accidentally drawn in during the drawing and charging of the retorts. In its passage through the scrubbers some of this oxygen acts upon the ammonium hydrosulphide in the liquors and converts it into bisulphide:—$2NH_4HS + O = (NH_4)_2S_2 + H_2O$. On the quantity of bisulphide (polysulphide) thus formed depends the quantity of carbon bisulphide that is absorbed; but the quantity formed from the oxygen naturally contained in the gas is too small to effect more than a very partial purification of the gas from this substance. We attempted to increase the amount by introducing an additional quantity of air, but found that the absorption of oxygen by the liquor was so slow and incomplete that it would have been necessary to introduce so much air as to seriously reduce the illuminating power of the gas.

We then adopted the present system of dissolving the necessary amount of sulphur in the liquor containing ammonium sulphide, and this method is successful in reducing the total sulphur compounds below the maximum allowed by the London Referees.

As carbon bisulphide vapour is, even when undiluted, practically insoluble in water, it is evident that, when it forms, as in the case of coal gas, only two or three hundredths per cent. by volume of the gas, it may be regarded as absolutely insoluble, and its removal by a liquid absorbent must be effected, as it is by solid absorbents such as calcium sulphide, by exposing a large surface of the purifying material to the gas.

For this reason we have found it necessary to increase the scrubbing power by the addition of a sixth scrubber, and to devote three of the scrubbers to this work, supplying them with the liquor containing ammonium bisulphide.

The course of the liquor through the scrubbers has therefore been altered, that of the gas remaining as before.

The wash water is pumped into A_5; from this it passes at once to A_1, the scrubber into which the ammonia first enters. Here it absorbs ammonia and sulphuretted hydrogen, and is then pumped into A_4. Before coming into contact with the gas in this scrubber, it passes through a quantity of sulphur and dissolves some of it, forming the necessary polysulphide.

From A_4 the liquor passes to A_3, from A_3 to A_2, and thence to A.

The carbonic acid is, as before, absorbed in A, the bulk of the ammonia and sulphuretted hydrogen in A_1, while the next three scrubbers, which are already charged with a liquor strong in sulphide of ammonium, absorb little of the principal impurities, which pass through them to A_5, where the purification is completed.

The carbon bisulphide is, for the most part, absorbed in the three scrubbers A_2, A_3, and A_4, which contain the polysulphide.

Since the adoption of this system, the total sulphur in the gas purified by our process has never exceeded 20 grains per 100 cubic feet.

By further increasing the size of the scrubbers this quantity could be reduced in proportion.

The gas is continually tested during the day with Harcourt's apparatus, and the highest result obtained was 12·5 grains S as CS_2, while many results below 5 grains have been recorded. The reliability of these tests has been confirmed by the Referees' test for total sulphur, the average of a number of tests being 16·9 grains, with a maximum of 19 grains.

Temperature does not appear to have any direct effect upon the absorption of the carbon bisulphide, but indirectly affects it by varying the composition of the liquors, a higher temperature causing the accumulation of ammonium sulphide in the intermediate scrubbers.

The only conditions necessary for the efficient purification of gas from carbon bisulphide are sufficient surface of liquor exposed, and enough polysulphide to keep the liquor distinctly yellow on its emergence from scrubber A. This amount is about 0·25 to 0·3 per cent. (weight in volume), of which about one-half is due to the oxygen of the foul gas, and the rest is obtained by the direct addition of sulphur.

In passing through scrubber A some of this sulphur (about 0·1 per cent.) combines with ammonium cyanide to form thiocyanate, and a further portion (about 0·05 per cent.) is converted into thiosulphate. If the amount of sulphur as polysulphide is not sufficient to form these compounds, then the absorption of the carbon bisulphide is incomplete.

Hill's Process.

The scrubber liquor produced in our process is similar in composition to ordinary gas liquor. A typical sample had the composition :—

Ammonia	4·50 per cent.	Grams in 100cc., or lbs. in 10 gallons.
Sulph. hydrogen	1·08 ,,	
Carbonic acid	5·20 ,,	
Sod. Thiosulphate	0·50 ,,	
Sod. Thiocyanate	1·00 ,,	

The simplest way of expressing the proportions of ammonia, sulphuretted hydrogen and carbonic acid is this :—

Ammonia	4·50
Sulphuretted hydrogen	1·08
Ammonia as carbonate	1·00

The equivalents of ammonia and sulphuretted hydrogen being the same (17), this mode of expression shows that this liquor consists, empirically, of normal carbonate and hydrosulphide of ammonia.

The scrubber liquor is pumped into the carbonating tower B$_1$, and on its way down this and the next tower it meets with the gases evolved from the liquor in the heating towers. These gases consist of ammonia sulphuretted hydrogen and carbonic acid. In the upper portion of B$_1$, where the temperature is low, the ammonia is almost completely absorbed, and what little does not escape condensation is absorbed in the catch tower B.

At the same time as the liquor absorbs ammonia it also takes up, at first, some of the other gases, and the ammonium sulphide is gradually decomposed by the carbonic acid, the decomposition becoming more complete as the liquor becomes warmer.

At the bottom of B$_2$ the temperature of the liquor is 160—170° F., and the greater part of the ammonium sulphide has been converted into carbonate. The liquor also contains a good deal of free ammonia which has been volatilised from the heating towers.

From the carbonating tower B$_2$ the liquor passes to the heating apparatus B$_3$ and B$_4$. It will be remembered that this consists of a series of 60 trays heated by steam, the liquor overflowing from tray to tray. The steam is adjusted so as to raise the liquor to a temperature of 195° F. By this the excess of ammonia over that contained in the original liquor is expelled together with most of the carbonic acid, so that at the outlet of the apparatus the liquor consists principally of caustic ammonia.

The extent to which the decomposition of the ammonium salts may be carried depends on three things—time, temperature, and strength of liquor ; the longer the time, the higher the temperature, and the weaker the liquor, the further can the decomposition be carried. Our heating apparatus is of such size that the maximum quantity of liquor worked takes at least two hours to pass through it, being raised during that time from 160° to 195°.

A scrubber liquor containing about 4 per cent. ammonia as carbonate and sulphide under such circumstances loses at least three-quarters of its acid constituents. The composition of the liquor mentioned before would be about —

Total ammonia	4·50 per. cent.
Ammonia as carbonate	1·40 ,,
Sulphuretted hydrogen	nil.

Liquors containing less than 3 per cent. of ammonia can be heated to 200° F., and the amount of ammonia causticised will be from 80 to 90 per cent. The additional expense of heating the larger volume of liquor of this strength would, however, more than compensate for the slightly greater yield of free ammonia.

Distillation of the Purified Liquor.

The last stage of the process is that in which the ammonia is expelled from the liquor and returned to the scrubbers.

The liquor from the heating apparatus, which is at 195° F., is pumped into the still, which consists of two towers, and the exhaust steam from the engine entering at the bottom of the still expels the whole of the ammonia and ammonium carbonate from the liquor.

It will be recollected that the scrubber liquor, besides carbonate and sulphide, contains thiocyanate and thiosulphate ; these salts are not decomposed at 212°, so that it is necessary to add a fixed alkali in order to obtain the ammonia from them. In our plant at Windsor Street we generally employ caustic soda for this purpose ; on a larger scale, lime would of course be substituted.

The whole of the ammonia from the liquor, together with some steam and carbonic acid, which has not been expelled by the previous heating process, pass from the still through a third tower, which acts as a condenser. In this most of the steam and carbonate of ammonia are condensed, and the resulting liquor returns to the heating towers. The rest of the ammonia, still at a temperature of about 100°, passes from the condenser back to the scrubber A$_1$, thus completing the cycle of operations.

The spent liquor from the still is cooled and pumped back to the scrubber A$_5$ to be used again for washing the gas. The excess, due to condensed steam, and not required in the scrubbers, is continually withdrawn, and from it the thiocyanate is recovered.

The whole series of operations described goes on continuously, and is easily kept in order. A few points only have to be looked to in order to maintain purification. The amount of ammonia supplied to the scrubbers must be sufficient, but not greatly in excess of that required to combine with the impurities. In order to regulate this, the gas must be tested at one or two points, easily found by experience, which the different impurities should reach, but not pass. If the ammonia is found to be in excess or the reverse the quantity is altered by increasing or diminishing the amount of wash-water (spent liquor) supplied to the last scrubber. As there is always a surplus of spent liquor produced there is always enough for any slight increase that may be required. It will easily be understood that an increase (or decrease) of the amount of water in the last scrubber means an increase in the liquor from scrubber A, which, passing through the heating and distilling plant, means an increased supply of ammonia to the scrubbers. Even considerable variations of the quantity of water supplied to the scrubbers do not appreciably affect the strength of the liquor ; the only effect is to vary the rate of circulation, and therefore the amount of ammonia entering the scrubbers in any given period of time.

The other points that require attention are the temperature of the heating apparatus and the still. With a regular circulation of the liquor and a tolerably uniform pressure of steam, these require very little attention: of course, if the quantity of liquor passing through the plant is altered, the steam must be altered in proportion.

It still remains to describe the method by which sulphur is recovered from the gases evolved by heating the liquor, and to mention the methods by which it is proposed to recover thiocyanates, and to obtain the ammonia of the foul gas in forms more valuable than ordinary gas liquor.

The foul gas entering the scrubbers contains carbonic acid and sulphuretted hydrogen, amounting together to about 4 per cent. of the volume of the gas. The ratio of the carbonic acid to the sulphuretted hydrogen is about two to one.

A small quantity of the sulphuretted hydrogen is oxidised, and the sulphur unites with hydrocyanic acid, but the greater part it, and the whole of the carbonic acid of the foul gas, pass out of the catch tower B.

The gas consists of about 25 to 30 per cent. sulphuretted hydrogen, and the rest is carbonic acid, with a trace of hydrocarbon vapour.

The process employed for recovering the sulphur is that invented by Mr. Claus, and now in use at several places in connection with the manufacture of sulphate of ammonia.

The apparatus consists of what we call a kiln, a depositing chamber, and catch purifiers as a safeguard against the possibility of a nuisance.

The kiln is a small chamber built of fire-brick, and enclosed in a shell of cast-iron plates. The chamber in our case is circular, 2ft. 6in. in diameter, and 3ft. high; it contains a layer, 15in. deep, of oxide of iron in lumps about 1in. diameter, supported on a grating built of 1in. split fire-bricks set on edge. A space of about 1 foot above the oxide is empty, and the gas enters this space, passes downwards through the oxide and out from below the grating into the depositing chamber. This is a brick building, 24ft. long by 8ft. wide and 5½ft. high, with 9in. walls and flat roof of ¾in. slates. Transverse baffle walls are built inside the chamber, which open alternately on one side and the other of the chamber, so that the gases are forced to traverse the whole area of the chamber before reaching the outlet.

Previous to entering the kiln the gases are mixed with a quantity of air (supplied by a small air-pump) 2½ times the volume of the sulphuretted hydrogen. This volume of air contains the oxygen necessary to convert the hydrogen of the sulphuretted hydrogen into water, thereby setting free the sulphur.

At starting, the kiln is filled with hydrated oxide of iron (manganese or other metal), the ordinary reactions take place between the substances present, sulphide of iron being formed and immediately reoxidised by the air, and, as these reactions take place in a small confined space, the heat produced accumulates until the whole mass is red-hot. At this temperature, of course, the sulphur produced by the reaction is immediately volatilised, and passes with the other gases into the depositing chamber, where it settles. As the proportion of sulphuretted hydrogen in the gas is not quite constant, it will generally happen that there is either a slight excess or a slight deficiency of air supplied. There will then be a small quantity of either sulphuretted hydrogen or sulphurous acid at the outlet. To prevent the escape of these gases into the air, a wash tower filled with pebbles and supplied with a little water is connected to the chamber, and beyond this is a small open oxide purifier. The water absorbs any sulphurous acid that may be present, and the oxide of iron any traces of sulphuretted hydrogen.

The sulphur obtained amounts to about 90 per cent. of the theoretical quantity. It is very pure, analysing over 99 per cent. sulphur, deducting the moisture that it generally contains. The gases from the gas liquor contain small quantities of naphthalene and other hydrocarbons, and these being charred in passing through the kiln impart a brownish tinge to the sulphur. The amount of carbon present, however, does not amount to 0·1 per cent.

THIOCYANATES.

Hydrocyanic acid exists in the foul gas to the amount of about 0·1 per cent. by volume. It is absorbed by the liquor, and combines with sulphur to form thiocyanic acid; $NH_4CN+(NH_4)_2S_2 = NH_4CNS+(NH_4)_2S$. If there is not sufficient polysulphide present to convert all the hydrocyanic acid into thiocyanic acid the rest remains unaltered until it reaches the heating apparatus, where at least some of it acts upon the iron of the apparatus and forms ferrocyanide.

The ammonium thiocarbonate, formed by the absorption of carbon bisulphide, also forms thiocyanate by spontaneous decomposition, $(NH_4)_2CS_3 = NH_4CNS+2H_2S$. The thiocyanide thus formed is converted into sodium salt by means of caustic soda added in the still, and is found in the surplus spent liquor derived from the condensed steam.

The amount of sodium thiocyanate formed is 2·3lb. per ton of coal.

From the spent liquor the thiocyanate is recovered, either by simple evaporation or by precipitation with cupric sulphate or cuprous thiocyanate.

From the sodium salt ferrocyanide may be made by Gelis's process.

AMMONIA.

It will be understood from the general description of the process that a certain stock of ammonia is constantly circulating through the system. The amount required is estimated at about 50lb. ammonia in the plant for each ton of coal carbonised per diem.

As the foul gas entering the scrubbers contains ammonia, equal to about 1½lb. per ton of coal, an accumulation would take place, unless an equal quantity was continually withdrawn. Of course this withdrawal may be effected in the form of ordinary gas liquor from scrubber A, but the process allows of its withdrawal in either one of two more valuable forms, sulphate and carbonate.

The manufacture of sulphate in connection with the process could readily be effected by substituting an acid saturator for the catch tower B, attached to the heating apparatus.

As the quantity of ammonia normally entering this tower is less than that which must be withdrawn, a connection is made from a part of the carbonating tower where, in consequence of the higher temperature, the gases contain a larger proportion of ammonia. By this means the amount of ammonia withdrawn may readily be made equal to that brought in by the foul gas, and at the same time the acid saturator would act as a perfect safeguard against the escape of any ammonia with the other gases.

If sulphate were made in this way the whole of the fuel, and all the plant, except the saturator, would be saved, the sulphate being manufactured for the cost of the acid and the labour.

In the description of the action of the heating and carbonating plant it was explained that the sulphuretted hydrogen was expelled from the liquor by the carbonic acid evolved in the heating tower. At or about the junction between the heating and carbonating towers the gases in the apparatus are ammonia, carbonic acid, and steam.

If these gases, or a portion of them, are conducted into a cold chamber there condenses a liquor, which on cooling, forms a mass of crystals of ammonium carbonate. The mother liquor usually contains a little sulphide, but the crystals are free from it. A specimen of such condensed liquor contained 24 per cent. of ammonia, of which 18 per cent. was carbonate, and only 0·6 per cent. of sulph. hydrogen.

This is equal to a liquor of 110oz. strength, or say ten times the strength of ordinary gas liquor.

I have now described the whole number of operations involved in this process of purification, and it may be useful to re-state the essential features of the process and point out the advantages which it offers over the ordinary process.

The most important feature of the process is that it effects complete purification of the gas by a perfectly continuous operation carried out in closed vessels. There is no possibility of nuisance arising from the opening of purifiers containing foul gas, or the exposure of the purifying material to the air, nor any loss of gas or admixture of air with the gas from the former cause.

The gas is completely purified from carbonic acid and sulphuretted hydrogen, from all but the usual traces of ammonia, and the obnoxious and troublesome carbon bisulphide is easily reduced to any desired amount by a simple and cheap addition to the ordinary process.

The illuminating power of the gas is not reduced by this process: indeed the average of a large number of tests showed a slight excess of illuminating power over that of the same gas purified by lime and oxide. This may be ascribed to the complete absence of carbonic acid, and perhaps also to the fact that a smaller proportion of the oxygen is absorbed.

The by-products, sulphur and ammonia, are recovered in more valuable forms, and thiocyanates, which may fairly be called a new product, at least as far as English gasworks are concerned, are easily recovered and converted into valuable salts. The ground space covered by the plant is less than that required for dry purification, especially where sulphur purification is carried out.

The cost of working I am hardly prepared to state, as the expenses of ordinary work cannot be calculated from that of an experimental plant, where the attendance and labour required for continual alterations are much greater than would be required for regular work.

The principal expense is for fuel in raising the necessary steam; the cost of this has been 2½d. per ton, taking fuel at five shillings per ton. It may reasonably be expected that considerable economies will be effected on this side; and especially the possibility of raising steam by means of the waste heat from the retort furnaces must not be lost sight of.

The amount of sulphur required to form polysulphide for the purpose of removing carbon bisulphide from the gas is about 2lb. per ton of coal. Taking sulphur at £4 per ton this would be 0·85d. per ton of coal, or 0·085d. per 1000 cubic feet. The cost of sulphur purification in London is given by Mr. F. Livesey at 1¾d. per 1000 cubic feet.

DISCUSSION.

Mr. Hack: We have been listening to a very interesting paper, and are very much indebted to Mr. Watts for the clear way in which he has described the process. A question I wish to ask is as to the alleged cost of ordinary purification. It was stated to be 1¾d., whereas I have reason to believe it is covered entirely by 1d. per 1000 cubic feet. I may say, that being in Birmingham I have had the opportunity, from time to time, of following out this very interesting process, and consider that much praise is due to Mr. Claus in respect to it, and should be glad to hear that we shall be able to purify our gas by the process as cheaply as we do at the present time. I am not prepared to contest anything that Mr. Watts has said with regard to the chain of beautiful chemical changes and reactions which take place; but I may state that on the last occasion when tests were made on my behalf the process was not efficient for reducing regularly the sulphur compounds to the desired limit, and I am therefore very pleased to hear that by the addition of sulphur to the liquor he has been successful in bringing them down to a very low point, and well within the limits prescribed by the London gas refiners. This is a very important point, and one that will weigh well with gas engineers; but, as a gas engineer, I should like to be assured, before adopting the process, that taking the value of the extra products—Prussian blue, etc.—into account there would be a saving over the prevailing method. For the last three years, at one of my works, we have been able to purify the gas from carbonic acid, sulphuretted hydrogen, and ammonia, and bring the sulphur compounds down very low; the whole cost, including new materials and labour (after crediting the materials sold), has not exceeded one-third of a penny per 1000 cubic feet of gas made. Now that is a very small item, and I repeat that we want to be assured that by this new plan we should be able to purify cheaper than this. I am not going to say anything against this beautiful chemical process, but we now wish to have some reliable information as to the net cost. Without considerable saving can be shown to result, this system will I hardly think take the place of our existing purifying arrangements, but it is more likely to be adopted where new works are contemplated, or extensions required, as at Belfast; and we shall all anxiously await the results obtained there upon the larger scale.

Mr. Watts: In actual practice it is impossible to use extremely concentrated solutions, on account of the rapid volatilisation of the ammonium sulphide. We have in the laboratory used such a solution containing polysulphide with good effects. I may say that I have made a number of experiments with different sulphides, more particularly barium and sodium sulphides, and I have found that solutions of monosulphides, unless very strong, are absolutely incapable of absorbing bisulphide of carbon. The conclusion I came to was, that the monosulphides are decomposed in solution into hydrate and hydrosulphide, and it is well known that hydrosulphides will not combine with carbon bisulphide. When the solution is very concentrated this decomposition will be incomplete, and the carbon bisulphide is then absorbed by the undecomposed monosulphides. The formation of a small quantity of polysulphide, either by addition of sulphur or by exposure of the solution to the air, at once confers upon the solution the property of absorbing bisulphide of carbon. The case of ammonium sulphide is somewhat different to that of barium and sodium sulphides. Monosulphide of ammonia only exists at very low temperatures, so that even very strong solutions, so long as they are free from polysulphide, will not absorb carbon bisulphide. The use of polysulphide of ammonia was discovered by Leigh, at Manchester, some years ago. How far the invention was carried into practice I cannot say. Mr. Turner asked about the effect of oxygen upon the illuminating power of gas. I mentioned that the oxygen in the foul gas was only partially absorbed in our process, and stated that this would be rather an advantage than otherwise. Dr. Frankland has proved that the reduction of the illuminating power of gas by the presence of air is due to the nitrogen, the oxygen tending to counterbalance the injurious effect of the nitrogen, doubtless by increasing the temperature of the flame. Consequently, given the unavoidable presence of a certain proportion of air, a process which does not absorb the oxygen is preferable to one that absorbs almost the whole of it. Then as to the additional cost of the removal of the sulphur compounds. The cost in London is given by Mr. F. Livesey as a 1¾d. per 1000 cubic feet; very likely this has been reduced since the date of his paper on the subject. In our case it is about 1d. for 10,000 cubic feet.

The Chairman: The question of purification in closed vessels is one that has occupied the minds of gas men for many years past, and many attempts have been made to arrive at a solution of it. About eleven years ago success was thought to have been achieved by Hill's process, by which ammonia is driven from its combination with other impurities in gas liquor, and used over again in the washers or scrubbers. Only partial purification, however, was effected by this means, and, substantially, little was accomplished until the matter was taken up by Mr. Claus, by whom complete purification, without the aid of any foreign material, has at length been effected. Hitherto we have regarded this as an object to be attained, not as a means for increasing the value of the residual products, but almost solely for the reduction of labour, the avoidance of the necessity for costly plant, and for doing away with the loss and nuisance resulting from the emptying and charging of dry purifiers. The operations of the Ammonia Purifying Co., however, while embracing all these objects, have revealed to us new sources of income, not only from the more saleable character of the residuals, but also from the addition they are able to make to the latter, in the utilisation of the sulphocyanides which have hitherto been run to waste. It is, therefore, greatly to be desired that the process may be successfully developed, and those who, from the data already furnished by the experiment, have determined upon adopting it on a larger scale, deserve our thanks for affording the only possible means by which its economical advantages can be fully and satisfactorily determined. In the observation made by Mr. Hack, as to the average cost of purification to the London companies being about 1d. per m., doubt was expressed as to the accuracy of Mr. Watts' statement of cost for the removal of the sulphur compounds—viz., 1¾d. per m. This, as stated by Mr. Watts, was given upon the authority of Mr. Livesey, and does not appear to me to be necessarily inconsistent with the statement of total cost; because Mr. Livesey was, I presume, speaking of the removal of sulphur compounds only, whereas the entire process of purification embraces at least one operation which is, or has frequently been, a source of profit—I refer to the removal of sulphuretted hydrogen by oxide of iron. If the oxide of iron be well bought the value of the spent oxide may become, as was frequently the case until recently, considerably greater than the first cost of the material. Mr. Hack referred also to the fact that at one of his works the cost of purification was extremely low, while at the same time the sulphur compounds never exceeded, but were frequently considerably within, the limits prescribed by the gas referees. Without special purification that was a very exceptional experience, and I think that the statement ought to have been supplemented by information as to how much of such a result was due to the process of purification employed; because it might very possibly be due simply to the employment of moderate heats, or to the use of a coal exceptionally free from sulphur, or to a combination of these causes. In any case it could prove nothing, either for or against the adoption of the ammonia process under such conditions, the advantages of which were not to be measured by the question of a few grains, more or less, of sulphur left in the gas. Having had the process working under my immediate supervision for some considerable time, I am in a position to say that for works of large size there is almost certain to be a considerable reduction on the cost of labour; although where the make of gas is small I should hesitate to recommend its adoption, for the simple reason that the labour required to work a plant for the purification of one million cubic feet per day would, in all probability, be equal to one of four or five times the dimensions. Mr. Watts has dealt fully with the prospect as regards increased value of residuals, and I need only add that, with respect to sulphur alone, which is recovered in a solid form, the return ought to be doubled, while the cost of oxide of iron and lime would entirely disappear.

Glasgow and Scottish Section.

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J. J. Coleman, Ardarroch, Bearsden, near Glasgow.

Local Secretary:

G. G. Henderson, Chemical Laboratory,
University of Glasgow.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

The Third Meeting of the Fourth Session of this Section was held in the Rooms, 207, Bath Street, Glasgow, on Tuesday, January 4, 1887.

MR. J. NEILSON CUTHBERTSON IN THE CHAIR.

ON WASTE GAS FROM OIL STILLS.

BY GEORGE BEILBY, F.I.C., F.C.S., AND J. B. M'ARTHUR.

Our attention has for some time been directed to the production of permanent gas, which invariably occurs at the later stages in the redistillation of crude shale oil and petroleum. The oil we shall refer to in this paper is crude shale oil, as it comes from the condensers of the retorts, containing, therefore, naphtha, burning oil, intermediate oil, lubricating oil, and solid paraffins, and, in addition, basic and acid tars and resinous bodies of high boiling point. The crude oil on entering the oil refinery is handled in one of two ways—it is either distilled to dryness in a moderate current of steam, or it is first treated with weak sulphuric acid and caustic soda for the removal of a portion of the basic and acid tars, and is then distilled to dryness. In either case this first distillation is, more or less intentionally, a destructive distillation; the original oil thus produces an oil of lower specific gravity, which contains a smaller quantity of acid and basic tars, and is therefore more easily refined. A residue of pitchy coke remains in the still, and hydrocarbon gas, sulphuretted hydrogen, ammonia and water vapours pass away from the condenser of the still. There is evidently a breaking down of complex bodies containing carbon, hydrogen, nitrogen, oxygen, and sulphur, into simpler hydrocarbons, and the other products enumerated above. But the amount of destruction permitted must be most carefully regulated, as the paraffins and olefines of higher boiling point are very easily decomposed and destroyed, so that a distillation which would produce excellent results on the basic and acid impurities might be disastrous in its effects on the solid paraffins and viscous olefines. The amount of destruction to be permitted is influenced by the nature of the original shale, the system of retorting employed, and by the market prices of the various paraffin products.

Our principal object was to study the history of one of the secondary products of this destructive distillation—the hydrocarbon gas. As far as we can learn, no measurements of the volume or tests of the quality of this gas had been made by other observers.

We have made experiments in the laboratory, distilling a litre, and in the works distilling about 10 tons at a time.

LABORATORY DISTILLATION.

A litre of crude oil was distilled to dryness in a glass flask over a Fletcher lamp, a current of low-pressure steam being passed through the oil during distillation. The gas from the condenser was drawn into a small gasholder. The entire distillate measured 985cc. The loss by volume was, therefore, 1·5 per cent.

Taking the weights of the oil and its products, we have :—

Crude Oil distilled		882grms.
Oil distillate	860·00grms.	
Residue	10·58 ,,	
Gas	7·93 ,,	
Unaccounted for	3·49 ,,	
	882grms.	

The volume of the gas was 6·85 litres, or at the rate of 1·1 cubic feet per gallon of oil. The illuminating power of the gas was 35 standard candles on a calculated consumption of 5 cubic feet per hour. It is a matter of general experience with oil works chemists, that in well-conducted laboratory distillations the amount of decomposition which takes place is small compared with that in works distillation.

WORKS DISTILLATION.

In January and February last year we made various determinations of the gas produced at the crude stills, in Oakbank Works. Through the courtesy of Mr. Fraser, the managing director of the company, we are enabled to quote some of these results here.

These experiments were made primarily to gain information as to the quantity and quality of the gas produced in actual distillation. Attempts were also made to measure the actual products from the crude oil so as to apportion the various losses as in the laboratory experiments, but in a going work it is absolutely impossible to get really trustworthy figures to a reasonable degree of accuracy. The large size of the vessels, the differences of temperature of the oil, the presence of water in the crude oil and distillate, all combine to prevent accurate measurement. We shall, therefore, only quote such portions of the results as refer to the gas evolved per gallon of crude oil.

The collection of the gas was effected by connecting the gas pipe of the condenser with a small gasholder about 20 feet in diameter. A steam jet was placed in the connecting pipe so as to draw the gas from the condenser and urge it forward to the holder. The gas on its way to the holder passed through a supplementary condenser, in which it was cooled to the temperature of the air, and deposited such naphtha and water as had escaped condensation in the ordinary condenser. All of the fittings were of a temporary description, and were ultimately found to be quite insufficient to pass the whole of the gas when it was at its maximum flow. In consequence of this only a portion of the gas could be collected, and the total make had to be estimated. The figures given below are certainly well within the truth.

A still charged with 2425 gallons of crude oil gave 2800 cubic feet of gas, or 1·15 cubic feet per gallon of oil.

A still charged with 2400 gallons of residues from the second distillation of crude oil gave about 4000 cubic feet of gas, or 1·66 cubic feet per gallon.

No systematic chemical examination of the collected gas was attempted, but its illuminating power was tested in a number of cases, and determinations of the amount of volatile hydrocarbons removable by scrubbing with heavy oil were made.

The average gas from the distillation, which yielded 1·15 cubic feet per gallon, had an illuminating power of 34 standard candles, calculated to a consumption of 5 cubic feet per hour. The average gas from the second residues, which yielded 1·66 cubic feet per gallon, had an illuminating power of 29 candles.

Samples of gas from various stages of the distillation were collected separately and tested for their illuminating power. It was found that gas began to come off freely when the distillate reached a sp. gr. of 890—from this stage till the yellow resinous end of the distillate began to make its appearance, the illuminating power was from 40 to 45 candles. During the running of the resinous distillate, that is, while the still was coking, the illuminating power fell to 24 candles.

By scrubbing with heavy oil, gas which had stood in the gasholder for 36 hours, 1·2 gallons of naphtha per 1000 cubic feet of gas was obtained. The illuminating power before scrubbing was 34 candles, and after scrubbing 22 candles. This shows that the gas is fairly permanent and might possibly be used for lighting railway carriages.

We did not chemically examine the naphtha separated by heavy oil scrubbing, but from its physical characters it seemed to consist chiefly of low temperature hydrocarbons. The comparatively high illuminating power of the oil-scrubbed gas seems to indicate that it probably contains some of the lower olefines.

We must point out that the experiments we have detailed were made with stills worked on the old non-continuous system. The recently introduced system of long-continued feeding certainly diminishes the decomposition of oil, and correspondingly reduces the gas production ; but, as we have pointed out at the beginning of the paper, regulated decomposition is one of the chief objects of the first distillation, and therefore a certain quantity of gas must always be produced. After due allowance is made for all reasonable deductions, there will still remain a large volume of excellent gas well adapted for the lighting of works and villages, and probably, also, of railway carriages. This is the more important to oilworks, as the practice of scrubbing the retort gas with heavy oil renders it absolutely useless for illuminating purposes.

DISCUSSION.

Dr. **Wallace** said the subject brought before them that evening was one which interested him very much, as it was the first time, so far as he knew, that this particular gas had ever been measured as regarded quantity or luminosity. He was very glad to hear that the illuminating power was so high. The gas obtained in the original distillation of the shale was much purer—perhaps 22 or 24 candles, and was, therefore, not so suitable for lighting towns or villages, or even railway carriages. Taking an ordinary work such as Mr. Beilby had been accustomed to, he would like to know what the quantity of gas per day would be, and whether this quantity would really be of some commercial value, for that really was the important point in the paper? If the gas could be turned to profitable account, his own impression was that it would do very well for compressing for use in railway carriages, although its illuminating power was not so high as the gas used at present.

Mr. **Stanford** asked how the gas stood compression, and whether it was easily condensed or not?

Mr. **Whitelaw** believed that Mr. Coleman had made some experiments in compressing gases of the kind under discussion. He remembered receiving a bottle of the oil, or compressed gas, which boiled with the slightest elevation of temperature; even the heat of the hand was sufficient to cause boiling. He was not aware, however, whether this was the same gas as Mr Beilby had operated on.

Mr. **Irvine** asked whether the amount of gas was decreased or increased by using steam in the distillation?

Mr. **Beilby**, in reply to Dr. Wallace's remarks, said that in a work like Oakbank the production of still gas would be about 20,000 cubic feet per day, but the production of some larger works would be from 80,000 to 100,000 feet. He had not had an opportunity of trying the effect of compression, as suggested by Mr. Stanford, but it was considered that oil scrubbing through a heavy oil was a much more severe test of the permanence of a gas than simple compression. Referring to Mr. Irvine's question, he had not tested the gas from stills worked without steam, but it was presumed that the production of gas would, in that case, be larger, because steam was used to prevent decomposition. Mr. Coleman's apparatus for the compression of gases, referred to by Mr. Whitelaw, was originally applied to waste gas from shale retorts. In that case the condensation of the very volatile hydrocarbons was due to the cooling by expansion in the working cylinder of the engine rather than to the preliminary compression.

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(*A*) NOTES ON "NESSLERISING." (*B*) NOTES ON THE EXTRACTION OF FATS BY SOXHLET'S APPARATUS.

BY J. M. MILNE, PH.D.

In these notes originality is not claimed. They simply embody a description of some modifications of apparatus which I have found extremely useful in my laboratory.

"*Nesslerising.*"—Wanklyn's original instruction for nesslerising water distillates involved the taking over of three separate quantities of 50cc. and the determination of the ammonia in each. This involved a great deal of trouble, and occupied a considerable amount of time. Some years ago, Hehner suggested an improvement in this method, as well as in the form of nesslerising tube used, and I was so struck with the simplicity of his method, as well as with the great saving in time resulting from its use, that I at once ordered a pair of his nesslerising cylinders from London, and have used them ever since. Although these cylinders can now be had in Glasgow, I understand they are very little used, and this fact has induced me to bring them under your notice this evening. Hehner's modification of the original process is very simple and easily carried out. Instead of separate quantities, the whole distillate is collected in one. I have a series of stoppered bottles, holding over 200cc., which are kept specially for water distillates. These are marked for 50cc., 100cc., 150cc., and 200cc. In the case of a water containing little ammonia, 100cc. of distillate will be found to contain the whole of it. Others may require 150cc., or even 200cc. to be taken over. It goes without saying that in every case a final quantity of 50cc. must be collected separately and nesslerised, in order to ensure that the distillation is complete. One great advantage of this method is that with a number of waters on hand at one time, the distillations can be carried on one after the other, and the various distillates put aside and nesslerised when convenient, or the light most favourable.

The construction of the cylinders is also simple. They are made with a somewhat broad foot, and are graduated to hold 100cc. Near the bottom a glass tap is soldered on, so that the contents of the cylinder can be slowly run off. The two cylinders are placed side by side on a white surface, a measured quantity of standard ammonium chloride is run into one, then ammonia-free distilled water up to the 100cc. mark. 2cc. of Nessler's solution are next added, and the whole thoroughly mixed with a glass rod flattened out at the end. 100cc. of the water distillate is placed in the other cylinder, 2cc. of Nessler added and well mixed. In practice I find that 1cc. of standard ammonium chloride (= ·000025grm. NH_3) in 100cc. gives a tint which very readily can be compared. After standing for five minutes, the two cylinders are compared. If, as usually the case, the water distillate is the darker of the two, a small beaker is placed below its tap, which is then turned on till the contents drop out slowly. If the eye is directed straight down the interior of the cylinders, no perceptible movement of the column is observable, and a point will be reached when the tint of the contents of the two cylinders are alike. The tap is now closed and the height of the water distillate read off. It is then filled up again from the beaker, and re-adjusted. This is repeated three times and the average of three readings taken as correct. As nesslerising cannot be done in gaslight, I have endeavoured to imitate the process with two shades of indigo solution. Assuming that the lighter shade in this cylinder represents the standard ammonium chloride (and contains 1cc. of it) and that the darker one (the water distillate) has been run down to 70cc. to equalise the tint, then a simple proportion calculation is all that is required: If 70cc. contains ammonia equal to 1cc. of standard chloride, how much will 102 (the total bulk in the cylinder) contain? The rest of the calculations are obvious. It is evident that these cylinders can be equally well made use of in any kind of colorimetric testing. There is one slight objection to these cylinders as at present made. There are sometimes little specks in the glass at the bottom. This could easily be obviated by making the feet a little thicker, grinding them quite flat and then polishing, just like this small specimen-jar on the table. I am at present trying to get a pair of cylinders made to this improved pattern.

"*Soxhlet's Fat Extractor.*"—In the determination of fats, especially with regard to milk analysis, the use of this apparatus is very convenient and greatly to be recommended, and may, I think, entirely take the place of any other form of percolator. The arrangement on the table has been made according to my own instructions, and works very well. It has the advantage of enabling duplicate or separate determinations to be made side by side, using only one inverted condenser. The condenser is made flat or oval, instead of round, so that two internal tubes can be fitted in and a Soxhlet's extractor attached to the lower end of each. It is obvious that by making the outer case round and larger, four internal glass tubes can be used, and four extractions carried on at once, the whole arrangement being set up on a round table, so as to admit of easy access. I have on the wall an enlarged drawing of the actual Soxhlet part of the arrangement, in order to show that the wide tube is closed at the bottom like a test tube, and communicates by a side tube with the flask below. At the other side is an extremely ingenious syphon-arrangement, which is automatic, and also leads into the flask. The flasks used are conical in shape, and have the weights marked on the necks. They have necks of the same diameter, so that they all fit one cork. In using the apparatus for milks I proceed as follows. Approximately 10cc. of the milk are measured into a small tared basin of porcelain, and the weight noted. The milk is then evaporated on the steam bath, with frequent stirring, in order to render it granular, until, on being removed and cooled, the residue is semi-solid. The residue can then be easily detached from the basin by means of an ordinary joiner's gouge, and is transferred to a paper cup, made by pressing a circular filter over the end of a glass cylinder. The cup and contents are then placed in the Soxhlet tube, the basin, etc., being thoroughly rinsed with dry ether, which is added to the residue. Sufficient ether is poured in to reach within a short distance of the bend of the syphon tube; and some ether is also placed in the conical flask. The various connections are then made, and the water bath below the flask started. The ether in the flask distils up through the side tube into the wide one, containing the residue, and as soon as the surface reaches the bend of the syphon, it is at once carried over into the flask below, carrying the extracted fat along with it. This process is repeated over and over again. Provided the joints are all tight, the apparatus can be left to itself for a long time. From one and a-half to two hours are quite sufficient. The flask is finally taken off, attached to an ordinary small condenser by a cork of the same size, and the ether distilled off. Within the last year or so a complete revolution has taken place as regards the extraction of fat from milk, in the introduction of "Adams's" paper coils for drying the milk up. These coils, several of which I have on the table, are made by rolling up long strips of thick white blotting paper into a not too closely compressed coil, and tying round with a thread. The coils are treated with ether to remove traces of fat from the paper. A quantity of the milk is placed in a small beaker, and the weight noted. A coil is then placed in the beaker so as to be not more than half immersed, and allowed to remain till no more milk is drawn up. It is then removed, the dry end placed on a glass plate, and the whole kept for two hours in a closed water bath, after which it is transferred to the Soxhlet tube, and extracted in the usual way. I have been using these coils for some time (in conjunction with the older method) with excellent results, and have been able to confirm the fact—pointed out by the committee of the Society of Public Analysts—that from ·3 to ·5 per cent, more fat is extracted by this method. The process has also been recently examined by several German chemists, who have recommended its adoption there. I believe the coil method of drying up milk for fat extractions will quite take the place of all others. In the case of duplicates, the results are very concordant. In his book on Milk Analysis, etc., Dr. Bell, of Somerset House, states that he has obtained less fat when using the Soxhlet's tube than by his own marceration process. This is certainly not my experience. A great advantage also is that the apparatus being automatic, requires no attention, thus saving much time. It can also be used for many purposes of extraction, such as oil cakes, etc. I have also found it extremely convenient for determining grease in cloths to be used for waterproofing purposes, and in which the presence of any considerable quantity of fat is objectionable.

DISCUSSION.

Dr. WALLACE said that so far as he knew Dr. Milne was the first in Scotland who had made independent experiments upon this process of Adams's, as compared with the ordinary mode of extraction of fats; and it was very satisfactory to know that the results obtained agreed thoroughly with those of chemists in London and elsewhere. His own impression was that Soxhlet's apparatus was a very perfect one, so much so that he could not see why it should not extract every particle of fat in any substance. What, in his opinion, had prevented the general adoption of Adams's method was the fact that the Somerset House chemists had not yet taken it up. The same state of matters existed with regard to the standard of light. So far as legislation had yet gone, there was only one standard of light—*i.e.*, the sperm candle, which was a very imperfect standard, and yet people continued to use it, because no other standard was recognised. Public analysts were in the same position with regard to the analysis of milk and the extraction of fat. He hoped, therefore, that Dr. Bell, of Somerset House, would start independent experiments, and convince himself regarding the analysis of milk.

Mr. STANFORD said the Section was certainly indebted to Dr. Milne for the excellent apparatus, and the able manner in which he had brought his subject before them. He believed that one of the difficulties pointed out by Dr. Milne, in connection with the nesslerising tubes, might be obviated by making the bottom of white enamelled glass.

Mr. GALBRAITH suggested that instead of setting the Nessler tube on a white slab, a thin disc of porcelain might be dropped into the tube before use, as it would not then matter whether the glass at the foot of the tube was perfectly transparent or not.

At the close of the discussion on Dr. Milne's paper, Mr. C. M. AIKMAN, M.A., B.Sc., exhibited Bayne's new form of condensing apparatus for water analysis. The construction is simple, the condenser consisting of an oblong box of block tin, with a tube running through it, the water for cooling runs in at one end and out at the other end of the upper surface. The apparatus, Mr. Aikman said, combined several advantages over the older forms of condensers, not the least of which was the escape from the danger of breakage.

Nottingham Section.

Chairman: Prof. Clowes.
Vice-Chairman: Lewis T. Wright.
Treasurer: J. B. Coleman.
Committee:

L. Archbutt.
W. A. Curry.
H. Doidge.
R. Fitzhugh.
E. Francis.

T. W. Lovibond.
H. J. Staples.
E. B. Truman.
R. L. Whiteley.

Hon. Local Secretary:
J. R. Ashwell, Midanbury Lodge, Bentinck Road,
Nottingham.

At an early date, "Water Softening," by J. B. Coleman.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

The Opening Meeting of the Session was held at University College, Nottingham, on November 19.

PROFESSOR CLOWES, D.SC., IN THE CHAIR.

The Chairman, in reviewing the work of the past session, stated that the inaugural soirée, held on June 5, 1885, had been followed by two lectures, to which the public were invited; Dr. Bowman, of Halifax, lecturing on "The Structure of Fibres used in Textile Fabrics," and Mr. T. Wardle, of Leek, selecting "Silk" for his subject. Both lectures were profusely illustrated, and well attended and received. At the ordinary meetings of the Society the following papers had been read and discussed:—"The Analysis of Gas Coal," by Lewis T. Wright; "Water Purification and Softening," by P. A. Maignen, "Use of Poisonous Materials in Dyeing Hosiery," by J. R. Ashwell and H. Forth: "Some Points in the Analysis of Oils," by L. Archbutt. The Publication Committee of the Society had acknowledged the importance of these papers by publishing all of them in the Journal. As regards papers for subsequent meetings, the Secretary had a goodly number of promises, but was quite open to receive more; and members were urged to fix dates, some of them *early* dates, for reading their papers. Members were reminded that communications were not necessarily composed of original work, or investigations carried out by their authors, although this would naturally be the highest standard to be kept in view. Accurate descriptions of processes not generally fully known to chemists, and furnished by men with special knowledge and experience of such processes, would usually be of value to the Section, and possibly even to the Society at large. Smaller shorter papers, constituting brief notes or notices, would also be welcomed, and might lead to useful discussion. The exhibition of chemical products, apparatus, or models likely to be interesting on account of their novelty, or from some other special characteristic, would also be welcome.

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Meeting held Monday, December 13, 1886.

LIQUID FUEL.

BY LEWIS T. WRIGHT.

In 1883 I had the honour of addressing the Manchester Section of this Society on the subject of "Gaseous Fuel," a subject then of absorbing interest, and the theme for numerous "papers." The attention of the technical world now seems likely to turn to "Liquid Fuel," since we are threatened with a deluge of petroleum, which would no doubt be an accomplished fact if it were possible for this material to be delivered at such a price as to enable it to compete with our cheap English coals. The fine paper read before the London Section of this Society in 1885, "On the Russian Petroleum Industry," by Mr. Boverton Redwood, has given us an idea of the enormous quantities of petroleum seeking a market; but we have yet to learn the lowest price at which it can be delivered in this country, for on the price depends, of course, whether it can successfully compete with coals. Mr. Redwood states that at Nobel's works 1lb. of petroleum residue evaporated 14½lb. of water in a boiler provided with Nobel's trough burner, and 12lb. when injected into the furnace by steam, whereas coal was only equal to from 7lb. to 8lb. of water. It is probable that the coal employed was not of the finest quality. I do not know what the constitution of the petroleum residue may be—but the higher classes of petroleum are surely the most concentrated fuel, weight for weight, we can hope to find. Whilst the American petroleum oils are mostly hydrocarbons of the paraffin series, the Russian appear to be mostly pseudo-olefines (napthenes) and benzenoid hydrocarbons. You will remember that the hydrocarbons of the paraffin series up to heptane have positive heats of formation, and from the regular progression presented by those bodies, as far as they have been investigated, we may conclude that the higher members of the series also have positive heats of formation, and yield on combustion less heat than would be indicated by their elementary composition, or calculated according to Dulong's formula. Methane, the first member of the series, yields on combustion about 11 per cent. less heat than would be given by the same amount of carbon and hydrogen in the free state. Hexane about 6 per cent. less. The members of the olefine series, at present studied, have either negative heats of formation or very small positive ones. Of the acetylene series, the two first members, acetylene and ethylene, have negative, and diallyl (C_6H_{10}) a small positive heat of formation; naphthalene, anthracene and benzene appear to have negative heats of formation. I mention these matters as I think it probable that carbon for carbon and hydrogen for hydrogen, the Russian will be found to yield more heat than American petroleums. As engineers we labour under the difficulty of being compelled to employ an empirical formula for the calculation of the combustion equivalents of our fuels, and this difficulty can only be removed when the chemists have had time to determine for us the true calorific values of the materials we employ as fuel. Until then we shall have to avail ourselves of Dulong's formula, with the mental reservation that it is likely to give results perhaps 8 per cent. from the truth. It is well known that most coals at present investigated yield in the calorimeter higher results than are obtained by calculation. There are, however, exceptions. I find that fourteen coals examined by Scheurer-Kestner and Meunier in their calorimeter gave an average result 9 per cent. in excess of the average calculated value. The coals examined by Ferd. Fischer, in his boiler trials, also gave about 7 or 8 per cent. more in the calorimeter than calculated from elementary composition[*]. I have had no experience of petroleum as a fuel, but I venture to make a theoretical comparison between it and coal. The average composition of fifteen petroleums from various parts analysed by M. Sainte-Claire Deville was—

Carbon..............	81·7
Hydrogen	13·1
Oxygen	2·2
	100·0

which gives a theoretical evaporative power per lb. of 19·63lb. water from a temperature of 100° C. at atmospheric pressure, reckoning the H_2O formed on combustion of the hydrogen to be in the gaseous condition, thus:—

$$\frac{84{\cdot}7\times8080+\left(13{\cdot}1-\frac{2{\cdot}2}{8}\right)28780}{536{\cdot}5\times100}=19{\cdot}63.$$

(the theoretical evaporative power will always be expressed on this basis). In a good boiler we may

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[*] Wagner's Jahresbericht, 1883—1885.

expect to get 80 per cent. of the calculated heat of combustion of such a class of fuel into the water. We should then have an actual evaporative power of 15·70lb. water; but as about 5 per cent. of the water evaporated would be required to work the injector, if the petroleum were worked on that system, we should have a net evaporative power of 14·92lb water. This estimate gives petroleum weight for weight 32 per cent. more evaporative power than coal of a practical evaporative power of 11·3lb.

D. K. Clark, in his "Manual of Rules and Tables," falls into a singular error in his notes on "Liquid Fuels," and credits some petroleum oils with a theoretical evaporative power of 29·08lb. A glance at the formulæ and elementary composition of his petroleum oils will immediately cause the error to be disclosed. In his otherwise useful manual the custom of calculating the combustion values of the fuels on the basis of the H_2O formed on combustion of the fuel being liquid, is objectionable, as it operates unfairly against those fuels containing but little hydrogen, and is a condition not to be arrived at in practice.

No doubt some of the purer petroleum distillates might give one or two pounds more than this figure, but would they not be commensurately dearer !

A crude petroleum of ·87 specific gravity would measure 257½ gallons to the ton of 2240lb., and at one penny per gallon would be equivalent to a coal of the above mentioned quality at 16s. 3d. per ton, without reckoning anything on account of a saving in labour of firing, and other advantages liquid fuel possesses, such as getting more work out of the boiler, etc. It is impossible to assign any value to these, as everything would depend upon particular circumstances. Of course, if it were found that trough burners could be successfully employed, then the comparison would be much more favourable to the petroleum; but petroleum at one penny per gallon is, at present, a thing only to be dreamt of. There are other liquid or semi-liquid fuels produced in this country at a very low price, such as tar oils and tar, and the attention of engineers and manufacturers who require *intense* and *regular* heats should be directed to these. The results of the boiler trials I have made with tar and creosote, and which were casually mentioned in a paper I read before the London Section of this Society, on November 1 last, I now propose to bring before your notice. The results in the paper referred to were given for actual working conditions—viz., feed water at 12° C. (53·6° F.) and 40lb. steam pressure. The boiler was a two-flued Galloway boiler 28ft. long, 7ft. diameter, of the best modern construction:—

Class of Fuel.	Number of Days Trial.	Pounds of Water evaporated from 12° C. at 40lb. Steam Pressure.	Pounds of Water from 100° C. and Atmospheric Pressure.
Nottingham Top Hard Cannel	11	7·40	8·78
Silkstone Gas Coal	7	8·42	10·01
Coke from Top Hard Cannel	6	8·31	9·91
Silkstone Gas Coke	6	9·49	11·15
Tar Steam injected	7	10·70	12·71
Creosote Steam injected	9	11·24	13·35

I give coals and coke in this table for the purpose of comparison.

I will now give the elementary composition of the materials employed, and their calorific values calculated according to the usual formula:—

$$\frac{C \times 8080 + \left(H - \frac{O}{8}\right)28780 - (H_2O \times 600)}{536{\cdot}5 \times 100.}$$

The carbon, hydrogen, oxygen, and moisture, etc., being expressed per cent., and the result being in units (lbs.) by weight of water evaporated from 100° C., and atmospheric pressure per unit (lbs.) weight of fuel.

The *Nottinghamshire top hard cannel* employed has the following elementary composition:—

C	67·0
H	5·6
N	1·2
S	1·0
H_2O	7·6
Ash	6·6
O	11·0
	100·0

$$\frac{67 \times 8080 + 28780\left(5{\cdot}6 - \frac{11{\cdot}0}{8}\right) - (7{\cdot}6 \times 600)}{536{\cdot}5 \times 100} = 12{\cdot}27$$

and would therefore have a theoretical evaporative power of 12·27lb. of water per 1lb. of fuel.

The Silkstone Coal—

C	79·0
H	5·2
N	1·5
S	1·5
H_2O	4·0
Ash	2·8
O	6·0
	100·0

$$\frac{79 \times 8080 + 28780\left(5{\cdot}2 - \frac{6{\cdot}0}{8}\right) - (4 \times 600)}{536{\cdot}5 \times 100} = 14{\cdot}24$$

with a theoretical evaporative power of 14·24lb. water per 1lb. of fuel.

The Top Hard Cannel Coke—

C	80·1
H	0·6
N	1·3
S	0·4
H_2O	4·1
Ash	11·9
O	1·6
	100·0

$$\frac{80{\cdot}1 \times 8080 + 28780\left(0{\cdot}6 - \frac{1{\cdot}6}{8}\right) - (4{\cdot}1 \times 600)}{536{\cdot}5 \times 100} = 12{\cdot}23$$

with a theoretical evaporative power of 12·23lb. of water per 1lb. of fuel.

The Silkstone Gas Coke—

C	89·0
H	1·0
N	1·0
S	1·2
H_2O	1·2
Ash	5·2
O	1·4
	100·0

$$\frac{8080 \times 89 + \left(1{\cdot}0 - \frac{1{\cdot}4}{8}\right)28780 - (1{\cdot}2 \times 600)}{536{\cdot}5 \times 100} = 13{\cdot}83$$

with a theoretical evaporative power of 13·83lb. of water.

The Tar—

C	80·2
H	7·0
N	0·8
S	0·5
O	11·5
	100·0

$$\frac{8080 \times 80{\cdot}2 + \left(7{\cdot} - \frac{11{\cdot}5}{8}\right)28780}{536{\cdot}5 \times 100} = 15{\cdot}06$$

with a theoretical evaporative power of 15·06lb. of water.

The Creosote—

C	87·4
H	7·3
N	0·3
S	0·5
O	4·5
	100·0

$$\frac{8080 \times 87\cdot4 + \left(7\cdot3 - \frac{4\cdot5}{8}\right)28780}{536\cdot5 \times 100} = 16\cdot78$$

with a theoretical evaporative power of 16·78lb. of water.

The following table gives the percentage of the theoretical evaporative power actually obtained:—

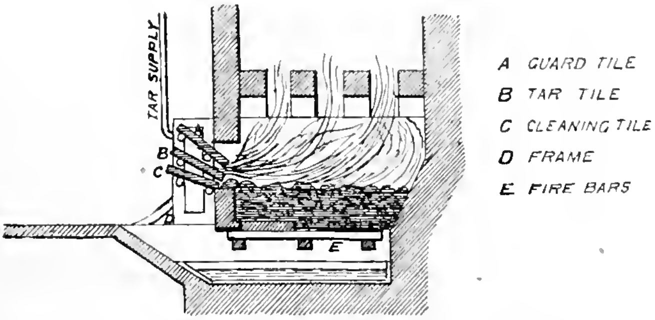
	Actual.	Calculated.	Per Cent.
Nottingham T. H. Cannel	8·78	12·27	71·56
Yorkshire Silkstone Coal	10·01	14·21	70·30
T. H. Cannel Coke	9·91	12·23	81·03
Silkstone Gas Coke	11·15	13·83	80·62
Tar Steam Injected	12·71	15·06	84·40
Creosote ,, ...	13·35	16·78	79·56

It will be observed that the coals come out low, the cokes and tar very well, and the creosote occupies a mediate position. It is also important to bear in mind that the coals examined by Scheurer-Kestner and Fischer were really seven to nine per cent. better than by calculation; but I cannot say that this would also apply to the coals used. The creosote results agree fairly with some I have had the privilege of seeing, that were obtained in the London district, and also in the neighbourhood of Nottingham; but as I have no information about the boilers employed, a close comparison is not possible. Creosote is an excellent fuel for boiler firing, and easy to manipulate. It requires to be warmed if it contains much "tar salts," to dissolve the naphthalene, etc. Tar is rather more difficult to manage with ordinary forms of injectors, as the peculiar orifices employed are extremely liable to obstruction with this viscous fluid, and there is a tendency to produce smoke if the flow of tar is irregular.

For the purpose of injecting these liquid fuels into furnaces, a great number of injectors have been invented, and if they materially differed in principle the study of them would be perfectly bewildering, but as they are almost all alike their study is really very simple. The one on the table before you is perhaps the simplest form, and is one I designed, and have called a "spray burner," and consists of one tube carrying the steam placed at right angles to another carrying the liquid fuel, in the fashion of those scent sprays that were and are, perhaps, now very popular for distributing scent in rooms.

These injectors are said to require about five per cent. of the steam made to work them, and suffer from the obvious difficulty of not being able to raise the steam to start themselves with. A supplementary boiler, fired by other means, would have to provide that in the first instance. There is no doubt that the oil could be burned without steam at all, after the manner of Nobel's trough burner. I have tried with an arrangement similar to the one I shall shortly describe for retort furnaces; but it was not large enough to be able to consume enough oil to evaporate anything like the usual quantity of water. Up to that point, however, the combustion of fuel was very perfect, and gave great promise for an extension of the system. The flame from these oils is very fierce, and it is no doubt advisable to place a ring of fire-bricks as a lining for those parts of the boiler in immediate vicinity to the flame, and fire-brick shields in front of the first tubes, if the boiler is of a Galloway type. The grate also wants covering with either a dense bed of ashes or fire tiles, and the lower half of the flue below the grate should be closed with a metal shield. I am inclined to think that it would be preferable, if the use of oil were intended to be permanent, to employ a fire-box of firebrick outside the boiler, with a furnace of the type to be described hereafter, and lead the flame into the boiler flues.

The attention of gas engineers has been forcibly directed to the use of tar as a fuel for the firing of retorts, now that this once high-priced material is suffering like everything else, perhaps even to a more marked extent, from what is called depression in trade, it has in many places reached so low a commercial value that it is profitable to burn it as a fuel. Happily, at Nottingham this is not the case, and our interest in tar as a fuel is more experimental in view of what may happen if a further fall in tar products sets in. I have abandoned the use of steam injection for our experimental tar fires, in favour of another system I am going to describe. The steam injectors produce magnificent heats, but are rather intermittent in their action, and the steam they require is a serious item and not always available.



Tar being a pseudo-liquid fuel, in arranging for its combustion one has to provide for the twenty to twenty-five per cent. of solid carbon it contains, and that is deposited in the furnace as a kind of coke or breeze on the distillation of the volatile portions, which are much more easily consumed than the tar-coke. The tar fire I have adopted is one that can readily be adapted to an ordinary coke furnace, and as readily removed, leaving the furnace as before. The accompanying sketch shows the arrangement.

An iron frame D standing on legs on the floor just in front of the furnace-door carries three fire-tiles on iron bearers. The upper one A is not moved, and serves to shield the upper face of the tile B from the fierce heat radiated from the furnace, and also causes the air that rushes into the furnace between the tiles A and B to travel over the upper face of the tile B on which the tar flows, thereby keeping it cool and preventing the tar from bursting into flame until it reaches the edge of the tile B, over the whole edge of which it is made to run fairly well by a distributing arrangement. A rapid combustion takes place here, but some unconsumed tar falls on to the bed below. About one-third of the grate area is filled up by a fire-tile, and on this the tar coke falls. The tile C is moved away from time to time, and the tar-coke that accumulates in front of it is pushed back on to the fire-bars E, at the back of the furnace, to be there consumed. Air is thus admitted by three narrow slot-like openings to the front of the furnace between the tiles A, B and C and under C and through the fire-bars E. The air openings below are about three times the area of the openings in the front of the furnace, but as the openings between the fire-bars and tiles are always more or less covered by tar-coke, it is impossible to say what the effective openings are. The disposition above described is found to answer admirably, and requires but little attention. Three minutes per hour per fire seems to be the average time required for attention, and the labour is of a very light kind, and consists of clearing the passages between the tiles, and occasionally pushing back the coke on to the fire-bars. These latter are not interfered with, and will not require cleaning unless any bricks in the furnace have been melted, when a bed of slag will be found on them.

The amount of draught required for these fires is very small, and less than with coke firing. I find that 0·08 of an inch vacuum is sufficient with tar fires, and 0·25 of an inch for coke fires. The fires would require less attention with more draught, and more tar, as the apertures do not easily close with a sharp draught, and the tar is better carried forward into the furnace. A regular feed of tar is, of course, required, and considerable difficulty seems to be experienced in obtaining this. So long as we employed ordinary forms of taps or valves, so long (even with filtration) did I experience difficulties with the flow of the viscous tar, but on the construction of valves specially designed for the regulation of its flow, this difficulty immediately disappeared, and there is no longer the slighest trouble on this account.

The labour connected with the feeding of furnaces with coke, and cleaning fires from clinker, is very arduous. Eight coke fires are normally considered to be work for one man. A lad could work 16 of these fires.

Considerable attention has been paid to the composition of the furnace gases from the tar fires. The slightest deficiency in the air supply, of course, results in the immediate production of smoke, so that the damper must be set to provide always a sufficient air supply. Under these circumstances of damper the following analyses have been obtained :—

ANALYSES OF COMBUSTION GASES FROM TAR FIRES.

No Smoke.

	CO_2.	O.	CO.
	11·7	5·0	not determined.
	13·3	3·7	,,
	10·8	5·4	,,
	14·8	2·5	,,
	13·5	3·0	,,
	12·4	5·6	,,
	12·1	4·6	,,
	13·1	5·9	,,
	15·3	1·0	,,
	10·8	4·0	,,
	14·0	2·8	,,
Average..	12·9	3·9 of 11 Analyses.	
	11·5	not determined.	
	14·3	,,	
	14·6	,,	

Damper adjusted so that a slight Smoke was observable in the combustion gases.

CO_2.	O.	CO.
17·3	none	not determined.
16·6	,,	,,
16·5	0·1	,,
15·8	0·1	,,
16·2	1·8	0·7

Obituary

SIR FRANCIS BOLTON.

Sir Francis Bolton died on 5th January at the Royal Bath Hotel, Bournemouth, where he and Lady Bolton had been staying for the last two months.

The deceased was born in 1831, and, entering the Army in 1857, was staff officer on the Gold Coast from 1858 to 1860. He became captain of the 12th Foot in 1861, major (unattached) for special military scientific services in 1868, lieut.-colonel in 1877, and retired colonel in 1881. He was the inventor of the system of telegraphy and visual signalling introduced into Her Majesty's Service in 1863. Since 1871 he had been the water examiner under the Board of Trade; and was the founder, vice-president, and hon. secretary of the Society of Electricians. Sir Francis Bolton will be best recollected by the general public in connection with the Health, Inventions, and Colonial and Indian Exhibitions, in all of which he played an important part. It was entirely due to the invention of Sir Francis that the prismatic fountains, which formed such an attraction at these exhibitions, were introduced, and it was under his immediate supervision that they were installed and improved. The Colonel was an implicit believer in his invention, and continued improving and enlarging on it up to the time of his death. The manipulating of the electric signals by means of which the fountains were worked was rarely entrusted to anyone by the inventor, and six nights out of seven it was Sir Francis himself who directed the operations from the little room in the clock tower. It was his great delight to be surrounded by ladies and gentlemen of his acquaintance, to whom he loved to exhibit the working of the machinery, and he was generally accompanied by a small circle of friends on his visits to the tower. Sir Francis had for a long time past been an acute sufferer, the symptoms of his disease which gave most trouble being an almost total loss of voice. In the hope of improving his condition, he underwent several operations, but with little result, and experienced considerable pain, notwithstanding which he invariably appeared in the best of spirits, and frequently made jokes at his own expense in reference to his loss of voice. Sir Francis was in appearance of somewhat burly build, and had a fine presence. He was exceedingly popular with all who came in contact with him, and his bearing towards his employés, even of the lower grades, was such as to render him exceedingly popular with them also.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Improvements relating to Filtration and Apparatus therefor. H. Stockheim, Mannheim, Germany. Eng. Pat. 397, Jan. 9, 1886. 8d.

THE specification describes a closed filter casing which is separated into two compartments by a division plate, and fitted with connecting pipes by means of which the compartments can be used either together or separately, in the latter case capable of treating different liquids if required. The invention next refers to a new filtering medium composed of two parts of dry, white, ground wood fibre, and one part of dry linen fibre, successively treated with soda lye, bisulphite of lime, and a small quantity of sulphuric acid, under repeated boilings and washings. After exposing for a day or two, boiling in steam and washing in cold water, it is finally treated with alcohol free from fusel oil for the purpose of preservation.—B.

An Improved Compound for Preventing and Removing Incrustation in Steam Boilers. J. L. Wade, Glasgow. Eng. Pat. 1037, Jan. 23, 1886. 6d.

THE inventor prepares the following compound—viz., 40 parts of esparto grass boiled in water to a pulp, to which are added 20 parts of powdered nut galls, and 20 parts of chestnut pitch extract. The mixture is boiled to homogeneity, when the following substances are added in solution—viz., carbonate of potash, chloride of potash, and silicate of soda 10 parts each, and of chestnut flour 20 parts. The quantity and composition is varied with the composition of the water to be treated, and he sometimes adds valonia and glycerine, the latter in 2½ times the quantity of the former. The mass on cooling may either solidify or remain fluid or semi-fluid, according to ingredients used, and is applied accordingly.—B.

Improvements in Raising Liquids and in Apparatus therefor. J. Mactear. From J. Kolb, Lille, France. Eng. Pat. 1990, Feb. 11, 1886. 8d.

THE invention is based on the principle that if two columns of liquid balance each other, one may be made of less specific gravity taken as a whole than the other, by intimately mixing with it air or gases in a state of minute subdivision. Application of this principle may for instance be made to a syphon in the way of drawing the liquid from a lower reservoir up through the long leg, and delivering it by means of the short leg into a higher reservoir. Air finely divided being admitted near the lower end of the long leg of the syphon, at the same time that exhausting action is applied at the highest points, the liquid will rise and be discharged as described. Other applications are shown in the specification.—B.

Improvements in Apparatus for the Manufacture of Acids and Distillation and Condensation of Corrosive Liquid and Gaseous Substances. J. Whitley, Leeds. Eng. Pat. 10,022, Aug. 5, 1886. 4d.

THIS refers only to the substitution of aluminium, or aluminium bronzes consisting of copper with from 10 to 50 per cent. of aluminium, for lead or brass in the manufacture of articles used in connection with apparatus as referred to in the title.—B.

Improvement in Vacuum Distillation Apparatus. H. T. Yaryan, Toledo, Ohio, U.S.A. Eng. Pat. 14,162, Nov. 3, 1886. 8d.

THE apparatus consists essentially of double coils of piping arranged one within the other and fitted in a special way, the inner pipe containing the liquid to be evaporated and the surrounding one the heating medium, such as steam. If several coils are used successively for double and triple effect, the steam coming off the liquid evaporated in the first inner coil may be used for heating the next coil or coils. The remainder of the apparatus is principally required for regulating the proper supply, distribution, and direction of flow of the liquids and vapours. A modification of the apparatus is also proposed in the substitution of multitubular evaporators for the double coils previously named. For further details the specification and its two sheets of drawings must be consulted. The number of claims set up is 27. —B.

II.—FUEL, GAS, AND LIGHT.

The Examination of Petroleum.† C. Engler. Chem. Zeit. 10, 1335.

IN referring to experiments by Chandler, R. Weber, and the Berlin officer of health, on the heating of the lamp reservoir in petroleum lamps, the author comes to the same conclusion as V. Meyer—viz., that the use of lamps should be forbidden in which the oil is heated to more than 5° C. above the surrounding temperature. A criticism on Thoerner's conclusions on the value and examination of petroleum (this Journal, 1886, 371) is entered into, with which the author in the main agrees. He admits the safety of an oil the flashing point of which is above 38°, but considers that, taking the expense of the oil and other matters into account, the raising of the minimum flashing point from 21° to 23° would be sufficient. That the temperature of ignition of oils in the oil reservoir of a lamp, or when determined by Abel's apparatus, only show slight differences as stated by Thoerner, both his own experiments, as well as those of R. Weber and of the Berlin officer of health disprove, differences of 7—10° having been observed on an average. This difference is chiefly due to the relation existing between the empty space in the reservoir and that occupied by the oil. An Abel's apparatus filled with 30cc. of various oils gave flashing points from 4° to 11°·5 above those obtained when the apparatus contained 75cc. (the normal amount) of these oils. The greater the relative volume of air, both in Abel's apparatus and in lamp reservoirs, the higher appears to be the flashing point. The harmless nature of the explosions in oil lamp reservoirs, as commented upon by Thoerner, has been thoroughly investigated by Weber, who has determined the exact conditions under which the explosions may be either of a violent or of a mild nature. No appreciable change appears to take place in the composition of an oil before and after the burning of a portion. This confirms Thoerner's results. The diminution in the illuminating power of a lamp after it has burned for some hours is due, as Thoerner found, to (1) the deposition of carbon on the wick, and (2) the greater distance through which the oil has to rise as its consumption continues. The former is the prime cause, and is diminished to varying extents by an increased supply of air. This diminution of the illuminating power of a lamp increases with the amount of heavy oils present. The rate of rise of an oil in the wick is independent of its specific gravity, except for different portions of one and the same kind of oil. It is directly dependent upon the viscosity of the oil. The author then remarks on the necessity of testing the illuminating power of oils by means of those lamps best suited for them, and *vice versa* in testing different forms of lamps to use those oils for which they are most applicable.—C. A. K.

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* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.........	½d.
Above 8d., and not exceeding 1s. 6d...	1d.
„ 1s. 6d., „ „ 2s. 1d...	1½d.
„ 2s. 1d., „ „ 3s. 1d...	2d.

† See also this Journal, 1886, 180; and *Chem. Zeit.* 10, 1228, 1271, 1321.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Notes from Baku. Chem. Zeit. **10**, 1337.

ALTHOUGH large quantities of petroleum are still obtained from the Baku region, it appears nevertheless that the yield is steadily decreasing, and that in four or five years it will hardly suffice to supply the Russian demand alone. Borings are now made to depths of 100—150 fathoms where formerly the oil was reached at 40—45 fathoms. In some cases borings right through the oil containing strata on to the underlying volcanic rocks (300 fathoms) have failed to produce oil. Boring is nevertheless continued, although the price of oil, owing to the market being overstocked, is practically nothing. The price for crude naphtha on the spot is less than a half-penny per gallon, and for petroleum and kerosine of the best quality 2d. per gallon. The opening up of new localities for boring is contemplated, and the whole district between the greater and lesser Caucasus is believed to contain oil-yielding strata. The value of the Baku products could be considerably enhanced were capital and chemical knowledge at hand to effect improvements in the processes employed.
—C. A. K.

IV.—COLOURING MATTERS AND DYES.

Preparation of Ultramarine Blue in the Wet Way. F. Knapp. J. Prakt. Chem. **34**, 328—340.

IN a previous communication (this Journal, 1886, 238, and *J. Prakt. Chem.* **32**, 375) the author referred to the uncertainty of converting the ultramarine mixture into the blue product in the wet way, and expressed the opinion that the formation of the blue is dependent on conditions which are as yet unknown. On fusing, the ultramarine mixture assumes a yellow colour, which subsequently changes to a brown tone, indicative of the completion of the fusion process. These conditions are entirely altered if air is allowed to have access to the mixture, the brown colour of the product being again changed to a yellow shade, which cannot be distinguished from the original colour, so that it is difficult to determine the end of the operation.

The author has obtained a species of ultramarine blue in the wet way from silica (without alumina). The success of the preparation, however, depends on the nature and condition of the silica employed. The results obtained with finely pulverised quartz being unsatisfactory, the silica was used in the form of a gelatinous precipitate. For this purpose a solution of sodium silicate was treated with an acid, the washed precipitate mixed with sodium carbonate and sulphur, then dried and heated. The yellowish-grey product, when moistened with water or with "liver of sulphur" solution, gradually became blue, but the colour was not very permanent. Better results were obtained when the following method was used:—A weighed quantity of commercial soda water glass (containing one third of its weight of solid sodium silicate) was treated with seven parts of water and the theoretical amount of hydrochloric acid required to precipitate the silica. Owing to the dilution of the liquid the silica remained in solution together with the sodium chloride. The mixture was then treated with sulphur and sodium carbonate in equivalent proportions to the amount of silica contained in the solution. It is recommended to moisten the sulphur with alcohol before it is added to the solution, owing to the difficulty experienced in mixing it with the other ingredients. The mixture was then dried and heated for about forty minutes at a dull red heat. A yellowish-grey mass was obtained which gave the deep blue of ultramarine on digestion with a solution of "liver of sulphur." The product was, however, more soluble in water than the blue obtained with a mixture of kaolin, soda, and sulphur.

Alumina yields a species of ultramarine blue which closely resembles the product prepared from silica. The behaviour of alumina in the presence of sodium carbonate and sulphur is, however, essentially different. On heating a mixture containing equal parts of alumina (in a gelatinous form), sulphur and sodium carbonate, sulphur is freely expelled and a white mass obtained, which consists mainly of sodium aluminate. The opposite result is obtained when the alumina is converted into the aluminate before it is mixed and fused with sulphur and sodium carbonate. Whilst on saturating a solution of soda with alumina in the cold, three atoms of Na_2O are taken up, only one atom is fixed when the mixture is heated to redness.

In conclusion it is stated that common salt may be permanently tinged blue with sulphur alone. It is also shown that it is possible to obtain a colour resembling ultramarine blue from substances having no direct bearing on the chemical constitution of ultramarine. Thus on heating a mixture of calcium phosphate, sodium carbonate and sulphur, a good medium blue is obtained. It is a remarkable coincidence that on mixing tricalcium phosphate with a concentrated solution of freshly ignited "liver of sulphur," the mixture gradually assumes a blue colour in the cold.—D. B.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Vegetable Silk from Cameroons. Chem. Zeit. **10**, 1335.

THE seeds of a species of *Cochlospermum* are surrounded with a covering of fine hairs, which are, however, too brittle and too loosely attached to render them of any importance for weaving purposes, even if mixed with other fibres. This is also the case with the hairs found on the seeds of several other plants (*Chem. Zeit.* **7**, 406). It is suggested that these hairs might be made use of in stuffing cushions, etc., or in twine making. These fibres are coloured faint red by phloroglucinol and hydrochloric acid, with aniline sulphate faint yellow, and are, accordingly, slightly lignified. The colour of a considerable portion of the fibres is somewhat yellowish, the lustre not insignificant (see this Journal, 1886, 642).
—C. A. K.

Improvements in the Treatment of Animal Fibres or Mixed Fabrics to remove Vegetable Matters therefrom. O. Chemin. Eng. Pat. 564, Jan. 13, 1886. 6d.

THE inventor substitutes hydrofluoric acid for the hydrochloric acid gas employed by other inventors.—E. J. B.

VII.—ACIDS, ALKALIS, AND SALTS.

Ignatjewite, a new variety of Aluminite. K. Flug. Chem. Zeit. **10**, 1291.

SPECIMENS examined obtained from Bachmut (Ekaterinoslaw, Russia), in the form of colourless kidney-shaped concretions, resembling kaolin or chalk in appearance. An analysis given shows the presence of 36·39 per cent. total Al_2O_3, more than half of which appears to be present as hydrate. The importance of this mineral for the preparation of aluminium sulphate and alum is remarked upon by the author.—C. A. K.

Eubœan Magnesite. A. Christomanus. Chem. Zeit. **10**, 1337.

A VERY pure magnesite, containing, according to analysis, 94·46 per cent. $MgCO_3$. The deposits are large, but localised.—C. A. K.

Notes from Baku. Chem. Zeit. **10**, 1337.

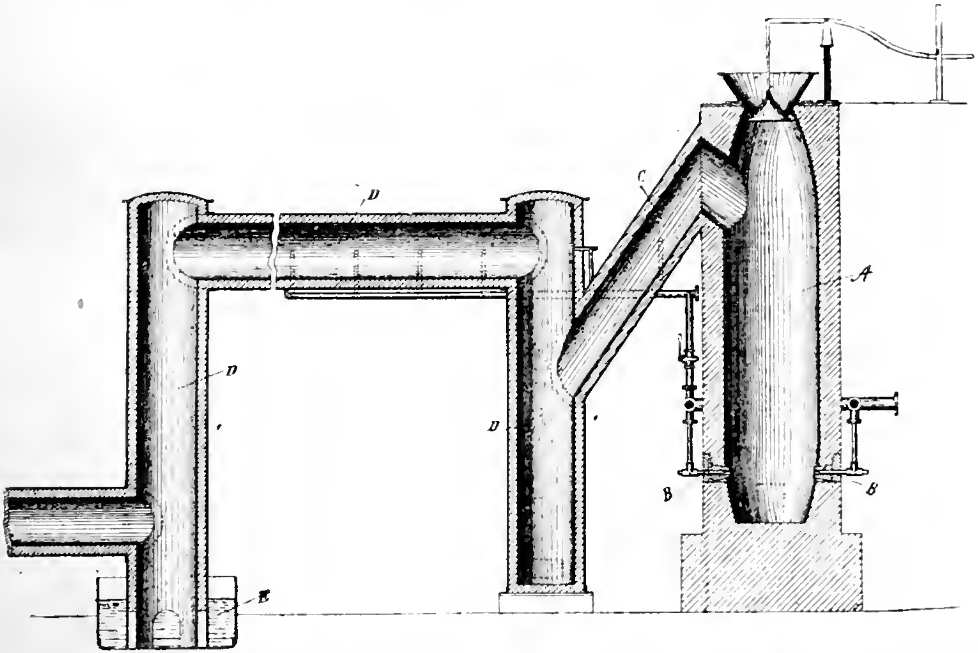
THE manganese ores obtained from this district (Kwirilskaja, Beschatuban, and Tiflis) are so plentiful that only the good and large pieces are considered worth the transport. The competition is very keen, the ore being almost wholly exported to England and France.
—C. A. K.

Improvements in the Manufacture of Alum and Sulphate of Alumina. T. Robinson, Glasgow. Eng. Pat. 150, Jan. 5, 1886. 6d.

The calcined alum yielding material is treated with sulphuric acid in the usual manner for obtaining a solution of aluminium sulphate. Sufficient calcium sulphide, in the form of Leblanc vat waste, is then added to neutralise any free acid and precipitate arsenic and other impurities. The "yellow liquor" from the vat waste may be substituted for solid calcium sulphide. —S. H.

An Improved Process for the Production of Sulphurous Acid Gas. John and James Addie, Langloan, N.B. Eng. Pat. 180, Jan. 5, 1886. 8d.

This invention consists of a process for the production of sulphur dioxide from pyrites or other sulphur compounds, wherein the sulphur, in combination with a metal, is replaced by silica, or other slag-producing material, and being thus liberated, is oxidised by a blast of hot or cold air. A small blast-furnace or cupola A is heated to a white heat, and then charged with a mixture of pyrites and sandstone, siliceous limestone, or other slag-producing material. A hot blast is directed into the furnace through the tuyères B, by which the mixture is reduced to the molten state, the sulphur being set free and carried upwards, together with some sulphurous acid formed, while the silica, combining with the iron, forms a slag, which is run off from time to time. In the upper part of the furnace, which is closed with a hopper-charging arrangement, or into the brick-lined tubes C and D, a blast of hot or cold air is directed, in order to completely burn the sulphur, which rises in a finely-divided state from the heated materials below. In connection with the pipe D, is a water lute E, which serves as a safety valve in the event of excessive pressure of the gas.—S. H.



Improvements in the Manufacture of Bicarbonate of Soda and Soda-Ash. N. Mathieson and J. Hawliczek, Widnes. Eng. Pat. 227, Jan. 6, 1886. 6d.

This invention has for its object the manufacture of either pure bicarbonate or of pure monocarbonate of soda direct from the crude "vat-liquor," or "red liquor," or "black ash," all of the Leblanc process, or from a solution of crude sodium sulphide, or from the crude sodium bicarbonate of the ammonia-soda process. If to a solution of chlorides or sulphates of an alkali there be added a solution of crude sodium carbonate, and the mixture be submitted to the action of carbonic acid gas, pure sodium bicarbonate is precipitated in a crystalline form. In practice vat-liquor is mixed with a strong solution of sodium chloride, or the black ash is directly lixiviated with brine and the mixture, obtained in either way, treated with carbonic acid. This treatment resolves itself into two stages—viz., the purifying and the carbonating process. In the first instance, the carbonic acid acts first on the crude liquors by precipitating alumina, iron, and silica. The solution is then filtered, and the clear liquor subjected to the further action of a current of carbonic acid gas, when pure sodium bicarbonate is precipitated. At this second stage, the sulphides and cyanides present are also decomposed, with the evolution of sulphuretted hydrogen and cyanogen. After washing, the bicarbonate is nearly chemically pure, and is either by drying converted into marketable sodium bicarbonate, or by calcining into pure monocarbonate. The liquor remaining consists mainly of sodium chloride, and can be used over and over again for lixiviating fresh black ash. To make pure bicarbonate from crude sodium bicarbonate (from the ammonia-soda process), the latter is dissolved in a solution of sodium chloride or sulphate, and subjected to the action of carbonic acid, whereby pure bicarbonate is precipitated. If a crude sodium sulphide solution be treated with carbonic acid in the manner previously mentioned, sodium bicarbonate is precipitated and sulphuretted hydrogen is evolved.—S. H.

Improvements in the Manufacture of Carbonates or Bicarbonates of Sodium or Potassium from their Sulphates. W. Bramley, Middlesbro'-on-Tees. Eng. Pat. 1050, Jan. 23, 1886. 6d.

Barium sulphate is reduced with coal to sulphide, and the latter treated with an excess of hydrochloric acid, so as to form barium chloride. To this solution magnesia, hydrate of magnesia, or hydrated magnesium carbonate is added, and carbonic acid, preferably under pressure, injected into it. The mixture is then heated and agitated in order to complete the reaction and drive off the excess of carbonic acid. Barium carbonate is thus precipitated, magnesium chloride being in solution. This solution is separated from the precipitate and treated for the recovery of the magnesia for further use and the production of chlorine and hydrochloric acid. The barium carbonate, after washing, is treated with a solution of sodium sulphate, or potassium sulphate, and carbonic acid gas is injected. Sodium or potassium bicarbonate is formed in solution and barium sulphate precipitated. For the decomposition of the bicarbonate and formation of sodium or potassium carbonate, magnesia is added to the solution in a closed vessel which is heated and agitated. The magnesia is rapidly converted into hydrated magnesium carbonate, which should be employed as previously described. The barium sulphate, after washing, also re-enters the cycle of operations.—S. H.

Improvements in Preparing Soda for Sale and Distribution. J. Mactear, London. Eng. Pat. 1989, Feb. 11, 1886. 4d.

Monohydrated or decahydrated sodium carbonate in a granulated state is compressed in suitable moulds so as to form tablets, cakes, or blocks of convenient size and weight. The most convenient shape is the rectangular form, allowing a number to be packed together without waste of space. The moulds may be arranged to impress a trade-mark on the blocks.—S. H.

Improvements in Apparatus for Distilling Ammoniacal Liquor for the Purpose of Producing Sulphate of Ammonia. A. Dempster, Yorkshire. Eng. Pat. 3220, March 8, 1886. 8d.

See this Journal, 1886, 379—381. This is an amended specification, made by merely deleting the fifth claim in the former specification, *loc. cit.*—W. S.

Producing Hyposulphite of Soda (Sodium Thiosulphate). T. Raynaud, Namur, Belgium. Eng. Pat. 12,255, Sept. 27, 1886. 6d.

Sodium hyposulphite is obtained by the action of sulphur dioxide on sodium sulphide, thus: $2Na_2S + 3SO_2 = S + 2Na_2S_2O_3$. The sodium sulphide solution required for this purpose is produced by the reduction of sodium sulphate with coal. This mass contains besides sodium monosulphide, the polysulphides, carbonate, hydrate, and sulphate of soda, together with hyposulphite of sodium (thiosulphate). The former by-products are not converted by sulphur dioxide into sodium hyposulphite, thereby forming a troublesome impurity in the solution during the process, and causing a loss of soda. The invention has for its object the treatment of the crude solution of sodium sulphide in such a manner that all the various compounds, except the sulphate, are converted by sulphurous acid into hyposulphite. This is effected by the addition of lime and sulphur, the former causticising the sodium carbonate, which is then acted upon by the sulphur, forming sodium sulphide.—S. H.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

On the Causes of the Weathering of Building Stones. T. Egleston. Dingl. Polyt. J. **262**, 190—191.

The results of Professor Egleston's researches are communicated in a paper read before the American Society of Civil Engineers. He finds that under favourable climatic conditions granite is practically unaffected. But the influence of unfavourable conditions is evidenced by the present state of the Egyptian Obelisk in the Central Park of New York, which, after 2000 years exposure to the dry climate of Egypt, was yet free from deterioration, whilst only five years in New York has sufficed to bring about a rapid decay. Sandstones vary in their weather-resisting power according to their binding medium, those containing a siliceous medium being the most stable, those with lime, oxide of iron or organic matter being less so in order of sequence. Of limestones, pure calcium carbonate and pure dolomite are best. In mixtures of the two there is a fear of disintegration by the solution of the calcium carbonate from among the particles of dolomite. The greater degree of weathering observed in blocks close to the surface of the earth in large towns is due to the impregnation of these portions by water rising from below, and thrown upon them by water courses from above, since the damp stones are more affected by the acid atmosphere near the ground than they would be when dry. Moreover, at greater elevations the deleterious effects of the acid constituents are minimised by dilution with much free air. The author finds also that the wind laden with dust (mainly consisting of sharp sand particles) beating against the buildings causes a gradual surface wear. No stone, however hard (not even the diamond), was found capable of resisting the action of the sand blast, though but for a short time. He has observed, also, that in cemeteries the letters graven on the tombstones are frequently illegible where they are exposed to the prevailing wind of the place. Finally, Egleston emphasises the necessity for extreme care in the selection of building-stones, and in the arrangement of cornices and water ducts in such manner that the water may not fall or collect largely upon any portion of the stone work.

—W. G. M.

An Improved Cement or Composition for Various Purposes. J. Bidwell and A. Bidwell, Axminster. Eng. Pat. 517, Jan. 13, 1886. 6d.

To produce a cement which, when dry, will burnish to a bright gold or silver colour, the patentees mix white coburg, copal, mastic, and white hard varnish with zinc white, bisulphide of tin, and powdered Dutch foil; or when a silvery lustre is required the Dutch foil is replaced by silver powder.—C. C. H.

X.—METALLURGY, Etc.

On the Blue-shortness of Iron and Steel. Professor A. Ledebur. Dingl. Polyt. J. **262**, 166—169; and Glaser's Ann. 1886, 208.

For the sake of uniformity in nomenclature, the author proposes to term "blue-shortness" that sudden increase in the brittleness of iron occurring at the temperature (250—350°) at which the metal assumes a blue colour. Whilst red- and cold-shortness may be ascribed to the presence of certain well-known substances, blue-shortness, though doubtless increased by certain kinds of foreign matter, appears to be common to all varieties of iron and steel, but chiefly, it would seem, to the latter. Valton (*Berg. u. Hutt. Zeit.* 1877, 25) was the first to observe this phenomenon, and Huston, Walrand, and others have continued the investigations. From these it would appear that at the temperature named (Kollmann would place the critical point at 500°) the metal, though, perhaps, unaffected as to actual strength, becomes far less ductile, this property being restored at a somewhat higher temperature. Metal forged, bent, or worked under these circumstances is liable to form cracks which defy any but the most careful inspection to discover, but which, under suitable conditions, may be developed into very serious flaws. By the light of these experiments, many otherwise unaccountable occurrences may be explained. By way of illustration a case in point is given. A pump rod for a mine was rolled from Bessemer iron made from best pig, and was found to stand a satisfactory test both for ultimate strength and elongation. After a short time several lengths of the rod gave way. A careful examination of the fractured portions showed circumferential cracks extending inwards (in some cases covering half the cross-sectional area) with smooth sides, on which there was here and there observed a distinct blue colour. Chemical analysis demonstrated a good metal for the required purpose; somewhat high, it is true, in arsenic (0·048 per cent.) and antimony (0·045 per cent.), but not sufficient to impair the working properties of the metal at a red-heat; for it was proved that the iron was not in any degree red-short, nor was there difficulty in welding it. The simplest explanation of the occurrence is that the metal was worked at that temperature at which it is more brittle than when cold or red-hot: the cracks thus formed under the hammer would be developed by the shrinkage during subsequent cooling. Further experiments to ascertain the influence of foreign substances on the blue-shortness of iron and steel are greatly to be desired.—W. G. M.

On the Martin Process with exclusive or preponderating use of Pig-iron and Ore. J. v. Ehrenwerth. Zeits. f. Berg. u. Hüttenw, **34**. 656.

FROM the experiments quoted the following conclusions are drawn:—1. The ores do not act directly but chiefly by the agency of the slag. 2. By the increased amount of slag from the exclusive use of pig and ore the heat of the bath is diminished, and the time of duration of a charge lengthened, and thus the lining is more strongly attacked, demanding more repairs, especially since the slag is rich in oxide of iron. 3. The reaction between the slag and the iron is accelerated at high furnace temperatures, and the charge is thus worked off more rapidly. 4. This process is much more dependent on the working temperature than is the ordinary process. 5. The ore should be supplied in small pieces, which will rapidly dissolve in the slag, rather than in lumps or briquettes of pig-iron and ore. 6. An ore of low oxidation is preferred because a larger amount may be used, thus leading to a higher yield of iron, but otherwise the degree of oxidation is of no importance. A great excess of slag with its attendant evils may be in part avoided by rapidity of work, by the use of high-class refractory materials and suitable fluxes, and by tapping the slag when its action is completed. In cost of working, this process, rightly carried on is at least on a par with Bessemer's, whilst in regularity of production, floor space required, absence of blast, and for low carbon metal, is actually superior to it.—W. G. M.

Improvements in the Preparation of Materials for, and in the Manufacture of, Cupels and Tests. F. Maxwell Lyte, Putney. Eng. Pat. 10,185*, August 27, 1885. 6d. (Amended Specification.)

THE amendment consists in an alteration in the title of a specification abstracted in this Journal for 1885, page 538.—W. G. M.

Improvements in Steel Converter Linings and Bottoms. A. E. Tucker, Birmingham. Eng. Pat. 14,507, Nov. 26, 1885. 4d.

BASIC Bessemer slag, alone or mixed with lime or iron oxide, cast into blocks, rammed into bricks, or used as a slurry, may be employed with advantage for lining the body and top sections of steel converters, or either copper, lead and glass furnaces or iron cupolas.
—W. G. M.

Improvements in Separating the Precious Metals from Lead. T. J. Greenway, Sheffield. Eng. Pat. 1027, Jan. 23, 1886. 6d.

THE "zinc skimmings" from the zinc desilvering process are first liquated in the usual way to separate the excess of lead; if the resulting metal contain less than seventy-five per cent. of lead, it will on fusion separate into two layers, of which the upper will be an alloy of sixty per cent. zinc, with over twenty per cent. precious metals and less than six per cent. lead, and the lower will be lead saturated with this alloy. On cooling, the argentiferous zinc first solidifies, and is to be removed, broken up, and retorted. The lead bath during cooling gives up a further quantity of the zinc alloy in the form of crystals, which may be treated in the same manner as the zinc crust.—W. G. M.

Manufacture of Refractory Bricks, Tiles, Tubes, Crucibles, Furnace Linings, and other Articles subjected to High Temperatures. A. Fould and P. Genreau, Nancy, France. Eng. Pat. 1243, Jan. 27, 1886. 6d.

CERTAIN modifications are described, but the method preferred by the patentees is to incorporate thoroughly calcined dolomite in the form of powder with eight per cent. of an agglomerant, made by fusing "molecular" weights of calcium, magnesium, or sodium chloride, or of cryolite with "equivalent" weights of calcium or sodium carbonate, or of lime: this mixture to be then, if necessary, recalcined to expel all traces of water and carbon dioxide, afterwards pressed into the required shape and fired for four hours, when it will have become hard, and may, if in a covered place, be preserved long in air without deterioration. During the firing, unless before moulding the ingredients have been fired at a white heat, some shrinkage will occur. Lime, magnesia, or alumina may be used instead of dolomite, provided care be taken to expel the whole of the carbon dioxide and water before moulding. The agglomeration may also be effected by slaking the base with a solution of chlorides, and subsequently calcining thoroughly.—W. G. M.

Improvements in the Purification of Iron, and of Phosphatic Ferruginous Slags. T. Twynam, London. Eng. Pat. 1796, Feb. 6, 1886. 6d.

THE melted pig iron is run into a reverberatory furnace with basic or neutral lining, and there treated with basic slag, the metallic oxides of which are reduced by the metalloids of the pig. When the iron is so rich in silicon that the slag will finally contain more than twenty to twenty-five per cent. of silica, phosphoric acid will be reduced, the phosphorus passing into the metal: in this case the siliceous slag must be tapped off and fresh slag added, or if preferred the desiliconised iron may be treated by the Thomas-Gilchrist or Siemens process.—W. G. M.

Improvements in the Smelting of Tin Ore and Recovering Tin from Tinned Sheet Iron Scraps. G. T. Lewis, Philadelphia, U.S.A. Eng. Pat. 3138, March 5, 1886. 8d.

THE tin ore is smelted in a cupola furnace, from which the gases, containing much volatilised tin, are sucked by a fan through sheet-iron cooling chambers, and then forced through a series of woollen bags which intercept the tin compounds. The latter may subsequently be treated in any suitable way. The temperature of the furnace, more especially if tin scrap be under treatment, should be high, in order to assist the volatilisation of the metal.—W. G. M.

XII.—PAINTS, VARNISHES, AND RESINS.

Improvements in the Manufacture of Paint. F. Wendling, Munich, Germany. Eng. Pat. 1086, Jan. 25, 1886. 6d.

IN order to prepare a washable paint able to resist atmospheric influences, the patentee forms a binding body by finely pulverising and mixing together the following substances:—about 30 parts of potash or soda water-glass, 15—25 parts of fluoride of calcium, 10 parts of cryolite, between 15 and 10 parts of marble or silicate of magnesia, between 20 and 15 parts carbonate of lime, 10 parts phosphate of lime. 100 parts of colouring matter are thoroughly mixed with 200 parts of the binding body, and 1 part of this mixture is added to 2 parts of caustic potash with sufficient water to form the proper consistency. The paint is applied in the ordinary way. To harden the paint it is washed with warm water containing about 15 per cent. potash or soda water-glass.
—B. H.

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

Reinsch's Tanning Process by means of "Alkaline Coal Extract" (Pyrofuscin). Dingl Polyt. J. **262**, 79—83.

THIS new tannin, composed of carbon, hydrogen and oxygen, exists in almost all coal (except anthracite), but in varying quantities. Its chemical reactions have been partly studied by the author (this Journal, 1885, 392). Its stability, when acted upon by strong chemicals and light, distinguishes it from most humic acid bodies. It is extracted from suitable coal by a boiling alkaline solution, in which it is readily soluble, and from which the "pyrofuscin" is precipitated by a mineral acid. Pyrofuscin is a weak acid, its alkaline salts being easily soluble, and alkaline-earth salts less soluble. By evaporating the potassium and sodium salts, microscopic, indistinct rhombic crystals are obtained. On boiling with concentrated chromic acid solution a weak acid of yellow-brown colour is formed. Pyrofuscin is a very stable body; its dilute or concentrated solutions in alkalis remain unaltered in contact with the air; neither concentrated hydrochloric nor sulphuric acid attack the pure substance. On the other hand, boiling nitric acid converts it into a body soluble in water. The alkaline solution of pyrofuscin is very antiseptic. A very dilute solution (0·02grm. of the moist substance per litre) exposed to the long-continued influence of direct sunlight is not chemically altered or discoloured. The direct extract from coal obtained by frequent boilings of the coal with caustic soda (about 100grms. caustic soda to 2—3kilos. coal) contains at least 2—3 per cent. pyrofuscein, and has a sp. gr. of 1·025—1·03. A hide, after treatment with the pyrofuscin solution, is converted into leather. This leather has a stronger grain, and withstands alternate wetting and drying much better than alum or bark-tanned leather. If tanned sheeps' skins be laid for twenty-four hours in a 2—3 per cent. pyrofuscein solution, they are greatly improved as regards firmness and toughness. Hides intended to be tanned with pyrofuscein are unhaired with lime in the usual way, and then the lime is removed by a bran "bate." The hides are then soaked for two to three days in a pyrofuscein solution containing about 25grms. per litre, and afterwards placed in a solution containing about 40grms. per litre, to which is added sodium carbonate (10grms. per litre) and slaked lime (20grms. per litre), in which they remain three to five days. They are then laid in a solution of two parts by weight of common salt and three parts of magnesium chloride in sixty parts of water, to which is added twenty-four parts by volume of hydrochloric acid This solution neutralises the alkali and precipitates the pyrofuscein in the fibre of the hide. The hides are then washed, lightly oiled, and dried. This process is said to be 50 per cent. cheaper as regards time and material than bark-tanning, and 30 per cent. cheaper than alum.—B. H.

Improvements in the Manufacture of Leather. W. R. Earp, Runcorn. Eng. Pat. 2052, Feb. 12, 1886. 6d.

THE patentee claims the use of an alkaline solution of a sulpharsenate or sulpharsenite, disulpharsenate or disulpharsenite, preferably the sodium salts, or a mixture of them containing five to eight parts sulpharsenical salt to 100 parts of water for unhairing hides. He also claims the use of sulphurous acid, or a bisulphite, in tanning, and adds about a gallon sulphurous acid solution at 4½° Tw. to a tan-pit of average size.—B. H.

XIV.—AGRICULTURE, MANURES, Etc.

Action of Sodium Nitrate as a Manure. V. Magerstein. Bied. Centr. **15**, 581—583.

IN the experiments described, sodium nitrate was applied to potatoes, barley and oats, on a sandy soil, which had received a light dressing of superphosphate. In some cases the nitrate was mixed with the soil, in others it was used as a top dressing, after sowing the seed, and when the plant had sprouted. Potatoes and oats yielded best with the top dressing, whilst with barley the contrary was the result. The rainfall during the period of growth (April to August) was 347·7mm. somewhat below the average. The weight per bushel and the ash of both the oats and the barley were greater in the case of top dressing. The author gives an explanation of this behaviour of sodium nitrate. In the case of top dressing the nitre dissolves in the moisture of the soil, and forms a tolerably concentrated solution there. This comes first in contact with the shallower rooted barley, oats and potatoes. The conditions in the other mode of manuring are different, hence the different results.—D. A. L.

Comparative Manurial Experiments with Ammonium Sulphate and Sodium Nitrate. V. Magerstein. Bied. Centr. **15**, 583—585.

OATS and barley were grown on a diluvial sandy soil, with 200kilos. sodium nitrate per hectare, and with 300kilos. ammonium sulphate per hectare. The yield per hectare was as follows:—

	NO MANURE.		SODIUM NITRATE.		AMMONIUM SULPHATE.	
	Straw. Kilo-ctr.	Grain. Hectolit.	Straw. Kilo-ctr.	Grain. Hectolit.	Straw. Kilo-ctr.	Grain. Hectolit.
Barley	15·85	18·28	24·50	26·41	24·62	23·71
Oats	27·50	28·47	39·80	38·72	48·45	35·41

Ammonium sulphate on this light soil favours straw production, but nitrate is superior as regards grain. The percentage of ash in the barley straw was:—Unmanured, 6·605; with sodium nitrate, 6·151; with ammonium sulphate, 5·205. In the oat straw:—Unmanured, 10·016; with sodium nitrate, 8·123; with ammonium sulphate, 6·861. From a financial point of view the nitrate proved the best.—D. A. L.

Value of Chili Saltpetre as a Manure. A. Stutzer. Bied. Centr. **15**, 585—597.

THE present article is the first part of a prize essay, written for the Committee of Nitrate of Sodium Producers. The original treatise is divided into two parts. 1. Manuring with nitrogenous substances with special reference to sodium nitrate. 2. The practical application of sodium nitrate as a manure. The essay represents fully the present state of our knowledge of this subject, and is, therefore, of much interest. First, the absolute necessity of nitrogen to plant life is indicated; and, after due consideration of the question of the need of a store of nitrogen in the soil, the following conclusion is given: That no plant cultivated on farms will grow normally unless nitrogen is supplied through the roots. Without nitrogenous manure plants grow but feebly, therefore such manure becomes necessary; and as the manure produced on farms in by far the greater number of cases is not sufficient for the requirements of crops, if really a good harvest is sought, nitrogenous manures must be used. The numerous nitrogenous manures of commerce are mentioned, nitrate being selected as best, ammonium sulphate coming next. Then the conditions necessary for the formation of nitric acid in the soil are detailed. Nitrates being the only form of nitrogen immediately assimilable by plants, sodium nitrate is specially adapted for producing vigorous nutrition and growth of plants; then owing to its mobility in soil it acts as a manure to the subsoil, and causes the roots to penetrate into the soil, and so make better use of the moisture and nutritious matter contained in it. Loss of sodium nitrate by drainage is referred to. Numerous instances of the injurious action of large quantities of ammonium sulphate on plants are compared with the few instances of such injury by sodium nitrate; in fact, injurious impurities frequently present in ammonium sulphate are never found in sodium nitrate. The following table gives, in round numbers, the mean excess of the increase in yield obtained by the use of 100kilos. sodium nitrate when compared with the increase in yield from 75kilos. ammonium salts:—

			Experiments.
25kilos.		wheat grain and 100kilos. straw	88
50	,,	barley grain and 100kilos. straw	81
150	,,	meadow hay	28
200	,,	potatoes	36
900	,,	sugar beat	144
1700	,,	mangold...............................	36

The last column of numbers indicates the number of experiments from which the averages were obtained. The advantage of using phosphates and potash salts in conjunction with sodium nitrate is explained. The next point considered is the quality of the produce after the use of nitrogenous manures. With regard to oats and barley, the albuminoids in the grain are increased 1 per cent. This is beneficial for distilling and feeding, but undesirable for brewing purposes. The albuminoid increase in the straw is quite unimportant. The effect of nitrogenous manuring on the bread-making qualities of wheat requires investigating. Authorities disagree as to whether the weight of grain per bushel is or is not affected by such manures. The quality of potatoes is not altered to any noteworthy extent when nitrate is sown with the seed, but when it is applied as a top dressing there is a decline both in the yield of tubers and in the quantity of starch in them. Sugar beet is even more sensitive than potatoes to the action of sodium nitrate, when the known limits are exceeded ; directions for the cultivation of sugar beet are given. The idea that sodium nitrate impoverishes the soil is shown to be fallacious, for experimental evidence demonstrates that sodium nitrate only occasions a need of more plant nutriment in quantities necessary to supply the requirements of the increased barvest it itself produces ; but this produce is not richer than usual in mineral matters ; and, moreover, sodium nitrate does not aid the washing out and removal of important plant foods, and by that means impoverish the soil. Lawes and Gilbert show that barley grown with nitrate does not remove more matter from the soil than barley grown with ammonium salts. Numerous experiments show that on an average the amount of straw produced by nitrate is not excessive when compared with the total produce. Numerous calculations are given as to the relative value of sodium nitrate for different crops. With sugar beet, the 1st, 2nd, 3rd and 4th hundred kilos. of sodium nitrate, per hectare, each produce 2324kilos. of roots, the 5th and 6th hundred kilos. each produce only 975kilos. ; therefore, it is not economical to use more than 400kilos. of sodium nitrate per hectare. Experiments with oil-plants, pulses, fodder-plants, meadow grass and fibre-plants are too few to afford matter for positive generalisation, but it seems that the profits from nitrogenous manuring on meadow grasses are nil, while for rape they are very high. The comparative action on summer and winter crops requires investigating. According to the results of scientific investigation and practical experience, the following may be regarded as the average amount of increased produce by manuring with sodium nitrate in average quantities and under average agricultural conditions :—Corn crops, 300kilos. grain, 500kilos. straw; potatoes, 1200kilos. ; sugar beet, 2300kilos. ; and mangold, 4000kilos. ; for every hundred kilos. nitre used. Meadow grasses take up nitrogen as readily as corn crops, but the increase produced is not so valuable, since it takes as much manure to produce 100kilos. of grass as it does to produce 100kilos. of barley-corn ; therefore, it is only under very favourable conditions of soil and market that it would pay to manure meadows with sodium nitrate. The smallest return for nitrogenous manuring is offered by leguminous crops such as peas, vetches, lupins, clover, etc. With regard to other crops there are no trustworthy data, but from general experience rape, mustard, poppy, maize, millet, buckwheat, hops, tobacco, cabbages, flax, and hemp may be classed with corn crops ; the vine and all fruit and berry-bearing plants are also very sensitive to nitrogenous manurings. A lower but still considerable profit may be anticipated in return of manuring carrots, chicory, parsnips, wild cabbage, and artichokes with nitrate of soda. With regard to the use of this manure on very porous soils, it should only be used as a top dressing, the best time being when the plant is just appearing above ground ; it may, however, be put on at a later period of growth. The question of autumn or spring sowing is not yet definitely decided ; but it seems best to divide the allotted quantity of nitrogenous manure, putting the smallest lot on in the autumn, and the larger lot in the spring, at any rate the nitrogen required for the winter growth of crops may, without hesitation, be applied in the form of nitrate of soda.—D. A. L.

Ammonia in Turnips. L. Battut. Bied. Centr. **15,** 604—607.

When turnip juice or slices of turnip are distilled with calcined magnesia (Boussingault's method), ammonia is given off. Juices from different turnips yield per 100grms. of root, 2·37, 1·67, 5·00, 1·53, 1·28mgrms., or a mean of 0·00215grm. ammonia. Fresh root cuttings give 0·9, 1·69, 0·97mgrms., or a mean of 0·0012grm. ammonia. Roots dried at 100—110 give more ammonia than fresh roots, evidently owing to the decomposition of organic matter. The following results show that, besides ammonia, the roots contain easily decomposable nitrogenous matter. Some fresh root gave, by the above method, 0·00169grm. ammonia ; the residue treated with lime-water, and the original volume made up with water, then distilled as before, gave a further 0·0204 per cent. of ammonia ; and this residue, in its turn, treated with potash, etc., and distilled, yielded a further 0·0061 per cent. ammonia. Pellet and Morchais suggested that the ammonia was present as ammonium magnesium phosphate, and therefore recommend treating with nitric acid before distilling with magnesia ; this treatment is, however, evidently quite inadmissable in the presence of such decomposable substances.—D. A. L.

Manurial Experiments with Oats. Bied. Centr. **15,** 642—643.

These experiments demonstrate that when the manures contained nitrogen, phosphoric acid and potash, or nitrogen and phosphoric acid, the plants were darker in colour, the straw longer and more perfect in grain ; but took eight days longer to ripen than in the following cases. With phosphoric acid and potash manures the plants at first showed no difference, but later on the green corn was more yellowish, and ultimately the straw was weak. Unmanured plants were worse than the others in all points, and had to be harvested earlier. The money value of the increase in yield in each case was :—With sodium nitrate, superphosphate, and potash, 93·38 marks (about £4 13s. 4d.) ; with sodium nitrate and superphosphate, 66·64 marks (about £3 6s. 7d.) ; with a moderate quantity of superphosphate and potash, 41·62 ; with larger quantity superphosphate and potash, a deficiency of 1·42. Potash manures made least show ; probably the soil contained sufficient already.—D. A. L.

Composition of Barley and Peas. Klien. Bied. Centr. **15,** 644.

The author has observed a decrease in the amount of albuminoids in barley and pea-corn, when grown on a sandy soil poor in lime, with large quantities of superphosphate. On the other hand, this was not observable when such soil was heavily dressed with precipitate (neutral phosphates), nor in the case of a soil rich in lime, even when ten times as much superphosphate was applied. Moreover, on a phosphorite soil, containing 20 per cent. of phosphoric acid, the amount of albuminoids in peas was not less than when they were grown with a slight dressing of phosphatic manure. Wagner found on a sandy soil poor in lime, heavily manured with superphosphate, that the albuminoids increased in straw and green plants, but decreased in grain and seed. It is hence inferred that the traces of free mineral acid, and not the great excess of combined phosphoric acid in the soil, impede the migration of the albuminoids in such cases.—D. A. L.

Disintegration of Basic Cinder by Exposure to Air. Edmund Jensch. Chem. Zeit. **10,** 1271—1370.

The author's experiments prove that during the disintegration which Thomas-slag undergoes by exposure to damp air, the phosphoric acid of the slag becomes more and more soluble in alkaline citrate ; so that after the lapse of, say, one year in contact with moist soil, it may be supposed that the whole of the phosphoric acid of the slag will be converted into a form in which it is immediately assimilable by plants.—J. M. H. M.

The Solubility of Thomas-slag. M. Maltzan. Chem. Zeit. **10**, 1337–1338.

The author criticises the papers of Reis and Meyer (this Journal, 1886, 381) on the solubility of Thomas-slag in aqueous solutions of carbonic acid, and holds to his statement that this slag "contains phosphoric acid in the most insoluble form conceivable." According to Reis' experiments, 22·839grms. of a saturated aqueous solution of carbonic acid are needed to dissolve 1grm. of phosphoric acid from Thomas-slag. One of Meyer's experiments gives a solubility of 1 in 34,000 in fifty hours. Considering that 2936 parts of a saturated aqueous solution of carbonic acid dissolve 1 part of phosphoric acid in artificially prepared tricalcium phosphate in ten hours, and that the solubility of the phosphoric acid in bone-ash is 1 in 13,158, and of that in bones buried for twenty years 1 in 7299, the author considers the experiments referred to to be decidedly in support of his statement.

—C. A. K.

On the Valuation of Slag from the Thomas Process, according to the fineness of the Ground Product. M. Fleischer. Rep. Anal. Chem. **6**, 673–681.

It is now well understood that the value of this slag, both for meadow-land and tilled fields, depends upon the fineness with which it is ground; and hence it is important in purchasing it that the fineness or percentage of fine-ground slag should be specified. It is usual in many places to stipulate that at least 75 per cent. should pass through a sieve the holes of which are 0·25mm. broad; but the results obtained by sifting specimens of the same slag often vary considerably, this being due to differences in the kind of sieve employed. The writer has been in the habit of using a sieve of sheet-metal in which holes of 0·25mm. in diameter were punched; whereas, at other places, wire sieves are employed, the distance between the wires being 0·25mm. In the former case, the area of the opening is 0·049sq. mm., in the latter, 0·063. He has carefully investigated the manner in which the determination is affected by (1) the nature of the sieve, (2) the duration of the shaking, and (3) the weight of the sample taken for sifting. Sieves with punched holes are unsuitable for the purpose, as the holes soon get stopped up; but the brass-wire gauze does well, and is very uniform. The particular kind of gauze selected was that known as No. 100; the distance between the meshes of this is 0·168mm., and the area of the holes 0·028sq. mm. The following method of estimation is recommended:—

The whole of the sample is weighed, and first sifted through a coarse sieve so as to remove the particles over 1·5mm. in size; these are weighed and allowed for afterwards. From the coarsely-sifted slag a sample of 50grms. is taken and shaken for half-an-hour in a sieve made of No. 100 wire-gauze. The residue is weighed, and the difference between this and 100 gives the required percentage—weighing the sifted slag gives too low a result, as some of the fine dust is always lost. Samples should contain at least 75 per cent. of "fine-ground slag," for although the sieve above recommended is finer than those at present used, the grinding of the slag is now more carefully carried out than was formerly the case.

The following example will show what compensation should be paid in case the slag does not come up to the specified degree of fineness. Suppose that 10,000kilos. of slag are sold for 360s., 20 per cent. of phosphoric acid and 90 per cent. of "fine-ground slag" being guaranteed. This corresponds to $\frac{9000 \times 20}{100} = 1800$kilos. of phosphoric acid in the "fine-ground" for 360s., or 1kilo. of fine-ground phosphoric acid for 0·20s. If the slag is found to contain only 19 per cent. of phosphoric acid and 80 per cent. of "fine-ground," the quantity of fine-ground phosphoric acid is only $\frac{8000 \times 19}{100} = 1520$kilos., the value of which is 304s. Hence, 56s. should be paid as compensation.—D. E. J.

XV.—SUGAR, GUMS, STARCHES, Etc.

Raffinose. E. von Lippmann and others. Bied. Centr. **15**, 630–636.

This is a resumé of the numerous researches of various authors, which have appeared from time to time, and have culminated in establishing the identity of the sugar obtained from molasses, from cotton seed, and from Eucalyptus-manna, now known as "raffinose." Raffinose exists as such in the original root; in the strontium hydroxide process it separates along with the cane sugar, as a saccharate; in the diffusion process it is the cause of the formation of needle crystals. Tollens has examined solutions containing, for 100 of cane sugar, 1, 3, 5, 7, 9, 12·5, and 25 per cent. of raffinose. When these solutions are crystallised, those containing 1 per cent. deposit unaltered cane sugar, those containing 3 and 5 per cent. give elongated crystals, the 7 per cent. gives long needles, whilst the 9 to 25 per cent. solutions also yield needles, but only after some months. When the mother-liquors from the crystallisation of the 1—3 per cent. solutions are diluted, beautiful long needles gradually separate. Raffinose is hence regarded as favouring the formation of molasses, or in other words, impeding the crystallisation of sugar to a certain extent. Raffinose, $C_{36}H_{64}O_{32} + 10H_2O$, crystallises in needles with 15 per cent. of water, which can be expelled, if care be taken, without fusing the sugar. It is very soluble in water, but only very sparingly in strong or dilute alcohol; from the latter it can be readily crystallised. Raffinose only reduces Fehling solution after inversion, and then very strongly. The specific rotation of raffinose (α) D=104—105°, after 1 hour's inversion is reduced to (α) D=about 53°, and levulose is found in the syrup. After 5 hours' inversion it is only (α) D= about 20°, and galactose may be obtained from this syrup. Heated with nitric acid, raffinose yields 22—23 per cent. of mucic acid; hence, the above formula is probably correct; with sulphuric acid it yields levulinic acid. With phenylhydrazin it yields a yellowish precipitate, after 1 to 2 hours' heating. Raffinose, either before or after inversion, ferments easily and completely with yeast and solutions containing the nutritive substances for the yeast, with the formation of alcohol. It forms a sodium compound, and like cane sugar a strontium compound in hot solutions. It differs from cane sugar in not forming with smaller quantities of strontium, or in cold solutions, a mono-strontium compound. These two sugars may be separated by means of this reaction. Raffinose also forms a calcium compound. For the estimation of raffinose two methods are proposed, one based on polarisation and inversion, the other on the formation of mucic acid, by means of nitric acid. Raffinose has been detected in barley by C. O'Sullivan.

—D. A. L.

On the Production of Crystallised Grape Sugar. Seyberlich and Trampedach. Neue Ztschr. f. Zuckerind, **17**, 186.

The authors find that grape sugar crystallises from acid or neutral solutions only in fine interlaced needle-shaped crystals, retaining obstinately much mother-liquor; whilst from alkaline solutions it may be obtained in smooth, strong plates, free from water, from which the liquor may be readily separated centrifugally. They, therefore, obtain a sugar of 96 to 98 per cent., by converting 1 part of starch, rubbed down with 2 to 3 parts of water, by nitric acid (5 parts to 1000 parts of starch) until 10 drops of the solution give no turbidity with 20cc. of 96 per cent. alcohol; then neutralising with chalk and rendering distinctly alkaline by soda, evaporating *in vacuô* to 35—36° B., and cooling slowly. The separated syrup may be evaporated and again crystallised, when, after adding sulphuric acid, and separating the resulting calcium sulphate, since it contains practically the whole of the nitric acid in the free condition, it may be employed for converting a fresh portion of starch. If sulphuric acid be used for the conversion, in addition to the soda, there must be added a small quantity of hydrogen peroxide to oxidise the albuminous bodies contained in the starch.—W. G. M.

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* Gmelin-Kraut. Anorg. Chem. II. 1, 368.

Determination of the Decolourising Power of Animal Charcoal. G. Laube. Rep. Anal. Chem. **6**, 660—661.

THIS is a simple process, yielding good comparative results, to avoid the costly apparatus usually employed in sugar factories. A sample of good animal charcoal is obtained, bad pieces in it being carefully picked out, ground, and then passed through a fine sieve. The powder is dried at 110° C., and is then kept as the "*standard char.*" 50—100cc. of good caramel are dissolved in an equal volume of water, mixed with 100cc. alcohol, and then made up to a litre: after standing for several days, it is filtered, and is ready for use as the "*standard colour.*" The decolourising power of the powdered "char" is determined by gently boiling 5grms. of it with 200cc. water, and then adding 10cc. of the "standard colour" solution. The boiling is continued for exactly 10 minutes, under an upright condenser. The liquid is then passed through a double filter until the filtrate is quite clear. Some of the standard colour solution is then run into 200cc. water, from a graduated pipette, until the water has exactly the same tint as the above filtrate. The tints are rendered more distinct by the addition of a drop of caustic soda, and the comparison should be made in test-tubes of equal diameter, as in Nesslerising. 10cc., less the number of cc. added in the second experiment, gives the number of cc. of "standard colour" solution, which has been decolourised by the 5grms. of standard "char." By repeating the experiment under exactly the same conditions with any other "char," its decolourising power, compared with that of the standard sample, can be readily determined. As the fineness of the powder influences the result, the same sieve should always be used for the experiments.—E. E. B.

On the Decolourisation and Purification of Sugar Juice by Hyposulphurous Acids, or its Salts. R. Englert and F. Becker. Ger. Pat. 36,851, Jan. 31, 1886.

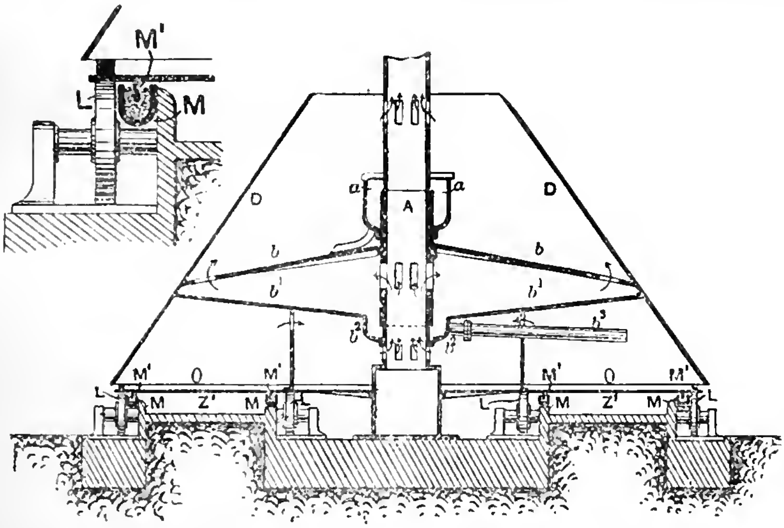
THE hyposulphurous acid with the formula, H_2SO_2, may be produced by mixing an excess of iron filings or zinc dust with aqueous sulphur dioxide solution, with exclusion of air and thorough cooling. The resulting reaction is thus expressed :— $2SO_2 + 2Zn + H_2O = SO_3Zn + SO_2Zn + H_2$. By adding milk of lime, the comparatively insoluble calcium sulphite is precipitated, and by the subsequent addition of phosphoric, oxalic or sulphuric acids, the required acid is obtained in the free condition. To prepare salts of the acid, the solution of the zinc salt should be mixed with the base to be employed, if by its action zinc oxide can be separated. The salts suitable for use in the clarification process are those of the alkali earth metals, magnesium, aluminium, zinc, manganese and iron; and these, being more stable than the free acid, are to be preferred. In practice, two to three parts of one of the salts suffice for the treatment of 1000 parts of the juice; it is thus four times more efficacious than calcium sulphite. In treating raw juice by this process, the following course is recommended:—1st saturation: The juice is mixed with 2—3 per cent. of lime, warmed and saturated with carbon dioxide to 0·10 of alkalinity, and the precipitate removed by a filter-press. 2nd saturation: 0·5 per cent. lime is added, saturation is effected, as before, to 0·04 per cent., and filtration. 3rd saturation: 1 per cent. of a hyposulphite is added, it is saturated to 0·02 per cent. of alkalinity, boiled, and filtered through double thickness of cotton cloth, under a pressure equal to 3—5m. of the juice. 4th saturation: The juice is evaporated to a thick syrup, and 2 per cent. of a hyposulphite is added, with 1—2 per cent. of milk of lime; it is then finally saturated to 0·03 per cent. by carbon dioxide, boiled and filtered. Lastly, after further boiling, a pure syrup of exceptionally high density is obtained.

—W. G. M.

XVI.—BREWING, WINES, SPIRITS, Etc.

Improvements in the Method of and Apparatus for Making Fodder from certain Liquid Waste Products. H. Henecke, J. Palm, and E. Seetig, Darmstadt, Germany. Eng. Pat. 14,459, Nov. 25, 1885. 8d.

THE closed conical receptacle D is revolved on rollers L by any suitable mechanism: the space M is a flue in connection with a furnace, the sides being rendered tight at M^1 by means of tongues or rings projecting from the under side of D into sand placed in the annular U-shaped chambers shown. The liquid refuse from breweries, etc., is fed into vessel a, from whence it is distributed upon the shelf b, from thence to b , and by pipe b^3 to the revolving heated floor O, where the evaporation commenced on the heated shelves b and b^1 is continued. The dried matter is removed from O by a scraper, and pressed between heated rollers.—C. C. H.



Chemical Characteristics of Beer manufactured from Pure Yeast. E. Borgmann. Zeits. Anal. Chem. **25**, 532—535.

HANSEN investigated the causes of the diseases of beer, and found them in some cases to be due to the yeast employed, which was contaminated with "secondary" forms. To remedy this, he proposed to prepare pure yeast—that is, yeast grown under conditions of absolute purity from a single selected yeast cell. This pure-cultivation yeast is now in use in the brewery of Old Carlsberg, and also in a great many other breweries on the Continent. At Old Carlsberg two pure yeasts are in use—No. 1 and No. 2—each of which is cultivated from a single yeast cell, and produces a beer with different distinct characteristics. Two experimental fermentations with these yeasts were carried on at Old Carlsberg. The wort used was ordinary bottom fermentation wort of 13–14 per cent. Balling, and the fermentations were so carried on that the results were comparable. After some months' storage the beers were bottled and sent to the author. Both were bright and pure flavoured. On analysis, they gave the following numbers:

Contains in 100cc.	Beer prepared with Yeast No. 1.	 Yeast No. 2.
Alcohol	1·13 grms.	4·23 grms.
Extract	5·35 „	5·84 „
Ash	0·20 „	0·25 „
Free acid (as lactic acid)	0·086 „	0·144 „
Glycerol	0·109 „	0·137 „
Phosphoric acid	0·0775 „	0·0828 „
Nitrogen	0·0710 „	0·0719 „

From these numbers, which are the mean of many determinations, the author concludes that the different yeasts cause a different chemical composition in the resulting beers. He also finds that the proportion of alcohol to glycerol is different from that found with other beers. From analyses of other beers he finds that the proportions are—

	Alcohol.	Glycerol.
Maximum	100	5·497
Minimum	100	4·140

whilst with the Carlsberg pure yeast beers the numbers are—

No. 1 Alcohol.	 Glycerol.	No. 2 Alcohol.	 Glycerol.
100	2·63	100	3·24

—G. H. M.

Composition of Old Wine. J. Moritz. Chem. Zeit. **10,** 1370.

By the analysis of some samples of Rothenberg, 1748, 1783, compared with other analyses previously made, the author shows that these old wines, especially when kept in the cask, contain a large proportion of glycerol, the maximum found being 14 glycerol to 100 alcohol. The proportions of extract and acid are also greater in the old wines.—J. M. H. M.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(*A*) CHEMISTRY OF FOODS.

On the Presence of Nitric and Nitrous Acids in Milk, and the Adulteration of Milk with Water. M. Schrodt. Rep. Anal. Chem. **6,** 684.

The author has examined the milk of cows which have been fed for some time upon turnips to which saltpetre has been added, and finds that none of the latter passes into the milk. Hence the presence of nitric and nitrous acids in milk would tend to prove that the milk has been adulterated with impure spring water containing nitrous acid.—D. E. J.

(*B*) SANITARY CHEMISTRY.

Improvements in Apparatus for Use in Softening and Purifying Water. A. Bell, Manchester. Eng. Pat. 14,372, Nov. 24, 1885. 8d.

After the addition of the reagents required for softening the water, it is run into a tall upright tank, the upper part of which is fitted with a number of ribbed shelves, or plates, sloping to one side of the tank. The ribs on the under sides of one plate are intermediate to those on the upper side of the next plate below, which nearly touch the surface of the plates between the upper ribs. The water passing across the plate travels in a circuitous path under and over the ribs at right angles to the direction of slope. The precipitate deposits upon the shelves, slides to their lowest edge and into a pipe communicating with all the shelves, from which the deposit is periodically drawn off. The clarified softened water flows off from above the shelves.—C. C. H.

Drying of Sewage. V. L. E. Miller, London. Eng. Pat. 10, Jan. 1, 1886. 6d.

The sewage is placed in an air-tight tank so as to nearly fill the interior thereof. The space above the sewage is put in communication with a fan or pump; a pipe or pipes communicate between the outer air and the bottom of the tank, ending in perforations. A current of air can thus be drawn through the sewage, whereby the water in the sewage is "either converted into vapour or absorbed by the air, and pumped out of the tank, the more or less dry residue alone being left."—C. C. H.

Improvements in the Arrangement and Constitution of Apparatus for Extracting Sewage Sludge or other Semi-solid Matter from Tanks or Places where it Subsides or is Precipitated. J. C. Bothams, Salisbury. Eng. Pat. 530, Jan. 13, 1886. 8d.

Along the bottom of the tank is a pipe communicating with a main pipe; the underside of the branch pipe is provided with a number of projecting branches fitted with a sliding or swivel valve. The sludge can be removed from all parts, or any one part, of a tank by opening the sliding valves and sucking the sludge up into the main pipe by means of a vacuum arrangement. —C. C. H.

Improvements in Disinfecting and in Apparatus therefor. T. Bradford, Salford. Eng. Pat. 591, Jan. 14, 1886. 8d.

The disinfecting chamber is placed over a furnace, at the side and front of which is a small boiler worked at atmospheric pressure, and kept filled to a constant level with water. The steam from the boiler passes first into a superheating chamber situated in the furnace, and from thence into the disinfecting chamber.—C. C. H.

Improvements in the Treatment of Sewage. S. D. Cox and J. Cox, Bexley Heath, Kent. Eng. Pat. 1259, Jan. 28, 1886. 4d.

After separating the solids, the sewage is passed through rusty scrap-iron, and afterwards through peat or wood charcoal.—C. C. H.

XVIII.—ELECTRO-CHEMISTRY.

Electrical Conductivity in Fused Alloys. B. Rösing. Inaug. Dissert. Jena, 1886.

The opinion that electricity may be conducted in two distinct ways—(1) molecularly, when the current exerts no chemical action on the conductor; and (2) electrolytically, when the conductor undergoes chemical decomposition—receives some support from experiments by the author. He finds that if an electrical current of sufficient strength to effect a considerable rise in temperature be passed through a fused alloy, a small fraction of the current is conducted electrolytically. —C. A. K.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

Examination of Japanese Oil of Peppermint. B. C. Niederstadt. Rep. Anal. Chem. **6,** 575.

This cheap variety of the oil has a pale yellow colour, a strong odour of peppermint, with a burning aromatic flavour, a specific gravity of 0·960 to 0·961, and a negative polarisation of 105° to 106°. It is neutral and unaffected by iodine, dissolving in one to two parts of alcohol of specific gravity 0·85, and giving with nitric acid but indistinctly the characteristic blue colour of the English oil. By the nitroprusside of copper test neither oil of turpentine, glycerol nor alcohol could be detected in it.—W. G. M.

On the Yield of Ethereal Oil of Peppermint. A. M. Todd. Pharm. Rundsch. 1886, **4**, 233.

THE quantity of oil yielded on distillation is identical whether from the fresh cut or the dried plant: and except that the latter gives a somewhat better aroma there is no practical difference in the quality.—W. G. M.

Fabiana Imbricata. C. Ochsenius. Arch. Pharm. **24**, 896.

THIS drug, recently imported into Europe from Chili, where its leaves and thin twigs are used as a remedy against the liver-fluke, common to cattle on damp pasture lands, is a plant of the Chilian *Solanaceæ* order. It is a strong, woody shrub, commonly about three feet in height, growing in dry mountainous districts between 29° and 37° south latitude at a height of 300 to 2000 metres above the sea level; its habitat being that of the tamarisk, its appearance in flower that of the erica. —W. G. M.

Researches on American Drugs. Amer. Jour. of Pharm. **16**, 417.

Xanthoxylum fraxineum.—The powdered bark, according to Edw. T. Maffet, gave with absolute alcohol 2·7 per cent. of extract, consisting of resin, with some sugar, tannin, colouring matter, and an alkaloid, which was obtained in yellowish crystals by treatment with ammonia and chloroform. The latter gave the usual reactions with alkaloid reagents, and appeared identical with that obtained by Colton, except that the latter was insoluble in chloroform.

Kalmia angustifolia.—This shrub, which acts as a strong poison with sheep, has been examined by T. J. Deibert. By treating the aqueous extract of the leaves with lead acetate, separating the lead, and extracting with alcohol, he obtained a residue which contained small crystals of a substance answering to the tests for arbutin. Considerable quantities of tannin were also found in the leaves.

Plantago major, according to D. Rosenbaum, contains a fair proportion of sugar and oxalic acid; whilst in the leaves of the plant, T. Koller found also albumen, pectin, with citric and oxalic acids.

Hamamelis Virginica.—W. B. Cheney found in this plant notable quantities of a saponifiable wax, green resin, tannin, and sugar, but no trace of an alkaloid or crystallisable body.

Smilax rotundifolia.—The bark was found by A. H. Cohn to contain a glucoside not yet isolated, but no calcium oxalate.

Equisetum biemale, F. J. Young finds to contain two resinous bodies of brownish-green colour, one semi-fluid, the other of firmer consistency. It in no wise merits its reputation as a remedy for dropsy.—W. G. M.

Indian Drugs. E. Egasse. Nouv. Remèd. **2**, 434, 462.

Chasmantera cordifolia (*cocculus cordifolius*).—Under the names of gulaucha, guloe, and giloe this plant flourishes in India, the drug being sold extensively in the bazaars as a tonic and antiperiodic, in the form of cylindrical pieces 2 to 5cm. long and 1 to 5cm. in diameter. It is a perennial creeper, climbing to the summit of the highest trees, its branches putting forth roots which, reaching to the ground, initiate a fresh growth; roots, stem, and leaves are equally in demand as a drug. The Indian pharmacopœia commends its use as a tincture (4 to 8cc. *in die*); as an extract (0·6grm. to 1grm. *per diem*, in the form of pills); and as an infusion (1 : 10) of which 60cc. to 90cc. are to be taken thrice a-day. The stems contain berberin, an uncrystallisable bitter substance changed by dilute sulphuric acid into a glucoside, and a bitter kind of starch meal known as "Palo."

Toddalia aculeata (*Paullinia aculeata*), one of the family of *Rutaceæ*, flourishes on the Coast of Coromandel, in Southern China, Ceylon, Java, and the Isles of Mauritius and Bourbon. All parts of the plant possess an acrid flavour when fresh: the leaves are employed to relieve pains in the bowels; and the fruit, when ripe, is used as a substitute for pepper, whilst after drying it is made into vinegar by the natives. The root has long been used as a stimulant and febrifuge, the Indian pharmacopœia recommending a tincture and an infusion, in doses of 10cc. of the former, or 3grms. to 60grms. of the latter, twice or thrice in the day. Notable quantities of a resinous body, an ethereal oil, in flavour recalling oil of cinammon, and a bitter substance, are found in the outer portions of the roots.—W. G. M.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

The Separation of Zinc from Iron, Cobalt, and Nickel. P. von Berg. Zeits. Anal. Chem. **25**, 512—519.

FROM Ostwald's numbers for the relative chemical affinity of acids it is probable that zinc can be completely separated from iron, cobalt, and nickel by hydrogen sulphide in formic acid or monochloracetic acid solutions. Hampe (this Journal, 1885, 419) has shown this to be the case with formic acid. The author has examined the question under Ostwald's direction.

Precipitation in Formic Acid Solution.—Hampe found that complete separation took place when at least 15—20cc. formic acid of sp. gr. 1·2 were added to each 250—500cc. of the solution; if less were added small quantities of other sulphides came down with the zinc sulphide. From the results of Ostwald's researches it seemed probable that better results would be obtained with very much more dilute solutions, and the author found that with 3cc. formic acid, sp. gr. 1·2 in 360cc. water, a precipitate of zinc sulphide quite free from iron was obtained. The precipitation must take place at about 50—60° C., and the precipitate must be filtered off at once, as a little iron comes down on standing. The precipitation is carried out as follows: When the solution is diluted to the required strength it is warmed to 50—60° C., and sufficient formate or acetate of sodium added to combine with the whole of the sulphuric acid, the proper amount of free formic acid is then added, and hydrogen sulphide slowly passed through the solution. When precipitation is complete and the precipitate has partly settled, it is thrown on a filter and washed with hydrogen sulphide water containing one per cent. free formic acid. In the analyses given below, 51·9195grms. $ZnSO_4.7H_2O$ were dissolved in 500cc.

DETERMINATION OF ZINC IN PURE ZINC SULPHATE SOLUTIONS.

	ZnO taken. Grm.	FOUND.		Formic Acid. sp. gr. 1·2. cc.	Total Solution. cc.	Difference in per cent.
		ZnS. Grm.	ZnO. Grm.			
1.	0·2940	0·3532	0·2950	1·0	100	+0·33
2.	0·2910	0·3526	0·2915	1·0	100	+0·16
3.	0·2940	0·3525	0·2944	2·5	300	+0·14
4.	0·2940	0·3524	0·2941	2·5	300	+0·02
5.	0·2940	0·3518	0·2938	5·0	300	−0·06
6.	0·2940	0·3505	0·2927	7·5	300	−0·43
7.	0·2940	0·3483	0·2909	10·0	300	−1·03

These numbers show that zinc can be completely precipitated from formic acid solution as zinc sulphide if the amount of free acid present is not too great. For the determination in presence of iron, 5cc. of the above solution were taken, mixed with 1·2grm. of iron-alum, diluted with water to required strength, warmed to 50—60°, and treated as above.

DETERMINATION OF ZINC IN PRESENCE OF IRON.

	Taken.		Found.		Volume of Solution. cc.	Formic Acid cc.	Difference in per cent.
	ZnO. Grm.	Iron alum Grm.	ZnS. Grm.	ZnO. Grm.			
1.	0·1470	1·2	0·1777	0·1181	200	2·8	+0·96
2.	0·1470	1·2	0·1772	0·1180	200	2 8	+0·68
3.	0·1470	1·2	0·1765	0·1174	280	2·8	+0·26
4.	0·1470	1·2	0·1762	0·1472	280	2·8	+0·11
5.	0·1470	1·2	0·1760	0·1470	360	3·6	−0·01
6.	0·1470	1·2	0·1758	0·1468	360	3·6	−0·12

The precipitates in Nos. 1 and 2 contained a little iron; in Nos. 3 to 6 they were quite free from iron.

DETERMINATION OF ZINC IN PRESENCE OF NICKEL.

	Taken.		Found.		Vol. of Solution. cc.	Formic Acid. cc.	Difference in per cent.
	ZnO. Grm.	$NiSO_4$. Grm.	ZnS. Grm.	ZnO. Grm.			
1.	0·1470	0·25	0·1768	0·1477	360	3·6	+0·47
2.	0·1470	0·25	0·1765	0·1474	360	3·6	+0·27
3.	0·1470	0·25	0·1761	0·1471	360	3·6	+0·06

These analyses were carried out exactly as before; no trace of nickel was found in either precipitate.

DETERMINATION OF ZINC IN PRESENCE OF COBALT.

	Taken.		Found.		Vol. of Solution. cc.	Formic Acid. cc.	Difference in per cent.
	ZnO. Grm.	$CoSO_4$. Grm.	ZnS. Grm.	ZnO. Grm.			
1.	0·1470	0·25	0·1764	0·1473	360	3·6	+0·22
2.	0·1470	0·25	0·1762	0 1472	360	3·6	+0·11
3.	0·1470	0·25	0·1753	0·1464	360	3·6	−0·40

In the precipitation of zinc in the presence of cobalt the precipitate, after a time, becomes slightly green. It is necessary, therefore, to dissolve the precipitate, after filtration, in hydrochloric acid in order to separate the small amount of cobalt sulphide it contains. The acid solution of zinc is then neutralised with ammonia, treated as above, and the pure zinc sulphide weighed.

Precipitation from Monochloracetic Acid Solution.—The analyses with this acid were carried out as follows:—The solution made up to the required volume was warmed to 50—60° C., 4cc. of a double normal solution of ammonia (34grms. NH_3 per litre), and 7cc. of a four times normal solution of monochloracetic acid (378grms. $CH_2ClCOOH$ per litre) added, and then a slow stream of hydrogen sulphide passed through the mixture. The precipitated zinc sulphide separated in a heavy powdery form and rapidly fell to the bottom of the vessel, thus allowing rapid filtration; it is necessary to filter at once, and wash with hydrogen sulphide water containing a little monochloracetic acid, or a little cobalt sulphide may come down. In analysis No. 9, as shown in the last table, the filtration was delayed fifteen minutes, with the result of getting about one per cent. cobalt sulphide thrown down.

The separation from iron and nickel is complete; with cobalt immediate filtration is required.

—G. H. M.

A New Test for the Detection of Picric Acid and Dinitro Cresol in Food. H. Fleck. Rep. Anal. Chem. **6**, 649—650.

Of late manufacturers of farinaceous foods, such as maccaroni, have been in the habit of dyeing them, usually with dinitro-cresol (Victoria yellow); since picric acid has been occasionally substituted for this harmless dye, the necessity of a test for distinguishing them has arisen, as the bitter taste imparted to such goods by picric acid is not always satisfactory evidence. The process recommended is to digest the finely-powdered sample of food with alcohol, filter, evaporate filtrate to small bulk, and then taste; if the liquid be bitter, picric acid is probably present. Warm for a few minutes with a little pure hydrochloric acid, cool, and then drop a fragment of metallic zinc into the evaporating basin. After standing in the cold from half-an-hour to two hours, the contents of the basin will become a beautiful blue colour if picric acid be present, or bright blood-red with dinitro-cresol. Mere traces of these two dyes can be detected by this test.

—E. E. B.

RESULTS OF ANALYSES.

	Taken.		Found.		$CH_2ClCOOH$ 4 times normal cc.	NH_3 twice normal cc.	Vol. of Solution. cc.	Difference in per cent.
	ZnO. Grm.	Grm.	ZnS. Grm.	ZnO. Grm.				
1.	0·3228	—	0·3860	0·3221	7	4	450	−0·13
2.	0·3228	—	0·3851	0·3216	7	4	450	−0·36
3.	0·3228	1·5 Iron Alum	0 3864	0·3227	7	4	450	−0 02
4.	0·3228	,,	0·3861	0·3225	7	4	450	−0·11
5.	0·3228	,,	0 3858	0·3222	7	4	450	−0·18
6.	0·3228	0·5 $NiSO_4$	0·3870	0·3232	7	4	450	+0·13
7.	0·3228	,,	0·3862	0·3225	7	4	450	−0·08
8.	0·3228	,,	0·3859	0·3223	7	4	450	−0·16
9.	0·3228	0·5 $CoSO_4$	0·3900	0·3257	7	4	450	+0·90
10.	0·3228	,,	0·3883	0·3243	7	4	450	+0·47
11.	0·3228	,,	0·3871	0·3233	7	4	450	+0·15

The Detection of Alum in Flour. J. Herz. Rep. Anal. Chem. 1886, 359.

A CYLINDER is filled from one-fourth to one-third full with the flour under examination, and the flour is thoroughly moistened with water. Then a few cubic centimetres of alcohol and two drops of a freshly prepared logwood solution (5grms. logwood in 100cc. alcohol) are added. After thoroughly mixing up the thick paste the cylinder is filled up with a saturated solution of common salt. At the same time, trials are made using pure flour and flour containing 0·01 %, 0·05 %, 0·1 % alum, and by comparing the depth of colour of the flour under examination with these standards the amount of alum in it can be estimated. The gradations of colour for each amount of alum are distinct and the colour is permanent for a day. In presence of 0·05—0·1 % alum the salt solution takes a clear blue colour; with 0·01 % the colour is a violet red. —B. H.

Examination of Red Wines for Artificial Colouring Materials. J. Herz. Rep. Anal. Chem. **6**, 650—652.

THE author prefers Blarez's method of detecting acid-magenta or other sulphonic acids. The wine is shaken up with lead peroxide, which quickly decomposes all the other colours, whilst even traces of acid magenta render the filtrate violet-red. To test for the other colours as well, 30—50cc. of the wine—either in its original condition or, preferably, after being concentrated by evaporation—is treated with 20—30cc. of a cold saturated solution of magnesium sulphate, and then 10—20cc. caustic soda solution is stirred in. The precipitate of magnesium hydrate carries down with it all the natural colouring matter in the wine, and also most of the artificial, except archil and the sulphonic acids; the former gives rise to a dark-blue filtrate, whilst the latter can be detected by treating the colourless or yellowish-red filtrate with sulphuric acid. If the filtrate be red or reddish-brown, the treatment with magnesium sulphate and soda must be repeated. By this test the acid-magenta may be detected in 30cc. of unconcentrated wine containing only 1 part in 100,000 (by weight) of it. After being well drained, the magnesium hydrate precipitate, together with the filter, is dried in a porcelain basin with some sand over a water bath. This residue is extracted with ether, and the extract tested for ordinary magenta by dyeing some woollen threads with it in the usual manner; the so-called "Cassissine" leaves a yellowish-brown colour in the basin, and dyes the wool reddish-brown, which becomes yellow with strong hydrochloric acid, and colourless with strong ammonia.

If some of the original wine be shaken up with amyl alcohol, and the extract evaporated to dryness, the colour of the residue is altered when treated with certain reagents, as shown in the following table:—

	With Concentrated Sulphuric Acid.	Concentrated Hydrochloric Acid.	Caustic Soda.
Archil, violet-red	Blue	Red	Blue
Bordeaux B, carmine	Carmine	Carmine	Carmine
Ponceau RRR, dark red	Crimson	Crimson	Brown
Cassissine, violet-purple	Yellow	Yellowish-brown	Red
Vinicoline Bordelaise, cherry-red	Brown	Red	Brown

The colour of the wine after extraction, changes in the presence of ordinary magenta to cherry-red, of magenta S. to reddish-violet, of Bordeaux to dark cherry-red, of Ponceau to yellowish-red.

To test for foreign vegetable colours, a cold saturated solution of tartar emetic is strongly recommended. 10—15cc. of the wine are shaken with 5cc. of the tartar emetic solution, allowed to stand for some hours, and then examined by reflected and transmitted light. If the wine shows a violet tint it has been artificially coloured. Experiments were made by the author with white wines, artificially coloured with various decoctions, and also with red wines, to which 20 per cent. of the artificially coloured wine had been added. When treated with tartar emetic, the following results were obtained:—

Red wine (genuine)	Cherry red.
Common red poppy (*Papaver Rhœas*)	Dark cherry red.
Cherries	Violet.
Elderberries (*Sambucus nigra*)	Reddish violet.
Dwarf Elderberries (*Sambucus Ebulus*)	Violet.
Bilberries (whortleberries)	Violet.
Privetberries	Pure violet.

The fresher the decoctions the more distinct is the reaction. An old solution of privetberries is not detected by the above test. To obtain the violet tint well, it is advisable to dilute the wine with at least an equal volume of water (if the colour be very dark more water must be added), and in all cases to compare the samples with genuine red wine, treated under exactly the same conditions. The spectroscope has not yet been found by the author to give reliable results.—E. E. B.

Notes on the Pyridine Alkaloids. Oechsner de Coninck. Compt. Rend. **103**, 640.

THE methyl- and ethyliodides of the pyridine alkaloids give delicate colour reactions in presence of caustic potash, a property not shared by the corresponding derivatives of the reduced pyridines (piperidine and its homologues). The methyliodides of aniline and its homologues give no colour reactions in presence of caustic potash. The reaction serves, therefore, to distinguish the pyridine alkaloids from the above groups. Hofmann's reaction for the pyridine bases (*Ber.* xiv. 1497) (characteristic smell on heating the methyliodides with caustic potash) is not given by the methyliodides either of piperidine and its homologues, or by those of aniline and its homologues.—C. A. K.

Determination of Tannin. E. B. Zeits. Anal. Chem. **25**, 527—528.

THE author has examined the various methods of tannin determination, and finds that Von Schroeder's modification (*Zeits. Anal. Chem.* **25**, 121) of Löwenthal's method gives the best results. The author carried out the determination, using a solution of ferrous acetate prepared from iron alum in the following proportions:—

Iron ammonium alum	48·2grms.
Crystallised sodium acetate	25·0 ,,
Acetic acid containing 50 % hydrate	10·0cc.

dissolved in one litre.

10cc. of this solution are added to 50cc. of the tannin solution to be determined, which is prepared according to Schroeder of 5grms. per litre; the mixture is examined at the end of fifteen minutes to see if the iron is in excess, which should always be the case, made up to 100cc. and filtered. 20cc. of the filtrate, equal to 10cc. of the original solution, are then titrated with standard potassium permanganate, after addition of 20cc. indigotin solution. The difference between the amount of iron added and that found on titration gives the amount precipitated by tannin. The author gets very good results with tannin and gallic acid by this method, but has not had an opportunity of trying it with other substances containing tannin.—G. H. M.

The End Reaction in Titrations with Fehling's Solution. E. Beckmann. Zeit. Anal. Chem. **25**, 529–530.

In order to determine the point at which all the copper disappears in volumetric determinations with Fehling's solution, the author recommends moistening the outside of a piece of filter-paper with a little of the filtered liquid, after folding the paper two or three times, and when it is soaked through, applying a drop or two of the reagent for copper—potassium ferrocyanide in acetic acid solution or ammonium sulphide—and then examining the paper against a white background.—G. H. M.

Estimation of Acid in Malt. E. Prior. Bied. Centr. **15**, 647.

In the ordinary way an aqueous extract is made by soaking malt in water for two hours, agitating frequently, filtering, and titrating filtrate. It is now shown that such prolonged contact with water is prejudicial to the results, since half-an-hour's action of water on malt is frequently sufficient to give rise to an abundant formation of acid. Hence the following method of procedure is recommended:—100grms. of crushed malt are left in contact with 500cc. of dilute alcohol (made by mixing commercial acid-free absolute alcohol with four volumes of water), stirred frequently and, after at least four hours, filtered. 100cc. of the filtrate are titrated with baryta water in the usual way.—D. A. L.

A New Process for Estimating Glycerin (Glycerol) in Fermented Liquids. L. Legler. Rep. Anal. Chem. **6**, 631—636.

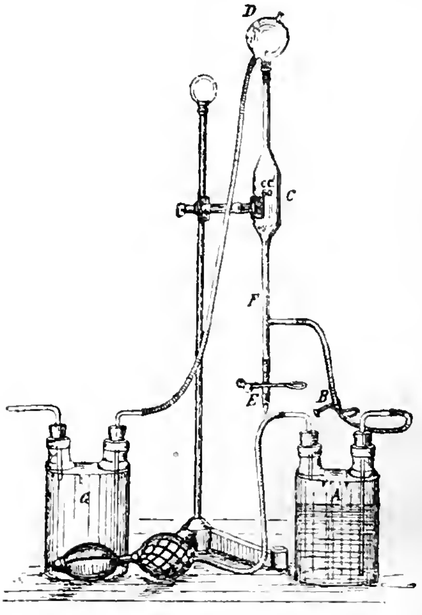
All the processes which have hitherto been proposed for determining the amount of glycerol in wine, etc., are inaccurate, since it is impossible to extract all the glycerol by means of a mixture of alcohol and ether. It is true that glycerol, if pure, is completely soluble in such a mixture; but if it contains any impurities which are insoluble the loss is frequently very considerable. To avoid this source of error, it is proposed to determine the amount of glycerol in a sample of wine by oxidising it to carbonic acid by means of a strong solution of potassium bichromate and sulphuric acid. The reaction is expressed by the equation $3C_3H_8O_3 + 7K_2Cr_2O_7 + 28H_2SO_4 = 7K_2SO_4 + 7Cr_2(SO_4)_3 + 9CO_2 + 40H_2O$. It is, however, advisable to use an excess of acid and of the bichromate. The determination can be made with a Will's carbonic acid apparatus; the mixture of the glycerol and the oxidising liquid must be allowed to boil gently until the action is complete, the gases evolved being passed through concentrated sulphuric acid. The apparatus is then cooled, and a current of dry air drawn through it. The loss in weight is due to the escape of carbonic acid, and from this the amount of glycerol can be calculated. The author recommends operating on about 1grm. of glycerol, and taking such a large quantity of strong sulphuric acid for drying the gases evolved that the mixture can be boiled for three to four hours without the loss of any aqueous vapour. The test experiments made by the author with pure glycerol are very accurate.

To determine the glycerol in a sample of wine, the impure glycerol (obtained by evaporating a known volume of the wine to dryness with milk of lime, and extracting with 96 per cent. alcohol) is oxidised as described above. The author assumes the absence of sugar, tartaric, malic, citric and tannic acids, which would evolve carbonic acid if oxidised with potassium bichromate and sulphuric acid. He makes a deduction of 0·035grm. glycerol for 100cc. wine for the other organic impurities; but, if desired, they may be first removed by precipitation with an ammoniacal solution of lead acetate, which would not interfere with the subsequent treatment of the liquid.

This method has not yet been thoroughly tried for determining the glycerol in beer or sweet wine; but to remove the cane sugar from the latter, before oxidising it, the author recommends heating the sample with baryta water, which will completely decompose the sugar, the resulting compounds being insoluble in alcohol. The results of future investigations of the subject are promised.—E. E. B.

An Ether-pipette for Fat Determinations. F. Soxhlet. Rep. Anal. Chem. **6**, 637.

The pipette, shown in the accompanying woodcut, was devised to avoid the injurious effects produced by constantly drawing off by suction the ether solutions into a pipette when the fat had to be estimated in a large number of samples of milk. The aqueous ether solution is placed in the two-necked bottle A, which is connected with an indiarubber air-syringe. If this be pressed with one hand, and then the pinchcock B is opened with the other, the ether will rise from A into the pipette C, and finally overflow into D. The cock B is then closed immediately, and the contents of the pipette allowed to run into the agitating flasks by opening E, until the liquid has fallen to the mark F. As soon as a large proportion of the ether solution is in the two-necked bottle G, owing to the overflow into D, this bottle is put in the place of A.—E. E. B.



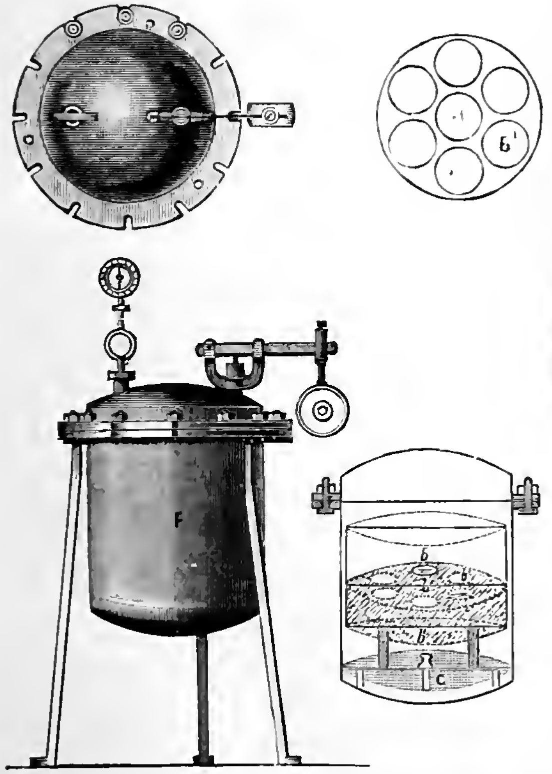
Estimation of Fusel Oil by Capillarimetry. J. Traube. Rep. Anal. Chem. **6**, 659—660.

In reply to criticisms on the author's former articles on this subject by A. Stutzer and O. Reitmar (*Rep. Anal. Chem.* **6**, 606), he denies that the ethereal oils which may be found in brandy and liqueurs, influence the height of the liquid in the capillary tubes more than ethyl alcohol, and states that consequently they would not interfere with the determination, even if present in large quantities. Only when certain acid compound ethers are present, as is the case in many ethereal oils, would the capillarity be appreciably affected, and these compounds are decomposed by the distillation with potash. The author has proved the accuracy of these statements by actual experiments with liqueurs.—E. E. B.

The Determination of Starch in Seeds, etc., by means of Soxhlet's Digester. Paul Zipperer. Rep. Anal. Chem. 699—703.

Although determinations of starch in starch-meal made by various analysts agree fairly well, the results obtained in the estimation of starch in seeds are often very discordant. Widely different results have been given by different chemists for the amount of starch contained in pepper; and whereas the percentage of starch found in cacao beans by some chemists varies from ten (Payen, Lampadius) to fourteen or eighteen (Mitscherlich), James Bell only found four or five per cent. of starch which could be converted into sugar. These differences are due to the faulty methods of analysis employed; and the writer points out that in dealing with seeds, a simple treatment with dilute acids in order to convert the starch into sugar is inadmissable, because they contain other substances (especially cellulose), which are thus converted into dextrose, and so influence the results.

Two methods of analysis are employed in agricultural laboratories. The first is that of Maercker, in which the finely-powdered substance is heated with water (Francke adds a small quantity of lactic acid) under pressure in a Reischauer's flask for some hours at 125—140° C.; it is then filtered, and after inversion with HCl, the sugar in the filtrate is determined by means of Fehling's solution. In the more recent method proposed by Faulenbach, a concentrated solution of diastase (prepared by extracting malt with glycerine and water) is employed. Both methods have disadvantages, especially when time is taken into consideration. The cover-glasses of Reischaur's flask frequently crack, owing to the unequal pressure of the screws; and Faulenbach's method seldom gives good results, because the solution of diastase soon loses its fermenting power, and becomes almost useless within a month after it has been prepared.



The author has adopted a modification of Maereker's method, in which the conversion of the starch is carried out under pressure, and the cellulose is almost completely separated. The apparatus employed is that devised by Soxhlet for the estimation of starch, and consists of a copper vessel F, 25cm. in diameter and 28cm. deep, tinned on the inside, and supported on iron feet. The disc *b* is supported by three feet, which rest upon a sieve *c* placed upon the bottom of the digester; in *b* there are seven openings *b*¹ which serve as supports for strong glass flasks of about 150cc. capacity. Water is poured into the vessel until it stands about 1cm. above the false bottom *c*, and then *b* (which is also filled with water up to the level of the holes *b*¹) is introduced. The finely-powdered substance is placed in the flasks, shaken up with a few cc. of distilled water, and 100cc. of hot distilled water added; 2grms. of meal or flour should be taken, and 2—5grms. of seeds, such as pepper or cacao. After thorough shaking the flasks are uncorked and placed in the holes *b*¹, the cover is screwed tightly on, and the temperature raised to 140—150 C., which corresponds to a pressure of four atmospheres, as indicated by the barometer. By proper regulation the temperature can be kept fairly constant for three-and-a-half hours; the steam is then allowed to escape by the safety-valve, and the cover is removed. The contents of the flasks are filtered while hot with a filter-pump, and the residue on the filter washed with hot water until the filtrate gives no reaction with iodine. The filtrate (measuring 300—350cc.) is heated with 20cc. concentrated HCl in a flask with inverted condenser on a water-bath for three hours, filtered, neutralised with caustic soda, and made up to 500cc.; the dextrose formed is estimated by titration with Fehling's solution. The percentage of starch is calculated by the formulæ given by Sachsse:—

$$\begin{array}{ccccccc} \text{Dextrose} & : & \text{Starch} & = & \text{Dextrose found} & : & x \\ 108 & : & 99 & = & y & : & x \end{array}$$

Or the percentage of dextrose found must be multiplied by $\frac{99}{108}$ = 0·916.

Seeds which contain much fatty matter should be pounded with an equal quantity of quartz-sand, placed in a cone of filter paper, and treated with ether for three hours in Soxhlet's extraction apparatus; the fatty matter can be determined in the ethereal extract. If they contain tannic acid and ready-formed sugar as well, they must undergo a further treatment for three hours with eighty per cent. alcohol, before the starch is extracted. The author gives examples of analyses in which the results differ only by a fraction of a per cent., and states the residue left after filtration gives no reaction with iodine.—D. E. J.

New Books.

TECHNISCH-CHEMISCHES JAHRBUCH, 1885—86. Ein Bericht über die Fortschritte auf dem Gebiete der Chemischen Technologie vom Juli 1885 bis April 1886. Herausgegeben von Dr. RUDOLF BIEDERMANN. Achter Jahrgang. Mit 263 in den Text gedruckten Illustrationen. Berlin: Carl Heymann's Verlag. 1887. London: H. Grevel & Co., 33, King Street, Covent Garden.

OCTAVO VOLUME, strongly bound in cloth and gilt lettered. It contains Preface, Table of Contents, List of abbreviated titles of works referred to in text, 471 pages of subject matter, with which are interspersed 263 woodcuts. Next follows a Review of New Books that have appeared during the session 1885—1886, arranged as works on Physics, Chemistry, Chemical Technology, Mineralogy, Geology, and Botany, and works on Miscellaneous Subjects. The Jahrbuch closes with carefully arranged Indexes of Names of Authors, and subject matter. The arrangement of the subject matter is as follows:—I. Gesetzgebung, Verordnungen U.S.W. II. Eisen. III. Magnesium and Aluminium. IV. Gold und Silber. V. Kupfer. VI. Blei. VII. Zink. VIII. Zinn. IX. Nickel und Kobalt. X. Mangan. Molybdan, Antimon. XI. Chlor, Salzsäure, Brom, Iod. XII. Schwefel, Schwefelwasserstoff, Schwefligesäure, Schwefelsaure. XIII. Säurrstoff, Wasserstoff, Wasserstoffsuperoxyd, Kohlensaure, Saltpetersaure. XIV. Soda. XV. Kaliumverbindungen und verschiedene Alkalisalze. XVI. Ammoniak und Cyanverbindungen. XVII. Alkalische Erden. XVIII. Thonerde und Alaun. XX. Glas. XXI. Thonwaaren. XXII. Cement. XXIII. Kunstliche Steine. XXIV. Explosivstoffe. XXV. Leuchtstoffe. XXVI. Heizstoffe. XXVII. Zucker. XXVIII. Stärke und Stärkezucker. XXIX. Wein. XXX. Bier. XXXI. Spiritus-XXXII. Fette, Harze und Seifen. XXXIII. Wasser. XXXIV. Nahrungsmittel. XXXV. Dungemittel, Abfälle, Disinfection. XXXVI. Gerberei. XXXVII. Osganische Sauren. XXXVIII. Alkaloïde. XXXIX. Farbstoffe. XL. Gespunistfasern, Cellulose, Bleichen, Färben, und Drucken, XLI. Papier. XLII. Photographie. XLIII. Apparate.

TRADE REPORT.

(From the "Board of Trade" and other Journals.)

RUSSIA (Classification of Articles in Customs' Tariff).—(Rouble=3s. 2d. Poud=36lb. av.) Syrups of white colour with yellow tinge, sweet in taste, and of sour odour, extracted from starch by treating it with sulphuric acid. Section 59, duty 1 rouble, 20 copecks per pond.

FRANCE.—Importation of Phosphorus. "By a decree of the French Government, dated the 16th December last, importers of phosphorus are required to take out '*acquits à caution*' at the post of arrival in France. These documents are to contain a statement of the quantities imported, and the name and residence of the person to whom they are addressed."

PERU.—By the new Peruvian tariff, which came into operation on the 1st of January last, the following are the revised rates of Customs' duties levied on various articles imported into Peru:—

To pay an ad valorem duty of 10 per cent.

Quicksilver
Sperm and Seal Oil
Colza Oil
Sulphuric Acid
Tar and Pitch
Roman Cement
Detonators for Mines
Scientific Instruments
Resin
Printers' Ink

GREEK CUSTOMS TARIFF.

Drachme = 9½d. Oke = 2·8lb. av. Quintal = 123·2lb. av. Drachme (weight) = 0·111oz. av.

No. in Greek Tariff.	Tariff Classification.	Old Rates of Duty.			New Rates of Duty.		
			Dr.	Lep.		Dr.	Lep.
80	Volatile oils (essences)	Oke	3	00	Oke	5	00
81	Fixed oils, comprising machine oils, as well as oils for the manufacture of gas, plasters, and ointment..	Free.			..	0	50
82	Patent Medicines:—						
	(a.) Liquids in bottles	Oke	8	00	..	2	00
	(b.) Solids ..	..	8	00	..	4	00
	(c.) .. in boxes	..	8	00	..	5	00
83	Chemical Products:—						
	(a.) Alkalis and salts produced from alkaline bodies	—			Drachme	1	00
	(b.) Salts and acids..	—			Oke	0	50
	(c.) Quinine..........	Free.			Free.		
	(d.) Quinidine and cinchonine........	Drachme	0	07	Drachme	0	10
84	Simple medicines and preparations of the same, chemical products used as medicines, not otherwise mentioned	Free.			Oke	0	20
86	(a.) Aniline colours, crystallised or in powder	Oke	8	00	..	8	00
	(b.) Aniline in shapeless lumps	..	8	00	..	6	00
87	Oil colours	..	0	30	..	0	30
88	Varnish prepared with oil or alcohol	Oke 0 50 and 0 80			..	0	70
89	(a.) Mineral and metallic colours, other, solid	Free.			Free.		
	(b.) Vegetable colours, other, solid.. ...	Free.			Oke	0	40
90	Perfumes, alcoholic or not, vinegars, pomades, oils, soaps, powders, pastes (aromatic), aromatic herbs and wood, scents in small bags, cosmetics, pearl paste, pearl powder, etc.	Oke	5	00	..	5	00
91	Soaps, ordinary, not perfumed............	Oke 0 20 and 0 40			..	0	40
93	Distilled products perfumed (with the exception of volatile oils and perfumes) ..	Oke	1	00	..	1	00
94	Starch	..	0	20	..	0	20
95	(a.) Ordinary isinglass, glue, of all kinds, liquid or solid	..	0	20	..	0	40
	(b.) Gelatine of all kinds	..	1	00	..	1	00
97	Matches of all kinds (monopoly)	..	0	50	Prohibited.		
98	White wax in cakes or sticks, stearine, and sealing wax	..	1	20	Oke	1	20
99	Kerosine, paraffin, and other artificial wax..	..	0	68	..	0	68
100	White wax tapers of all kinds and sizes, and mouldings of wax..................	..	4	00	..	1	00
101	Candles..........	..	2	00	..	2	00
102	Inks of all kinds	..	0	50	..	0	50

IMPORTS INTO UNITED KINGDOM FROM SPAIN.

Articles.		Nov. 1885.	Nov. 1886.
Chemical Products unenumerated	Value	£7,495	£6,373
Copper Ore and Regulus—	Tons	2,993	3,933
	Value	£69,304	£72,539
Iron Ore	Tons	158,716	210,228
	Value	£99,518	£135,722
Pyrites of Iron or Copper—	Tons	28,311	45,807
	Value	£53,571	£83,171
Quicksilver	Lb.	17,472	—
	Value	£1,400	—

EXPORTS OF BRITISH AND IRISH PRODUCE FROM THE UNITED KINGDOM INTO SPAIN.

Articles.		Nov. 1885.	Nov. 1886.
Alkali	Cwt.	18,934	22,848
	Value	£6,670	£8,004
Cement	Cwt.	8,900	12,500
	Value	£917	£1,025
Chemical Products, including Dyestuffs.............	Value	£3,671	£3,927
Soap	Cwt.	824	996
	Value	£722	£881

FLOATING EXHIBITIONS.—The project for a floating exhibition at Bordeaux has been abandoned, in consequence chiefly of the Bordeaux Chamber of Commerce having declined to give its support to the undertaking.

REMARKABLE DEPOSIT OF SULPHUR.—Sulphur deposits of vast extent and remarkable purity have recently been discovered in the neighbourhood of Tarawera Mountain, the scene of the late volcanic disturbances. The deposits occur in the Onepu Block, and are all within an area of about 500 acres. Upwards of one-fourth of this area—or 125 acres—is covered with sulphur in a nearly pure state, and varying in depth from 3 or 4 to 15 feet. The sulphur exists in the form of well-developed crystals, aggregated in masses, and presents a good, clean, yellow colour. In some of the deposits there is a crust of several inches of fused sulphur, on breaking which the crystalline variety can be shovelled out. In other parts of the area referred to several feet of stones and earth have to be removed before the sulphur is reached; but all over the various deposits it can be obtained with very little trouble, and averaging 85 to 95 per cent of pure sulphur.

The deposits have long been known to the natives, but it is only recently that Europeans have had their attention drawn to them, and at present a company, having secured from the native owners a lease, is working the district. The only work necessary in recovering the sulphur, consists in shovelling it into barrows and wheeling it a few hundred yards to the river Tarawera, which runs past the Block, and is navigable thus far from the sea, a distance of 12 or 15 miles. A small steam barge is employed for carrying the sulphur down the river to Matata, where it is transhipped into larger vessels.

The district described is about 150 miles by sea south of Auckland, on the river Tarawera, and near the shores of Lake Rotoiti Te Pak. It is about 15 miles distant from the ill-fated Maori village—Moura—which, with its inhabitants, was destroyed during the recent volcanic disturbance.—*Brit. and Col. Druggist.*

TRADE MARKS IN GERMANY.—A decision in connection with German trade mark law of considerable interest to manufacturers has recently been arrived at. In Germany, under the Trade Mark Law of 1874, it has always been held that trade marks consisting solely of letters, figures, or words cannot be registered. So far as this affected native manufacturers outsiders could have no cause of complaint, but when the Commercial Tribunal at Leipsic decided that foreign trade marks of this description, however stringently they might be protected at home, were also debarred from registration, the case became very different. Obviously well-known English houses could not change the distinctive word by which their goods were known all over the world for the sole purpose of bringing themselves within the German law; and the consequence was that a system of wholesale piracy was carried on in connection with trade marks of this nature. As a result of this, not only did our manufacturers lose trade, but their wares were discredited because of the low-priced imitations bearing the same letter or word, which were palmed off as being the real English article. When the negotiations for the conclusion of an International Convention for the protection of industrial property came to an abortive conclusion, another strenuous effort was made to upset the ruling of the Leipsic Tribunal. This has at length been attended with complete success, the third section of the Imperial Court having decided that, whilst the limitation holds good as regards natives, any foreign trade mark, of whatever description, would, if properly protected in the country of its origin, be also entitled to registration in Germany.—*Chemist and Druggist.*

PERIODICAL RETURNS OF IMPORTS AND EXPORTS.

IMPORTS and EXPORTS into and from the undermentioned COUNTRIES in the latest Month for which RETURNS have been received, with Aggregates for the Period of the Year, including such latest Month.

Note.—Rouble = 2s. 0d.; Franc = 9$\frac{6}{10}$d.; Milreis = 4s. 6d.; Gulden = 1s. 8d.; Lire = 9$\frac{6}{10}$d.; Dollar = 4s. 2d.

I.—*Imports.*

NAME OF COUNTRY.	Latest Month.		Value for the Month.		Aggregate for Period of the Year, including latest Month.	
			1886.	*1885.*	1886.	*1885.*
Russia in Europe	September	Roubles	71,129,000	*30,424,000*	283,399,000	*277,493,000*
	October	,,	37,857,000	*37,519,000*	321,256,000	*315,012,000*
France	November	Francs	376,117,000	*326,775,000*	3,787,533,000	*3,676,078,000*
Portugal	September	Milreis	3,336,000	*2,475,000*	28,217,000	*24,855,000*
Italy	October	Lire	110,756,000	*118,228,000*	1,232,607,000	*1,242,214,000*
Hungary*	June	Gulden	No Returns.		186,806,000	*217,526,000*
United States	November	Dollars	51,019,000	*50,602,000*	607,107,000	*585,657,000*
British India†	October	Rupees	6,23,23,156	*5,54,82,284*	41,06,90,201	*40,00,57,573*

II.—*Exports.*

NAME OF COUNTRY.	Latest Month.		Value for the Month.		Aggregate for Period of the Year, including latest Month.	
			1886.	*1885.*	1886.	*1885.*
Russia in Europe	September	Roubles	51,172,000	*41,175,000*	303,356,000	*360,077,000*
	October	,,	53,299,000	*55,179,000*	356,655,000	*415,256,000*
France	November	Francs	323,125,000	*269,460,000*	2,984,200,000	*2,788,361,000*
Portugal	September	Milreis	1,925,000	*1,866,000*	19,675,000	*18,889,000*
Italy	October	Lire	102,918,000	*93,237,000*	877,533,000	*927,515,000*
Hungary*	June	Gulden	No Returns.		193,511,000	*177,965,000*
United States	November	Dollars	72,619,000	*67,552,000*	627,917,000	*613,976,000*
British India†	October	Rupees	6,22,98,255	*5,80,13,246*	50,42,73,448	*45,62,41,899*

The above figures are subject to revision in the Annual Returns.

NOTE.—The figures are those of the "special" imports and exports, except in the case of the United States and British India, where the figures are "general." "Special" means, in the case of imports, imports for home consumption; in the case of exports, exports of domestic produce and manufacture only.

* Including trade with Austria.

† The aggregate figures are for the financial year commencing 1st April.

FOREIGN TRADE OF INDIA.

Imports and Exports into and from British India.

—	Imports from Foreign Countries.		Exports to Foreign Countries.	
	Seven Months 1st April to 31st October.		Seven Months 1st April to 31st October.	
	1886.	*1885.*	1886.	*1885.*
	R.	R.	R.	R.
Chemicals, drugs, medicines and narcotics, and dyeing and tanning materials	48,73,730	*45,63,489*	7,59,21,205	*7,29,34,591*
Oils	77,43,453	*59,89,614*	21,28,065	*22,91,564*

THE COAL TRADE.

The following table shows the commercial movement of coal in the Customs Union during July, 1886, and during the first seven months of the same year:—

		IMPORTS.		EXPORTS.	
		July, 1886.	Seven Months, 1886.	July, 1886.	Seven Months, 1886.
Germany—					
Bremen	Tons	178·5	1,008·8	24,610·3	182,320·8
Hamburg	,,	15,751·6	212,696·7	22,560·1	163,331·8
Other Freeports	,,	207·1	1,495·6	2,070·0	16,864·0
Belgium	,,	6,231·3	37,275·5	29,122·5	292,606·8
Denmark	,,	75·6	125·3	515·0	2,237·9
France	,,	1,735·6	18,804·4	68,635·8	582,231·4
England	,,	167,383·0	766,358·2	229·6	862·1
Italy	,,	0·1	0·1	3,780·0	27,271·2
Holland	,,	2,506·7	11,397·3	217,717·5	1,594,886·1
Norway	,,	—	—	35·6	35·6
Austria-Hungary	,,	32,702·1	227,211·6	182,391·0	1,377,750·1
Russia	,,	74·5	513·2	35,361·5	185,304·8
Sweden	,,	—	0·1	805·3	2,216·4
Switzerland	,,	12·4	256·9	50,622·5	336,706·4
Spain	,,	—	—	95·8	566·3
United States	,,	—	—	800·0	800·0
Other Countries	,,	—	23·1	121·5	621·5
Totals 1886	,,	256,861·8	1,277,580·1	670,107·3	4,767,306·5
,, 1885	,,	210,603·8	1,196,285·0	688,821·9	4,928,910·8
Difference 1886	,,	+46,258·0	+181,295·1	−18,711·6	−161,604·3

—*Chemist and Druggist.*

BOARD OF TRADE RETURNS.

For the year 1886 the imports into the United Kingdom amounted to £319,381,000, a decrease of £21,023,000, or a little over 5½ per cent., as compared with 1885. More than three-fourths of the reduction is in articles of food and drink. The exports amounted to £212,361,000, a decrease of £681,000, or about ⅓ per cent. Most classes of articles show reductions. During the first half of the year trade was very bad, and foreign commerce was no exception to the rule; but during the last few months a decided improvement has set in. The imports showed a decrease of £19,086,000, or over 10 per cent., for the six months ended June 30th, while the exports for the same period showed a decrease of £1,036,000, or about 1 per cent., as compared with the first half of 1885. During the last six months, however, the decrease in the imports was only £1,237,000, or at the rate of only 1 per cent., and the exports showed an increase of £355,000.

The Board of Trade Returns for last month show a small decrease in the exports. The imports amounted to £31,011,000, an increase of £57,000, or about a ¼ per cent., and the exports to £17,051,000, a diminution of £151,000, or about 1 per cent. Nearly all the dutiable articles show increases in the quantities taken out for home consumption.—*Brit. and Col. Druggist.*

LAST MONTH'S TRADE STATISTICS.

The Board of Trade Returns for December show the following figures:—

Imports.

	December, 1885.		December, 1886.
Total value	£30,953,588	......	£31,011,283

Exports.

	December, 1885.		December, 1886.
Total value	£17,204,128	....	£17,053,510
Foreign and Colonial produce (partly estimated)	5,172,782	......	1,596,559

Below are the details affecting drugs and chemicals:—

Imports.

		Dec. 1884.	Dec. 1885.	Dec. 1886.
Chemical manufactures—				
Products unenumerated	value £	123,400	120,953	104,084
Alkali	cwt.	4,184	3,249	4,330
,,	value £	4,024	3,142	3,216
Brimstone	cwt.	112,275	47,835	39,985
,,	value £	30,306	11,159	9,885
Nitre (nitrate of soda)	cwt.	163,885	83,325	197,049
,, ,,	value £	70,451	42,677	89,277
,, (nitrate of potash)	cwt.	25,289	40,244	21,057
,, ,,	value £	22,171	33,377	20,979
Quicksilver	lb.	105,250	127,420	30,000
,,	value £	8,895	10,425	2,875
Bark (Cinchona)	cwt.	8,657	19,467	16,503
,,	value £	67,188	128,878	78,254
Gum Arabic	cwt.	3,616	10,053	3,259
,,	value £	10,521	38,137	16,382
Lac, seed, shell, stick, and dye	cwt.	9,418	5,998	8,591
Lac, seed, shell, stick, and dye	value £	32,935	17,485	24,500
Dyes and tanning materials—				
Bark (for tanners' or dyers' use)	cwt.	21,017	17,113	13,821
Bark (for tanners' or dyers' use)	value £	7,868	5,586	3,419
Aniline dyes	value £	24,298	19,099	19,365
Alizarin	value £	17,391	17,963	27,523
Other coal-tar dyes	value £	1,140	87	37
Cochineal	cwt.	1,240	1,606	1,517
,,	value £	7,624	9,288	9,409
Cutch and gambier	tons	2,709	1,750	2,318
,,	value £	56,702	39,332	52,213
Indigo	cwt.	1,591	6,371	4,983
,,	value £	34,676	150,799	109,101
Madder, madder root, garancine, and munjeet	cwt.	2,522	2,311	2,791
Madder, madder root, garancine, and munjeet	value £	3,489	3,833	2,816
Valonia	tons	2,392	2,483	1,217
,,	value £	43,616	39,193	18,311
Oils—				
Cocoa-nut	cwt.	27,217	19,826	10,621
,,	value £	41,717	28,321	11,219
Olive	tuns	1,235	2,062	1,156
,,	value £	50,506	82,768	42,001
Palm	cwt.	74,411	70,803	99,014
,,	value £	114,821	87,969	107,621
Petroleum	gals.	7,187,097	8,267,715	9,511,331
,,	value £	231,873	261,310	272,578
Seed, of all kinds	tuns	1,716	1,646	1,185
,,	value £	50,563	44,308	2 7,822
Train, blubber, and sperm	tuns	1,638	1,859	1,626
Train, blubber, and sperm	value £	52,119	51,041	58,107
Turpentine	cwt.	40,048	22,747	39,910
,,	value £	15,616	29,101	32,052

Exports.

		Dec. 1884.	Dec. 1885.	Dec. 1886.
British and Irish produce:—				
Alkali	cwt.	566,976	510,254	504,318
,,	value £	173,934	154,491	143,266
Bleaching materials	cwt.	119,337	127,305	121,687
,, ,,	value £	56,386	11,965	13,153
Drugs and medicinal preparations	,,	76,519	82,572	72,618
Oil (seed)	gals.	1,275,900	1,173,200	1,430,800
,,	value £	120,755	105,135	119,086
Soap	cwt.	35,383	32,662	36,228
,,	value £	11,714	39,629	38,073
Painters' colours and materials (unenumerated)	value £	89,137	88,233	100,285
Foreign and Colonial merchandise:—				
Bark, Cinchona	cwt.	13,628	12,528	16,522
,, ,,	value £	58,800	73,026	73,376
Chemicals (unenumerated)	,,	22,873	17,012	12,030
Cochineal	cwt.	259	1,222	803
,,	value £	1,770	8,334	5,520
Cutch and gambier	tons	532	512	766
,, ,,	value £	12,517	11,978	17,415
Gum Arabic	cwt.	3,830	6,150	2,492
,,	value £	13,035	21,011	9,891
Indigo	cwt.	2,455	2,244	2,187
,,	value £	52,743	46,832	48,716
Lac, various kinds	cwt.	4,811	7,204	4,779
,, ,,	value £	17,005	23,781	13,033
Oils, cocoa-nut	cwt.	13,067	5,450	5,011
,, ,,	value £	20,223	8,086	7,485
,, olive	tons	147	188	113
,, ,,	value £	7,579	8,382	6,656
,, palm	cwt.	24,828	31,129	56,038
,, ,,	value £	38,839	38,317	59,368
,, petroleum	gals.	75,626	56,203	45,806
,, ,,	value £	3,649	1,992	2,260
Quicksilver	lb.	420,694	288,870	289,311
,,	value £	32,645	23,071	27,558
Nitre (nitrate of potash)	cwt.	797	7,903	231
Nitre (nitrate of potash)	value £	801	6,197	232

…ned crystals, aggrega…
…yellow colour. In so…

HEMATITE ORE.—The requireme[illegible] sul[illegible]tch makers of hematite pigs are reported to be such [illegible]hovelled [illegible] certain to be a large trade in the importation of Spa[illegible] stones [illegible] the Clyde during the whole of the present year, for w[illegible]hed; b[illegible]od, indeed, sales have been made in some cases by [illegible] litt[illegible]ts. Ore-freights from Bilbao to the Clyde have recently imp[illegible]ed from 5s. 3d. to 6s. 3d. per ton.—*Chemist and Druggist.*

BERLIN.—A report of the Berlin Chamber of Commerce states that European commerce is feeling more and more the influence of the United States. The export of German corn has decreased by 50 per cent., and Mannheim, which at one time was one of the principal markets for cereals, has lost much of its importance. The sugar industry is everywhere in a precarious state. The cotton trade, chemicals and colours have greatly suffered. At the conclusion the report protests strongly against the protectionist policy of most of the European countries, and points out the disastrous consequences for Germany.—*Chemist and Druggist.*

ROUMANIA.—THE PAPER MANUFACTURE AND TRADE IN ROUMANIA AND SERVIA.—The manufacture of paper is, as stated by the Brussels *Bulletin du Musée Commercial*, only slightly developed in Roumania. Nearly all the paper consumed there is imported from Austria-Hungary, France, Germany and England. There are only two paper factories in Roumania, one at Busteni, producing about 250,000kilos. per annum; the other at Letea, established with the support of the Government, from whom it has obtained great privileges. The expenses of the construction of the latter, the property of the Roumanian Paper Manufacturing Company, and the great outlay for works to protect it from the inundations of the Bistritza, which flows at a short distance from the factory, are, however, so great that the result is most unsatisfactory, in consequence of which the shares can be got at a discount of 50 per cent. This company is, under a contract, compelled to supply all the paper the Government requires, but it is hardly able to supply the paper necessary for the printing of the *Moniteur Officiel*, and produces, therefore, barely 150,000kilos. per annum. The factory at Busteni produces likewise only paper for printing purposes. Every variety and quality of paper is consumed in Roumania. Of foreign countries, Austria-Hungary imports the largest quantity, amounting in value to 1,970,695 francs. Next follows France with 487,529 francs, Germany with 291,128 francs, and England with 43,271 francs. In Servia there is no paper factory at all, most of the paper used being imported from Austria-Hungary. In 1881 the importations were as follows:—(1) Of ordinary paper, 617,912kilos.; value 295,421 francs. (2) Of writing, printing and drawing paper, 212,630kilos.; value 290,202 francs. (3) Of cigarette paper, 53,336 kilos.; value 68,960 francs. (4) Of coloured paper, 84,145kilos.; value 80,031 francs. (5) Of card pasteboard, etc., paper, 30,102kilos.; value 57,638 francs. Payment is made by bills of exchange at four or six months. The customs duty on entry into Servia is: on silk paper, 10 francs *ad valorem*; on post paper 10 francs per 100kilos.; on thin packing paper, 8 francs *ad valorem*; on drawing paper, 8 francs *ad valorem*;

on writing and printing paper, 7 francs per 100kilos.; cardboard, 4 francs per 100kilos.; on ordinary packing paper, 4 francs per 100kilos. The customs charges do not exceed 1 per cent.—*Chemist and Druggist.*

ANALYSES OF CINCHONA BARKS

Grown in the Madras Government Plantations, and forwarded to the Indo-Colonial Exhibition, London, 1886, by David Hooper, F.C.S., Government Quinologist.

	Sulphate of Quinine.	Quinine.	Cinchonine.	Quinidine.	Cinchonidine.	Amorphous Alkaloids.	Total.
C. succirubra, natural..	2·57	1·91	2·11	—	1·11	0·88	6·01
,, ,, mossed ..	2·27	1·69	2·03	—	1·68	0·98	6·34
,, ,, renewed ..	2·17	1·84	1·48	—	1·25	0·71	5·28
,, ,, branch ..	1·85	1·38	2·28	—	1·59	1·16	6·41
,, ,, root ..	1·66	1·21	0·77	0·11	1·13	1·27	5·12
,, ,, renewed (shavings) ..	3·09	2·30	1·16	—	2·06	1·45	6·97
,, robusta, natural	1·92	1·43	2·08	—	1·58	0·31	5·40
,, ,, mossed	2·58	1·92	3·16	—	0·77	0·35	6·20
,, ,, renewed	5·92	1·40	2·54	—	0·51	1·65	9·10
,, ,, branch	2·20	1·64	2·71	—	1·17	0·50	6·02
,, micrantha, natural ..	—	—	—	—	1·92	0·40	2·32
,, ,, renewed..	tr	tr	2·45	—	1·12	1·02	4·54
,, ,, branch ..	—	—	—	—	1·60	0·45	2·05
,, Calisaya, natural	1·62	1·21	2·32	—	2·13	0·29	5·95
,, ,, branch	0·79	0·59	0·73	—	1·93	0·48	3·73
,, Anglica, natural......	1·09	0·81	0·88	0·29	1·49	0·44	3·91
,, ,, branch......	tr	tr	—	0·25	2·04	0·36	2·65
,, Ledgeriana, natural..	7·38	5·49	1·33	—	0·82	0·88	8·52
,, ,, branch ..	2·97	2·21	0·49	—	1·07	0·50	4·27
,, Javanica, natural	—	—	—	1·32	2·64	0·48	4·44
,, ,, branch	—	—	—	1·43	1·49	0·45	3·37
,, officinalis, natural....	3·72	2·77	1·57	0·16	0·39	0·50	5·39
,, ,, mossed....	4·57	3·40	1·50	0·20	0·45	0·62	6·17
,, ,, renewed ..	5·66	4·21	0·85	0·22	0·65	0·70	6·63
,, paludiana, natural ..	0·05	0·04	0·10	—	0·39	0·43	0·96
,, ,, renewed..	0·68	0·51	1·19	—	0·28	0·87	2·85
,, pitayensis, natural ..	3·11	2·34	0·56	1·10	1·93	0·39	6·32
,, ,, mossed....	5·12	3·81	0·95	0·63	1·91	0·37	7·67
,, ,, renewed ..	3·36	2·50	0·52	0·78	2·33	0·55	6·68
,, Humboltiana, natural	3·01	2·21	1·55	tr	0·49	0·90	5·18
,, ,, renewed	1·72	1·28	0·64	—	0·43	1·07	3·4

THE PERCEN[illegible] [illegible]LOID IN VARIOUS QUININE SALTS.—The [illegible] from the *Pharmaceutische Post*, will be usef[illegible] [illegible]ating the amount of real quinine in any prepa[illegible]

..ne acetate	75·0	per cent.
,, bisulphate	59·1	,,
,, hydrobromate (basic)	73·5	,,
,, hydrobromate (neutral)	60·0	,,
,, hydrochlorate	81·6	,,
,, lactate	78·2	,,
,, purum (hydric)	85·7	,,
,, sulphate	74·3	,,
,, sulphovinate.................	72·0	,,
,, tannate.......................	20·6	,,
,, valerianate	72·9	,,

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

1886.

16715 F. N. Mackay, Liverpool. Apparatus for refrigerating enclosed spaces, such as cold stores. December 21

16780 J. H. Lorimer, London. Drying machines. December 21

16816 R. Johnson, Bradford. Method of and apparatus for compressing air. December 22

16817 J. T. Naylor, Bradford. Valve for steam, water or gas. December 22

16855 A. Firth, Sheffield. Improvements in the grates of steam-boilers and other furnaces. December 23

16863 F. Livet, London. An improved generator for the production of steam with efficiency and economy. December 23

16947 S. Pearson, Bradford. Hot-water heating apparatus. December 28

16994 H. E. Newton, London—From W. M. Deutsch, United States. Filtering apparatus. Complete specification. December 28

17015 C. A. Backstrom, London. Improvements in centrifugal machines. Complete specification. December 28

17037 W. J. Thomas, London. Improvements in pressure gauges. Complete specification. December 29

17100 A. Dervaux, London. A purifying apparatus for steam boilers. Complete specification. December 30

17133 D. Hancock, D. C. Hancock, and A. H. Hancock, London. Construction of valves for hot and cold water and other fluids. December 31

17152 J. Tangye and R. J. Connock, London. Apparatus for compressing air or the like. December 31

1887.

208 W. F. Pamphlett, London. Evaporating and condensing apparatus for producing fresh water from sea water, for drinking purposes and for boiler feed. January 6

231 G. M. Page, London—From D. Morgan, South America. An improved furnace bar. January 7

265 P. C. Vivien and A. Laine, London. Improvements in the process of and apparatus for distilling. January 7

281 J. Parkes and J. Parkes, Birmingham. Carburetting apparatus. January 8

501 P. Ewens, London. Improvements in or connected with furnaces for heating air preparatory to its use in what is known as the cool air drying process. January 12

519 M. F. Ryden, London—From C. Qvarnstrom, Russia. An apparatus for burning liquid fuel, applicable as a smith's hearth, and for other purposes. January 12

560 W. Whittaker, London. Mechanical stokers for supplying fuel to the furnaces of steam boilers. January 13

561 E. Perrett, London. Means or apparatus employed in connection with filters for the purpose of cleansing the same. January 13

592 J. B. Stubbs, Manchester. Self-acting water expellers or steam traps, applicable also as a low-pressure indicator for steam boilers. January 14

601 T. Taylor, London. Improvements in or applicable to steam boilers for consuming smoke. January 14

669 Zehren Freres, Paris. An improved form of tap or cock for water, steam, or gas purposes. January 15

673 W. Beaumont, London. Improvements in gas taps and water taps. January 15

677 A. Arnold and W. H. Webb, London. Open boilers or coppers. January 15

*COMPLETE SPECIFICATIONS ACCEPTED.**

1886.

672 A. Neubecker. Refrigerating apparatus. January 19

731 J. R. Shearer. Filters applicable for the filtration of water and other liquids. January 19

2408 H. A. Fleuss. Freezing and refrigerating machines. December 24

2520 J. Thomson. Apparatus for indicating or regulating temperature, pressure, or volume of confined fluids. December 24

2927 H. E. Newton—From E. Theisen. Apparatus for cooling and condensing purposes. January 5

3020 W. Beesley and J. Beesley. Steam boilers applicable for utilising the waste heat from puddling, forge, mill, and other furnaces. January 5

3316 H. A. Galliers and F. Klaerr. Apparatus for heating water by gas. January 8

3326 A. M. Clark—From P. Oriolle. Process and apparatus for distilling water. January 8

3420 G. A. Jarvis. Improved basic bricks. January 19

3617 C. A. Tew. Taps for governing the flow of liquids. January 19

3730 C. W. Burton and F. T. Moison. Improvements relating to the purification of water. January 19

3779 J. Love. Furnace bars and attachments thereto. January 19

1511 W. Schmidt. Steam generators and apparatus connected therewith. January 12

4693 G. Daverio. A refrigerating apparatus for roller mills. January 19

5693 F. J. Crossley. Rotary fan or propeller for the movement of air for ventilating, blowing, etc., also for the movement of fluids and gases. January 8

6531 W. Foulis. Apparatus for heating by gas. January 19

8917 J. Phethean. Apparatus for generating motive power. January 5

11624 H. Gerdes. Apparatus for supplying steam boilers with water. December 31

15215 H. J. Allison—From J. H. Blessing. Apparatus for purifying water. December 31

15216 H. J. Allison—From J. H. Blessing. Water purifying apparatus. December 31

15263 A. J. Boult—From N. Carvalho. Apparatus for heating air, steam, etc. December 24

15292 G. Westinghouse, jun. Thermostats. December 21

15715 J. Joly and J. Bochon. Apparatus for granulating or disintegrating coke, etc. January 5

15778 C. A. Knight. Apparatus for heating and purifying the feed water supplied to steam boilers. January 5

16263 W. R. Dennis. Heating apparatus. January 12

16277 E. Seger. Centrifugal apparatus. January 12

16414 W. W. Popplewell—From J. Trueb. Thermometric regulators for heating apparatus. January 15

16433 D. Rylands and R. Potter. Construction of port mouths of regenerative gas furnaces. January 19

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* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

1886.

16899 G. Tolson and J. Illingworth, Halifax. Means or apparatus for producing gas, and combining such apparatus with gas engines. December 24

16930 A. Fritschi and E. Beautils, London. The manufacture of hydrogen. December 24

16955 A. Eckford, Edinburgh. An improved automatic oil gas, etc., apparatus for lighting, gas engines, portable and other purposes, without the use of a gas-holder. December 28

16992 R. S. Lawrence, London. Improvements in carburetors and gas generators. Complete specification. December 28

17020 G. Tolson and J. Illingworth, Halifax. Gas purifiers. December 29

17021 W. C. Haigh and A. A. Haigh, Manchester. Artificial fuel. December 29

17143 G. A. Skinner, London. Apparatus for heating apartments. December 31

1887.

31 J. A. Yeadon and R. Middleton, Leeds. Machinery for the manufacture of blocks or briquettes of fuel or materials for smelting or analogous purposes. January 1

131 P. Greyson and A. Verley, London. Composition for preventing the accumulation of deposits in the retort pipes of gas apparatus or for facilitating the removal of such deposits. January 1

218 A. Chadwick, Sale. An improved fuel by the admixture of pitch and coke. January 7

411 T. Ray, Sunderland. A means of preventing explosions in petroleum or paraffin, or other mineral oil tanks. January 11

509 E. Edwards, London — From A. Lego, France. Machinery for manufacturing compressed bricks or blocks of artificial fuel. January 12

610 J. Lyle, Glasgow. Burning mineral and other oils for heating and lighting purposes, and appliances connected therewith. January 14

626 G. Rook, London. Machinery for charging and drawing gas retorts. January 14

670 J. Broad & Sons, and G. C. Fowler, London. Improvements in night lights. January 15

740 A. Kitson, London. Improvements in gas apparatus and process for generating illuminating gas. Complete specification. January 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

1807 W. S. Morland. Removing and discharging the material used in gas purifiers. January 8

2641 G. Delaporte. Improvements in lighting by gas, and in apparatus therefor. December 24

2807 S. W. Allen and G. Breflit. Apparatus for the manufacture of artificial fuel. December 31

3058 J. A. Yeadon and R. Middleton. Machinery for the manufacture of artificial fuel, etc. January 5

3581 J. A. Yeadon and R. Middleton. Machinery for the manufacture of artificial fuel, etc. January 12

15013 J. Lilley and F. Metge. Manufacture of artificial fuel. January 8

15189 A. J. Boult—From W. P. Lane and A. M. Sutherland. Manufacture of gas. December 24

15478 F. Lux. Purification of illuminating gas, etc., and apparatus therefor. December 31

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

1886.

16774 R. G. Price, J. Harvey, and A. J. Dodd, London. An improved manufacture of colouring matter. December 21

17083 J. Y. Johnson, London—From the Farbenfabriken vormals F. Bayer & Co., Germany. Manufacture of azo-dyes. December 30

17132 J. R. Geigz, London. Production of blue colouring matters. December 31

1887.

126 H. J. Walder, London. Process for the production of colouring matter from carbolic acid and other hydrocarbons. January 4

127 H. J. Walder. Process for producing colouring matter from anthraquinone. January 4

737 O. Imray, London—From the Farbwerke vormals Meister, Lucius & Bruning, Germany. Manufacture of colouring matters by the action of nitroso-derivatives of secondary aromatic amines upon phenols and oxycarbonic acids. January 17

COMPLETE SPECIFICATION ACCEPTED.

1886.

3198 J. Y. Johnson — From the Actiengesellschaft Farbenfabriken vormals Bayer & Co. Manufacture of azo-dyes and benzidine and tolidine mono-sulpho acids. January 8

V.—TEXTILES, COTTON, WOOL, SILK, ETC.

APPLICATIONS.

1886.

16787 W. H. Beck, London—From C. Delerne, France. Process and apparatus for washing and preparing wool and other fibrous materials. Complete specification. December 21

17080 J. Obozinski, Liverpool. New or improved waterproof, vegetable, animal or mineral fabrics, and process of manufacturing the same. December 30

1887.

611 C. Scheibler and O. Bluth, London. Manufacture of lacquered leather-like material from felt. January 14

639 F. A. Gatty and J. Leemann, Manchester. Improvements in woven fabrics, and in the method of treating the same for the production of patterns or designs thereon. January 15

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

2417 J. Howgate & Sons, and F. Smith. Method of and apparatus for producing Astrachan yarn. December 24

3065 R. W. Thom. Starching and finishing textile fabrics, and apparatus therefor. January 5

3755 W. S. Johnston. Manufacture and softening of linen, hemp, jute, or other yarns. January 8

3957 H. Birbeck—From T. F. Peppé. Treating "tussur" and other wild silk cocoons, and applying the silk therefrom to the manufacture of lace, etc. January 19

14367 E. W. Serrell, jun., and E. Fourgeirol. Process and machinery for preparing silk cocoons for reeling. January 19

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

1887.

171 W. Birch, Manchester. Apparatus for washing, soaping, dyeing, and dunging woven fabrics. January 6

443 G. Jagenburg, London. An improved process and apparatus for dyeing unspun textile fibres. January 11

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

2732 H. Kershaw. Dyeing textile goods. January 19

3758 W. Cockcroft. Apparatus for producing designs on textile piece goods. January 19

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

1886.

17101 G. Kamensky, London. See Class XVIII.

1887.

62 W. Donald, London. Treatment of hydrochloric acid gas for the production of chlorine gas. January 3

329 O. von Gruber, London. Process for manufacturing sulpho-phosphates of ammonia and potassium. Complete specification. January 8

553 H. Porter, London. Manufacture or preparation of a compound of soda or potash and lime adapted for use in the purification and softening of waters, and for other purposes. January 13

629 D. G. Fitzgerald. See Class XVIII.

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

65 L. Mond. Obtaining ammonia and hydrochloric acid from ammonium chloride. December 21

66 L. Mond. Obtaining ammonia and chlorine from ammonium chloride. December 24

1018 L. Mond. Obtaining ammonia and hydrochloric acid from ammonium chloride. January 8

1019 L. Mond. Obtaining ammonia and chlorine from ammonium chloride. January 8

1831 A. MacDonald Graham. Manufacturing sulphates of metals from their oxides. January 12

1881 J. J. Hood and A. G. Salamon. Preparation of sulphate of alumina. January 15

2207 H. J. Leslie—From R. Finch. Concentration of sulphuric acid, and apparatus therefor. January 8

3406 E. F. Trachsel. Production of carbonate of sodium or of potassium, and hydrate of strontium, or of barium. Jan. 12

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

1886.

16833 W. D. Clift, London. Manufacture of porcelain and metal baths. December 22

16877 W. Boulton, London. Apparatus for making bats for use in the manufacture of various articles of pottery. Complete specification. December 23

17115 J. L. Napier, A. D. Brogan, and A. M. Malloch, Glasgow. Manufacture of plate glass. December 31

1887.

87 W. H. Hales, Stoke-on-Trent. Machinery for making pottery ware. January 4

120 W. H. Turner, London. Improvements in the printing or decorating of earthenware, china, and the like, and in the preparation or manufacture of materials therefor. January 1

178 J. Van de Loo, Berlin. Construction of presses for the embellishment of bricks or other ceramic products. Complete specification. January 12

576 P. M. Justice, London—From La Société Anonyme des Manufactures de Glaces, Verres, Vitres, etc., Belgium. Apparatus for handling crucibles, such as those used for the melting of glass. January 13

662 O. Paterson, Glasgow. Rendering enamel paintings on stained glass impervious to atmospheric, destructive, or injurious influences. January 15

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

2855 H. S. Sant and S. Sant. Process for mosaic or other decoration of pottery ware by the use of skeletons of leaves, or other parts of plants, trees or vegetables, or of insects, etc. December 31

3119 W. Cartlidge and H. Cartlidge. Enamel, lustre, and hardening kilns used in the manufacture of pottery ware. January 12

3972 W. E. Chance. Machinery for the manufacture of sheets of rippled glass. January 19

8713 M. H. Blanchard. Manufacture of ornamental and other tiles. January 19

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

1886.

16922 E. Clarke, Leeds. Improvements in briquettes. December 21

16926 E. A. Bronson, London. Compounds for coating and finishing walls and the like. Complete specification. December 21

17055 J. Tall, London. Admixing or combining ingredients and producing a compound suitable for exterior surfacing or facings of concrete structures or concrete articles used in buildings. December 29

17098 W. Sonnet, London. An improved mode of and apparatus for continuously manufacturing Portland cement. Complete specification. December 30

17130 A. Mack, London. Plaster boards for use in the immediate construction of dry and fireproof rooms. December 31

17158 S. P. Wilding, London—From Stamme & Co., Germany. Manufacture of briquettes. Complete specification. December 31

1887.

315 G. G. M. Hardingham, London—From P. J. Grouvelle, France. Manufacture of what is known as "iron cement." January 8

421 W. White, London. Improvements in roads and pavements, and paving blocks therefor. January 11

577 P. M. Justice, London—From C. Dietzsch, Germany. Manufacture of cement. January 13

578 P. M. Justice—From C. Dietzsch. Furnaces or kilns for calcining or burning limestone, lime, and similar materials. Complete specification. January 13

589 J. M. Murphy, Liverpool. Fireproof construction. January 11

628 J. F. O'Connor Wood, London. The disintegration of clay. January 11

642 F. V. Hadlow, Buxted. A new artificial stone or cement. January 15

678 E. W. Jones and C. Brand, London. Manufacture of paving blocks from scoria or slag, and means to be used therefor. January 15

684 F. U. Benekendorff and C. Yüngst, London. Improvements in roofing tiles. January 15

731 T. Royle, London. Treating wood with antiseptic and preservative fluids. January 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

1126 C. D. Alison. Manufacture of cements or plasters. December 31

3217 J. B. Hannay. See Class XVII.—B.

5026 J. B. Warwood and J. Wallis. Apparatus for sifting cement, etc. January 19

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

1886.

16758 C. Puddefoot, London. Seaming machines for sheet metal. Complete specification. December 21

16788 W. L. Purves, Wimbledon. Steel tempering. December 22

16790 T. C. Sanderson, London. Process for reducing antimonial ores and for separating gold and silver therefrom. December 22

16869 D. Sinclair and G. Johnstone, Glasgow. An improved solder bar or block. December 23

16870 J. H. Noad and H. R. Hammond, London. Production of aluminium from clay alumina or any of the salts of aluminium. December 23

16882 G. F. Redfern, London—From M. Raty and E. Lambert, France. Improvements in treating slag, and the like. December 23

16923 E. Veasto, London. Improvements in and apparatus for cleaning or pickling metals, and in utilising the liquids that have been employed therefor. December 24

16935 E. de Pass, London—From La Societe Industrielle et Commerciale des Metaux, France. A process for preserving the surface of copper or its alloys. December 24

16951 J. J. Robins, Derby. Forming deep corrugations in steel, iron, or other metals, to ensure sharp edges. December 28

16991 A. J. Boult, London—From J. Walton, United States. Coal-mining machines. December 28

17008 T. Archer, jun., and T. O. Robson, London. Apparatus for watering or wetting, and laying dust in the workings of mines, or for analogous uses. December 28

17049 K. W. E. Mornhu, London. Treating slag and recovering metal therefrom. December 29

17107 H. N. Penrice, London. Machinery to be used in rock tunnelling. December 30

17129 A. B. Southall and J. H. Clegg, Sheffield. Machinery, apparatus, and appliances for screening, sorting, cleaning, washing, and travelling coal and other minerals, and the like substances. December 31

1887.

24 R. Oswald, Talk-o'-the-Hill. An improved safety lamp. January 1

38 A. Gay, London. Means and apparatus for extracting iron, steel, or other magnetic substances from China-stone or other materials. January 1

63 W. H. Beck, London—From M. Marcus and C. Finaly, France. Process for the manufacture of alloys of aluminium and copper or tin for the purpose of obtaining aluminium gold and aluminium silver. January 3

105 C. Parker, London—Partly from H. L. Gault, United States. Improvements in converters used in the manufacture of steel. January 4

129 L. Plom and J. D'Andrimont, London. Blasting or breaking down coal and other minerals or rocks, and in apparatus employed therefor. January 4

247 R. Riley, Habergham. Improvements in or applicable to miners' lamps. January 7

251 H. Davis and A. Davis, London. Improvements in miners' safety lamps. January 7

260 J. Nicholas and H. H. Fanshawe, London. Improvements in the reduction of ore. January 7

285 E. Hunt, Glasgow—From G. Thomson, United States. Obtaining silver from ores, mattes, or compounds containing it. January 8

298 T. Allen, Reading. Method of forging or shaping articles of metal or other substances. January 8

301 O. Zadig and E. Feldtmann, London. Treatment of refractory ores for the extraction of gold, silver, copper, or zinc by thermo-hydro-electricity. January 8

331 J. Vavasseur, London. Steel projectiles for piercing armour-plates. January 8

382 T. C. Sanderson, London. Means and apparatus for reducing metallic oxides. January 10

433 J. Beveridge, London. Treatment of minerals and production of by-products therefrom. January 11

447 H. J. Haddan, London—From M. Neuerburg, Germany. Improvements in crushing apparatus. January 11

463 H. H. Lake, London—From W. White, United States. Improvements relating to ore separators. Complete specification. January 11

482 E. Whitehouse, Bilston. Rolling metal tubes of various sections direct from the forge, bar, billet, pile, or ingot, at one heat, process, or operation. January 12

616 Sir I. Lowthian Bell, Bart., London. Manufacture of alloys of aluminium with iron. January 14

621 H. H. Lake, London—From J. Illingworth, United States. Manufacture of metal ingots, and apparatus therefor. Jan. 14

629 D. G. FitzGerald. See Class XVIII.

630 J. H. Darby, London. Process for the manufacture of certain kinds of steel. January 14

631 J. H. Darby. Manufacture of steel or iron by the basic process January 14

657 M. Settle, Manchester. Improved apparatus for "shot firing" in mines or other places liable to the accumulation of explosive or inflammable gas, or the like. January 15

704 H. Hall, London. Apparatus and process for coating sheets, plates, and pieces of iron and steel or other metal with tin, terne, and other metals. January 17

738 C. D. Abel, London—From A. Klonne, Germany. Apparatus for screening or sorting ores and other materials. January 17

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

15954 G. Lowry. Machines for crushing stone, ore, etc. December 24

1886.

310 H. C. S. Dyer. Manufacture of compound armour plates. January 8

1010 E. Morewood. Coating iron and other sheets, plates, and pieces with tin or other metal. January 12

2867 J. H. Johnson—From La Societe Anonyme de Commentry-Fourchambault. Manufacture of iron and steel. December 31

3261 W. Potthoff. Manufacture of metal castings, and apparatus therefor.

3157 W. D. Allen. Furnaces for melting and treating pig-iron, and feeding or charging same. January 15

3684 C. Clarke. Producing a "coloured gold" surface on articles of gold or other metal or alloy. January 19

3836 A. Kurzwernhart and E. Bertrand. Method and apparatus for casting ingots of steel or ingot metal. January 5

3867 A. M. Clark—From H. Harmet. An improved basic lining for metallurgical apparatus. January 5

10241 H. H. Lake—From E. Thomson. Welding of metals, and apparatus therefor. January 5

11413 M. Settle. Electric safety lamps for use in mines. January 12

11756 S. Gratrix. Apparatus for the manufacture of lead or other metal pipes. January 12

12861 J. Warwick. Treatment of fume in lead works. January 15

14928 J. R. Whitney. Improvements in and connected with the casting of metals. December 21

15154 J. T. King—From H. Kennedy. Manufacture of mineral wool, and apparatus therefor. December 24

15246 F. B. Felt. Manufacture of iron bars, plates, etc. December 24

15270 F. A. Herbertz. Cupola smelting furnaces. Dec. 24

15357 J. T. King—From D. Brose. Making steel. Dec. 31

XI.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

1886.

16925 Sir D. L. Salomons, London. An improved buoyant soap. December 24

16979 A. W. MacIlwaine, London. Apparatus for extracting oils by volatile solvents. December 28

1887.

1 R. Tervet, Glasgow. Apparatus for treating or purifying paraffin wax. January 1

16 R. Wright, Chesterfield. Angelic cuticle and washing soap. Complete specification. January 1

198 M. Mackay. See Class XVII.—C.

360 A. G. Wass, London. An improved lubricant. Jan. 10

588 W. S. Somers, Liverpool. The manufacture of solidine or solidified burning and other oils grease. January 11

608 R. G. Price, J. Harvey, and A. J. Dodd, London. An improved manufacture of soap. January 11

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

2762 E. Edwards—From L. Rivière. Process for the saponification of fatty bodies. December 21

3614 A. W. MacIlwaine. Means for extracting oils by volatile solvents. January 15

XII.—PAINTS, VARNISHES, AND RESINS.

APPLICATION.

1887.

207 R. J. Worrall, London. Improvements in the preparation of distemper. January 6

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

3636 A. C. Ireland and J. R. Bowbear. Composition for preventing attachment of barnacles to the bottoms of plated ships. January 15

15561 W. Carter. Anti-fouling compostion for ships' bottoms. December 31

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

1886.

16832 H. Buczkowski, London. Polish or coating (soluble in water) for leather. December 22

16894 J. Straighton, Liverpool. Apparatus for burring and cleaning hairy and woolly skins, and for unhairing and softening skins. December 24

17026 J. H. G. Langenhagen, Liverpool. A new or improved leather polish. Complete specification. December 29

1887.

646 W. P. Kermann and G. A. Kermann, Liverpool. An improved composition for dressing leather. January 15

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

9604 W. Ross. Application of a material produced by the treatment of waste leather. January 19

15200 H. H. Lake—From A. Miliochau and F. Chailly. Improved process of tanning. December 24

XIV.—AGRICULTURE, MANURES, ETC.

APPLICATIONS.

1886.

16866 J. H. Barry. See Class XVII.—B.

17000 A. W. Carlson, London. A process and apparatus for utilising urine as manure. December 28

XV.—SUGAR, GUMS, STARCHES, ETC.

APPLICATIONS.

1886.

16775 B. J. B. Mills, London—From A. Fayaud, France. A new process for the vulcanisation of pure caoutchouc in sheets or in articles made therefrom. December 21

16827 H. Vivien, London. Apparatus for the manufacture of refined sugar, partly applicable to the manufacture of glucose, starch, and similar products. December 22

16921 J. Anderson, jun., London. Compound for use as a substitute for indiarubber, or to be compounded therewith. December 24

17011 R. Campbell, Glasgow—From J. Foster and J. Campbell, Java. Improvements in and connected with triple effect evaporating steam vacuum pans used for boiling sugar, and for other evaporating purposes. December 29

1887.

165 C. D. Abel, London—From Messrs. Pfeifer and Langen, Germany. Method of extracting foreign substances, in particular raffinose, from sugar solution by means of lead, either in the form of oxide or as electrode. January 5

256 W. Powell and E. Powell, Liverpool. A compound to be used for making adhesive paste. January 7

602 R. A. Robertson and J. G. Hudson, Glasgow. Improvements in sugar-cane mills. January 14

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

3196 R. Englert and F. Becker. Process for purifying saccharine juices. January 8

14117 C. N. Waite. Compound for use in preparing starch or flour size for yarn, textiles, etc. January 12

16016 F. Scheibler. Moulding sugar, and apparatus therefor. January 8

XVI.—BREWING, WINES, SPIRITS, ETC.

APPLICATIONS.

1886.

17013 N. Browne, London—From A. Braconier, France. Manufacture of champagne and foaming wines, and apparatus therefor. December 29

17059 W. Gerdes, London. Improvements relating to the treatment of the waste products of breweries for the production of alcoholic liquor. December 29

1887.

51 P. Weinig, London. Malt germinating apparatus. Jan. 3

265 P. C. Vivien and A. Laine. See Class I.

328 B. J. B. Mills, London—From C. Brada, United States. Improvements in malt kilns. Complete specification. Jan. 8

521 E. Beanes, London. An improvement in the treatment of wines of the port and claret class. January 12

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

2627 A. W. Gillman, S. Spencer, and E. S. Spencer. Apparatus for treating grain or cereals to be used in brewing, distilling, and vinegar-making. December 24

2629 A. W. Gillman, S. Spencer, and E. S. Spencer. Apparatus for steaming grain or cereals to be used in brewing, distilling, and vinegar-making. December 31

14312 A. J. Boult—From C. F. Elze. Beer refrigerators. January 19

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

APPLICATIONS.

A.—Chemistry of Foods.

1886.

16929 M. Ross, Glasgow. Improvements in and connected with the drying and withering of tea-leaf, and apparatus therefor. December 24

16950 R. Glover, Stratford. An improvement in dog biscuits. December 28

17017 M. Samelson, London. Manufacture of liquid extract of coffee. December 28

17016 J. P. Larieux and H. Gregoire, London. An improved food for cattle and other animals. December 29

17075 C. S. Boynton and W. J. van Patten, London. An improvement in the preparation of food products. Dec. 30

17087 A. B. Imrie, Glasgow. Refrigerating machinery applicable to air-cooling or freezing machines for use at sea or on land, for preserving meat or other perishable substances. December 30

17136 G. F. Redfern, London—From J. Petit, France. Stoppering or closing bottles, jars, and like vessels for containing preserved food. December 31

1887.

122 H. F. von Konitz and J. Zuntz, London. Manufacture of extract of coffee. Complete specification. January 4

216 W. Olsson, London—From G. Bergman, Sweden. Improvements in food for herbivorous animals prepared from fish and vegetable substances. January 7

712 J. M. Fletcher, Cheadle. Apparatus for compressing and preserving vegetable products. January 17

B.—Sanitary Chemistry.

1886.

16866 J. H. Barry, London. Treatment of excreta, urine, and sewage sludge for the production of manure, and apparatus for use in such treatment. December 23

1887.

402 H. Schlichter, London. Platinum lamps for deodorising and disinfecting purposes. January 11

C.—Disinfectants.

1886.

16729 F. Goddard, Nottingham. Construction and arrangement of apparatus for disinfecting by steam. December 21

16831 F. H. Weber, London. Process for the manufacture of candles for fumigating or deodorising. December 22.

1887.

198 M. Mackay, London. A new deodorising and disinfecting oil. January 6

276 C. T. Kingzett, London. The production of solutions for use as antiseptics, disinfectants, deodorants, oxidants, and general sanitary reagents. January 7

381 J. C. Stevenson and J. G. Tatters, London. An improved disinfectant and oxidising agent. January 10

451 R. V. Tuson, London. Combination of ingredients, and the production of "powders" therefrom, for disinfecting and deodorising purposes. January 11

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1886.

2909 C. Hansen. Treatment of rennet. January 5

9690 I. Grun. Preparation of preserves for making milk and flour dishes of all kinds. January 12

11835 G. F. Redfern—From L. J. Eriksson and E. J. R. Nordling. Manufacture of dry rennet. December 24

B.—Sanitary Chemistry.

1886.

2439 F. H. Danchell. System of treating sewage. Jan. 12

3217 J. B. Hannay. Treating sewage and making cement. January 5

C.—Disinfectants.

1886.

15201 J. Watt. An improved deodorising material. December 24

XVIII.—ELECTRO-CHEMISTRY.

APPLICATIONS.

1886.

16739 C. G. Curtis, F. B. Crocker and S. S. Wheeler. Electric motors and dynamo-electric machines. Complete specification. December 21

16810 T. Goodman, London—From C. Gossner, jun., Germany. Improvements in galvanic elements. December 22

16823 E. Barbier and M. Leclanché, London. Improvements in electrical batteries, and in the manufacture of depolarising bodies to be used therein. December 22

16865 L. R. Davies and M. Shearer, London. Improvements in batteries for lighting and other purposes. December 23

16936 A. J. Boult, London—From F. L. Pope, United States. Improvements in or relating to dynamo-electric and electrodynamic machines December 24

16942 J. D. F. Andrews, London. Apparatus for the conversion of electrical currents. December 24

17018 M. H. Smith, Halifax. Improvements in and appliances for a method of transmitting electric currents. December 29

17056 G. Kapp, London. Improvements in dynamo-electric machines. December 29

17101 G. Kamensky, London. Manufacture of caustic soda, or potash, or carbonate of sodium, or potassium, together with sulphuric acid, by means of electrolysis. December 30

17120 R. E. B. Crompton and J. Swinburne, London. Dynamo-electric machinery. December 31

1887.

111 W. C. Quinby, London. An electrolyte and depolarising solution for voltaic batteries. Complete specification. January 4

114 W. A. Leipner, London. An improvement in dynamo-electric and electro-dynamic machines. January 4

171 H. C. Gover, London. Improvements in dynamo and other such-like machines. January 6

301 O. Zadig and E. Feldtmann, London. Treatment of refractory ores for the extraction of gold, silver, copper, or zinc, by thermo-hydro-electricity. January 8

305 O. Zadig and E. Feldtmann. Secondary electrical batteries. January 8

563 H. H. Leigh, London—From J. L. Clerc, France. An improved dynamo-electric machine. January 13

629 D. G. FitzGerald, London. Means for effecting the electro-chemical generation of chlorine in metallurgical operations for the extraction of gold and other metals from their ores. January 14

634 J. Hopkins, London. Electricity meters. January 15

700 S. Z. de Ferranti, London. Electric furnaces and apparatus for heating, lighting and carrying on chemical processes; and working such furnaces or apparatus. January 15

701 S. Z. de Ferranti. Electrical meters. January 15

702 S. Z. de Ferranti. Dynamo-electrical machines. January 15

717 W. B. Sayers, London. Disc dynamo-electric machines and motors. January 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

2631 J. G. Johnson—From L. A. W. Desruelles. Electric batteries. December 24

2632 J. G. Johnson—From L. A. W. Desruelles. Treatment of materials used in electric batteries. December 21

2932 A. Schanschieff. Galvanic batteries. January 5

2956 M. Immisch. Electro-motors and dynamo machines. January 12

3476 A. Schanschieff and G. R. Fludder. Galvanic batteries. January 12

4057 P. Haddan—From J. Crosse. Voltaic piles and accumulators. January 19

7966 E. Commelin, G. Bailhache, C. Desmazures, A. L. de Bousignac. Improvements in secondary batteries acting as accumulators of electricity. December 31

12015 R. Eisenmann. Dynamo-electrolytic battery. January 8

12372 L. J. Crossley, W. T. Goolden and A. P. Trotter. Regulating the action of dynamo-electric machines. January 8

14352 J. Wodicka. Armatures for dynamo-electric machines. December 24

15988 W. Elmore, A. S. Elmore, and H. Barrett. Means and apparatus for extraction of metals from ores, especially from "bluestone" and similar complex ores; for refining copper, and manufacturing sulphuric acid electrolytically. December 31

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

1886.

17159 N. Browne, London—From J. Scherbel and T. Remus, Germany. Apparatus for drying strawboard, cardboard, and the like. Complete specification. December 31

1887.

117 A. M. Clark, London—From S. J. Depont, France. An improved manufacture of artificial ivory.

517 H. H. Lake, London—From E. R. Wiggin, United States. Manufacture of corrugated paper and similar fabrics or materials. Complete specification. January 12

523 H. H. Lake, London—From E. R. Wiggin. Machinery for use in the manufacture of corrugated paper and similar fabrics or materials. Complete specification. January 12

647 W. O. A. Lowe, Liverpool. Utilisation of a waste product, and manufacture of an improved antiseptic paper therefrom. January 15

COMPLETE SPECIFICATION ACCEPTED.

1886.

2915 J. C. W. Stanley. Preparation of materials suitable for paper making, and apparatus therefor. December 31

XXI.—EXPLOSIVES, MATCHES, ETC.

APPLICATIONS.

1886.

16868 T. T. Parkinson, Cheltenham, and C. V. Boys, London. Improvements in rockets and other fireworks. December 23

16888 J. T. Coles, London. An improvement in or connected with fusee vestas or wax matches for lighting cigars, pipes, etc. December 23

17035 J. Boag, Glasgow. The construction of blasting cartridges. December 29

1887.

272 H. E. Harris, London. Improvements in or connected with the manufacture of fusees, vesuvians, and the like. January 7

391 W. Bickford-Smith and G. J. Smith, London. Means of igniting fusees without exposing flame or sparks. January 10

393 W. Bickford-Smith and G. J. Smith. Means of igniting fusees without exposing flame or sparks. January 10

410 W. Walton, Sunderland. Method of, and apparatus for, lighting cigars, cigarettes, and pipes in wind or rain. January 11

448 E. Edwards, London—From R. Sjöberg, Sweden. A new or improved explosive. January 11

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

758 W. D. Borland. Explosive substances, and absorbent materials therefor. January 19

3578 A. H. Durnford. Manufacture of gunpowder. December 31

3593 O. Bowen, A. S. Tomkins, and J. Cobeldick. Manufacture of gunpowder. December 31

8368 T. Johnston and G. Smith. Detonators or caps to be used with dynamite or other explosive. January 5

11137 W. Holmstrom, London. Machinery for applying igniting material to match sticks or splints. December 24

19079 C. R. E. Bell. Lighters for pipes, cigars, etc. January 12

UNCLASSIFIED.

17088 P. Ward and W. S. Oliver, London. Improvements in the manufacture and production of carbon. December 30

17140 A. Bessell and A. Bessell, London. Improvements in the process of purifying graphite. December 31

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The Society of Chemical Industry.

COUNCIL FOR YEAR ENDING JULY, 1887.

THE JOURNAL.

NOTICES.

Notice is hereby given that the next Annual General Meeting will be held in Manchester in the month of July, 1887, instead of in Glasgow as originally arranged; the Annual General Meeting in Glasgow being postponed until 1888.

This change originated in a generally-expressed desire, resulting in a special invitation from the Manchester Section, supported by the cordial acquiescence of the Glasgow Section. It will enable members to visit both the Royal Jubilee Exhibition in Manchester, and the Glasgow Exhibition of 1888.

Full particulars as to the Manchester Meeting will appear in a subsequent issue.

The supply of copies of the Journal for January, 1882, and January, 1883, being now exhausted, the Secretary would be glad to receive communications from members possessing extra copies of those numbers, in good condition, with a view to purchase.

Should sufficient applications for complete sets be received, the numbers will be reprinted.

Authors of communications read before the Society or any of its Local Sections are requested to take notice that, under Bye-Law 43, they cannot receive the prescribed 50 copies of their communications unless they comply with the condition laid down in that Bye-Law—viz., that they give notice of their desire to receive such copies upon their manuscript before sending it to the Editor. Mention should also be made as to whether the Discussion is to be included in the reprint.

CHANGES OF ADDRESS.

H. E. Bunker, l/o Stocks Street; 21, Great Cheetham Street West, Lower Broughton, Manchester.

G. L. Cabot, l/o Cambridge; 82, Water Street, Boston, Mass., U.S.A.

C. F. Claus, jun., l/o Old Ford; 9, Nassington Road, Hampstead, N.W.

A. De Deken, l/o Cincinnati; 18, Rue Villette, Liège, Belgium.

C. S. Doggett, l/o Munich; Boston, Mass., U.S.A.

Jno. Dyson, l/o Cheetham; Derby Court, Long Millgate, Manchester.

C. D. Ekman, l/o London; Dieppe, France.

S. H. Emmens, l/o London; Silver Valley Railway Co., Thomasville, N.C., U.S.A.

A. Haacke, l/o Fenchurch Street; Kieselguhr Wharf, Gainsbro' Road, Hackney Wick, E.

Walter R. King, l/o Cannon Street; 22, Lawrence Pountney Lane, London, E.C.

H. A. Lawrance, l/o Harlesden; Brockweir, Grosvenor Road, Gunnersbury.

Jas. Lawrence, l/o Stevenston; 7, Bellgrove Terrace, Glasgow.

D. A. Louis, l/o Harpenden; 77, Shirland Gardens, London, W.

R. F. Macfarlane, l/o Cwm Avon; Grange Metal Works, Jarrow-on-Tyne.

E. G. Marks, l/o Unity Street; 38, Cornwallis Crescent, Clifton, Bristol.

N. H. J. Miller, l/o Regent's Park; Harpenden, near St. Albans.

Dr. Hugo Muller, Journals to 13, Park Square East, Regent's Park, N.W.

Jas. Murrie, l/o Gallowgate; 103, Bishop Street, Anderston, Glasgow.

J. A. Nichols, l/o Bankfield Terrace; Spring Bank, New Mills, near Stockport.

G. B. Nicoll, l/o Devonport; c/o Balfour, Guthrie & Co., Portland, Oregon, U.S.A.

J. H. Porter, l/o Tudor Street; 165, Queen Victoria Street, London, E.C.

Dr. A. Ree, l/o Leeds; 121, Manchester Road, Middleton, near Manchester.

T. Anderson Reid, l/o Weston; 11, Mersey View, Runcorn.

Jno. Robinson, l/o Farnworth; 5, Elizabeth Terrace, Ditton, Widnes.

A. Sansone, l/o Technical School; Vauxhall Chemical Works; and 8, Bignor Street, Cheetham Hill, Manchester.

A. H. Tuer, l/o Manchester; 28, Church Street, Standish, near Wigan.

P. G. W. Typke, l/o Cannon Street; 22, Lawrence Pountney Lane, London, E.C.

A. Wache, l/o Crepy; 6, Rue Lambrecht, Douai, France.

Thos. Warne, l/o Walsall; c/o Rainham Ferry Vitriol Co., Rainham, Essex.

J. D. Watson, l/o Whitehaven; Irtside, Holmrook, Carnforth.

C. J. Whittaker, l/o Plantation Street; Willow House, Accrington.

Chas. Wigg, l/o Runcorn; Hoole Bank, Chester.

W. Collingwood Williams, l/o 86; 68, Grove Street, Liverpool.

E. H. Winstone, l/o Bloomsbury Square; 2, Victoria Mansions, London, S.W.

CHANGE OF ADDRESS REQUIRED.

James Park, l/o Millburn Chemical Works, Glasgow.

LIST OF MEMBERS ELECTED, 2nd FEBRUARY, 1887.

R. H. Annison, 16, Water Lane, Tower Street, London, E.C., master lighterman.

J. F. L. Brunner, Trinity Hall, Cambridge, undergraduate.

W. A. Carlyle, The Elms, Yardley, Worcestershire, electrolytic engineer.

John Dickson, 16, Dale Street, South Side, Glasgow, oil merchant.

G. E. R. Ellis, 10, Colville Road, Bayswater, London, W., analytical chemist.

Upfield Green, Liebenheim, Clarendon Road, Watford, Herts., stationer.

R. A. Hadfield, Newhall Road, Attercliffe, Sheffield, steel founder.

Josef Hawliczek, 10, Bentley Road, Liverpool.

Wm. Scott Heriot, Pln. Leonora, Demerara, W.I., sugar factory engineer.

D. Lloyd Howard, City Mills, Stratford, London, E., chemical manufacturer.

Wm. Hume, 18, Lonsdale Terrace, Edinburgh, scientific instrument maker.

John Hunter, Minto House Medical School, Edinburgh, analytical chemist.

Jno. Laing, 38, Warrender Park Terrace, Edinburgh, chemical and oilworks manager.

Jno. McGlashan, Woodneuk, Gartcosh, near Glasgow, chemist.

W. G. McKellar, Eglinton Chemical Works, Irvine; N.B., analytical chemist.

J. G. McKinlay, 15, Charing Cross, Glasgow, student of chemistry.

T. E. Marshall, 4, East Castle Street, Merchiston, Edinburgh, student (science).

C. H. Master, Friary Brewery Co., Guildford, brewer.

Jno. Morison, Newbattle, Dalkeith, N.B., mining engineer.

Robt. Pinkney, 18, Bread Street Hill, London, E.C., manufacturing chemist.

Oliver Quibell, Highfield, Newark-on-Trent, manure manufacturer.

David E. Reid, Kaboonga Mines Co., Kilkivan, Maryborough, Queensland, smelter.

Thos. Robinson, 401, West Street, Glasgow, manager, Glasgow Alum and Ammonia Co. Limited.

A. Humboldt Sexton, 7, Sefton Terrace, Rutherglen, Glasgow, professor of chemistry.

G. M. P. Vary, 25, Grange Road, Edinburgh, science student.

Arthur J. Walker, 38, Portsdown Road, Maida Vale, London, N.W.

Alfred P. Wire, 1, Seaton Villas, Birkbeck Road, Leytonatono, schoolmaster.

RESIGNATIONS CANCELLED.

C. D. T. Bushill, Broom Hill, Great Barr, Birmingham.

Thos. Crawford, 10, Haldane Terrace, Newcastle-on-Tyne.

A. G. Jackson, The Willows, Martintown, Port Douglas, Queensland.

Wm. Kennedy, 28, Royal Exchange Square, Glasgow.

H. Meadows, Spa Place, Humberstone Road, Leicester.

V. de M. Mellin, The Polygon, Ardwick, Manchester.

Fred. H. Paul, c/o The Steel Co. of Scotland, 150, Hope Street, Glasgow.

Deaths.

G. T. Chinnery, Redheugh Chemical Works, Gateshead.

Astley P. Price, 47, Lincoln's Inn Fields, W.C.

J. M. Roberts, of Cornbrook Chemical Works, Manchester. —At Southport, February 18.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

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John Spiller.
G. C. Trewby.
J. Williams.

Hon. Local Sec. and Treasurer: Thos. Tyrer, Garden Wharf, Church Road, Battersea, S.W.

The meetings of the London Section will be held on the first Monday in each month.

SESSION 1886—87.

Prospective Arrangements.

March 7.—Messrs. Cross and Bevan, "Mr. Hermite's Method of Electrolytic Bleaching."
„ Mr. J. Mactear, "The Castner Process for Production of Sodium."
„ "A New Method of Elevating Liquids, specially applicable to Acids."
April 4.—Triennial Election of Sectional Officers and Committee.
„ Discussion on Papers read 7th March.
„ Dr. J. M. H. Munro, "Further Notes and Experiments on the Composition and Manurial Value of Filter-pressed Sewage Sludge."

Notices of Meetings and Papers will be found in the Scientific Journals.

Notices of papers and communications to be made to the Local Secretary.

ON THE VARIOUS FORMS OF FILTER PUMPS OR WATER-JET ASPIRATORS.

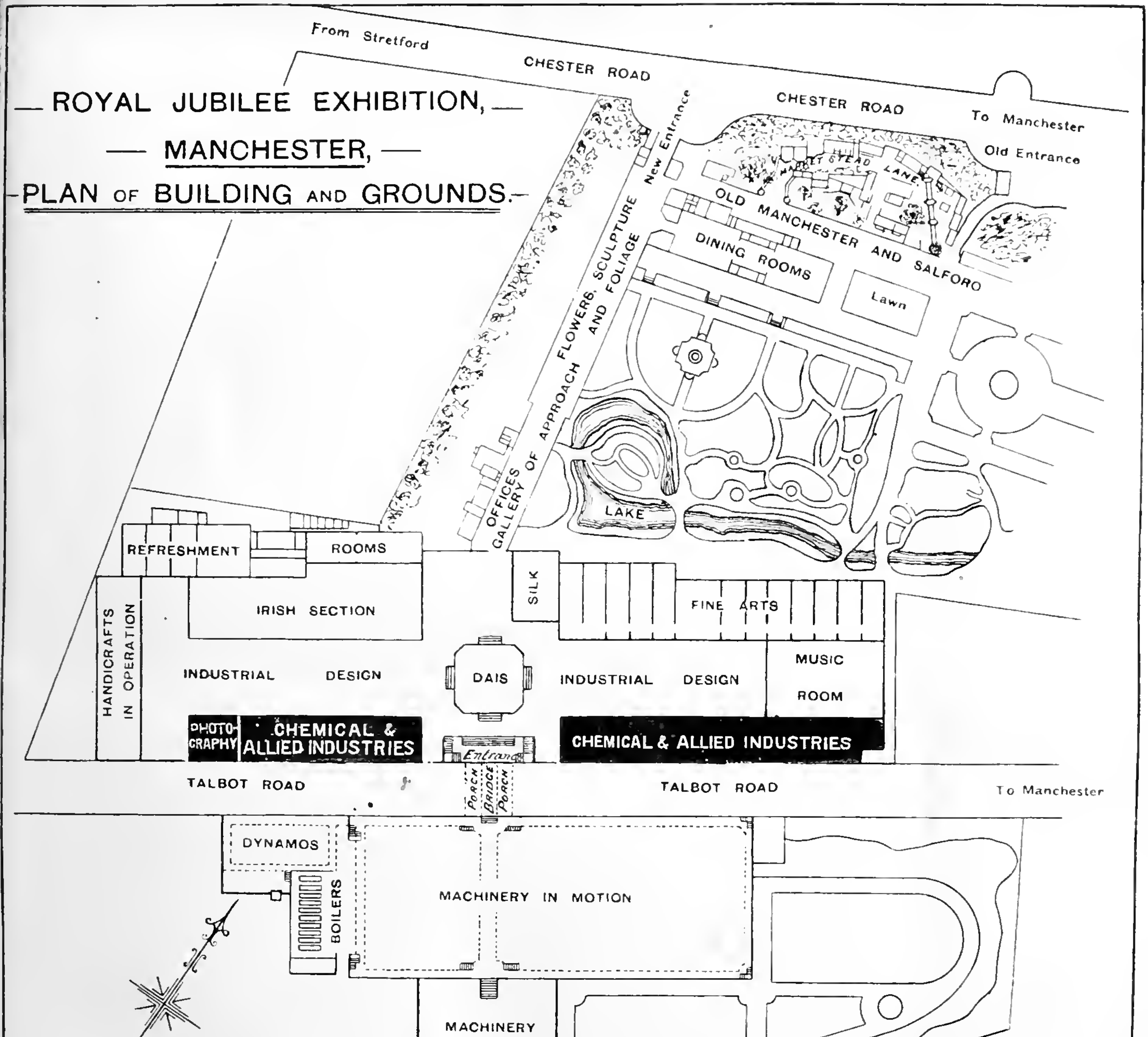
BY T. FAIRLEY, F.R.S.E., F.I.C.

Since the publication of Sprengel's paper on the vacuum in 1865, and Bunsen's paper on an improved mode of filtration in 1868—69, the applications of the air pump have become so familiar as to be considered almost indispensable in chemical and physical laboratories.

As commonly understood, the air pump and the aspirator are machines which differ not in principle, but only in degree, and Geissler, Joule, and others have constructed mercurial aspirators which are air pumps capable of giving very perfect vacua.

The pumps used in chemical and physical laboratories may be classified as follows:—

1. Barometric or weight pumps, which are: (*a*) *Statical*, such as the Geissler, which exhaust air by the alternate emptying and filling of a vessel forming the upper part of a barometric column. (*b*) *Dynamic*, such as the Sprengel, in which the continuous falling of a liquid through a tube of uniform



A Ground Plan of the Royal Jubilee Exhibition of Manchester is herewith inserted, and shows the position of Section III. (Chemical and Allied Industries). Space has been allotted to applicants as far as the area available will allow.

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R. F.
Jarrow
E. G.
Clifton,
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Dr. H
Park,
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Portlan
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bore and of a length rather greater than the barometric column of the liquid produces the exhaustive effect. The barometric pumps are generally worked by mercury or water.

2. Momentum or pulsation pumps, such as the Jagn pump, which depend on the momentum and pull of an intermittently interrupted column of the liquid used, the action being similar to that of the hydraulic ram used for lifting water by the suddenly interrupted flow of a larger quantity of water. In the ram the water is raised in front by the momentum; in the Jagn pump air is pulled in behind.

3. Injector or pressure pumps, which depend on the laws relating to the flow of fluids (either gases or liquids) through an expanding mouth-piece. In laboratories they are generally worked by water, but they may be worked almost equally well by any gas or liquid under pressure, and acting in any position downward, horizontal, or even upward. They are identical in principle, and nearly so in construction, with the injector water pump described by Professor J. Thomson in 1852 for raising water, or with the steam injector patented by Giffard for feeding steam boilers.

The injector pumps are the most numerous of those employed in laboratories, and they are adapted either to work with a small quantity of water at high pressure, or with a larger quantity at low pressure.

The following is a brief statement of the history of the subject:—

1. *The Barometric or Weight Pump:—*

(*a*) *Statical.*—Toricellian vacuum discovered, 1643.

1722. Description, by Swedenborg, of a barometer pump.

1847. Patent for application of the barometric column in the working of vacuum pans in sugar refineries, granted to J. Johnstone.

1855—58. Geissler introduced and used his mercurial barometric pump, which has been modified and adapted for various purposes.

1862. Improved by Töpler, *Dingl. Poly. Jour.* 1862, p. 426; 1865, by Poggendorff, *Ann.* cxxv. p. 151; 1865, by Jolly; 1873, by Mitscherlich, *Pogg. Ann.* cl. p. 420; 1881, Bessei-Hagen, *Wiedemanns. Ann.* xii. p. 425; also by Dittmar (Challenger Reports), 1882; F. Neisen, *Zeitsch. f. Instrumentenkunde*, 1882, p. 285.

1885. Improved pump patented in Germany, by Albert Geissler, D.R.P., 32,224. Modifications of the statical pump have also been described by Pflüger, Weinhold, Lane Fox, Joule, and many others.

(*b*) *Dynamic.*—The trompe or water air blast used from time immemorial.

1852. G. S. Johnson described an aspirator for use in laboratories worked by a constant stream of water, *Chem. Soc. Qu. Jour.* 1852, p. 186.

1865. Sprengel published his researches on the vacuum and described his pumps worked by mercury or other liquids, *Jour. Chem. Soc.* 1865, p. 9.

1868. Bunsen described pump and apparatus for quickened filtration and other purposes, *Ann. der Chem. u. Pharm.*, Bd. 148, p. 277. Modifications of the Sprengel pump or parts of it have also been described by McLeod, Swan and Stearn, Gimingham, Weinhold, St. Claire Deville, and many others.

2. *The Momentum or Pulsation Pump:—*

1872. Jagn described his pump which he had used for about two years before that time, *Pogg. Ann. der Phys. u. Chemie.* 148, p. 317.

1873. Mendelejeff on the "Pulsir pump," *Annalen der Chem. u. Pharm.* 165, p. 63—91.

1872. Thorpe on a modification of the Jagn pump, *Phil. Mag.* 1872, p. 249.

1873. Foote on a modification of the Jagn pump, *Amer. Jour. Science and Arts*, 1873, p. 361.

1876. Linneman on a practical form of water air pump, *Annalen der Chem. u. Pharm.* Bd. 176, p. 327; 177, p. 295.

1886. O. Witt on a simple air pump, etc., *Chem. Zeit.* 10. 760: also this Journal, Sep. 1886, p. 503.

1886. A. Bornträger on same, *Ber.* 19, 1690.

3. *Injector or Pressure Pumps:—*

1719. Hawksbee, one of the improvers of the common brass air pump, found that on blowing through a tube into a small box, the air escaping by another tube opposite the first, the pressure of air in the box became less than that of the atmosphere, and not greater. Fig. 1.

1738. Daniel Bernouilli discovered that water passing from the narrow to the wide end of a conical tube could draw into its current water from another vessel at a lower level. Fig. 2.

1801. Eytelwein published his "Handbuch der Mechanik und der Hydraulic," in which he described many original experiments and investigated the laws relating to the discharge of water from variously-shaped outflow tubes.

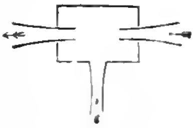

FIG. 1.

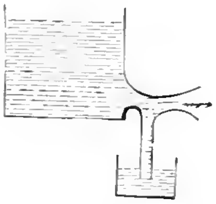

FIG. 2.

1830—50. The steam-jet aspirator used in ventilating mines, patented by S. Carson in 1840. Also used by G. Stephenson in improving the draught of the locomotive.

1852. Prof. James Thomson described a jet pump for lifting water (*Brit. Ass. Reports*, 1852—53), and found that it utilised about one-fifth (0·18) of the power due to the falling water. Through A (Fig. 3) water descends from a height, passes through the jet C, and comes out at B, drawing up with it water from D.

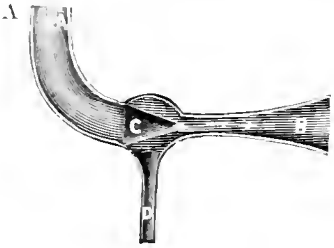

FIG. 3.

1855. Clement Desormes (*Ann. de Chem. et de Phys.*, 36, p. 39), showed that a plate of metal or wood brought near an orifice in the side of a reservoir of compressed air will, after the first repulsive action of the current, be attracted; and will remain rapidly oscillating within a short distance of the opening.

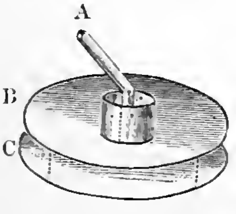

FIG. 4.

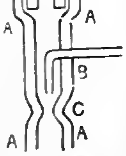

FIG. 4*a*.

This experiment may be demonstrated by blowing between the fingers against a piece of paper, or by two circular cards mounted as in Fig. 4, as described in Weinhold's "Physics," p. 315. On blowing through the tube A (Fig. 4), the card C, which is hung from the card B by three small threads, is drawn up and attracted towards B. This, like each of the preceding experiments, is a case of the passage of a fluid through an expanding mouthpiece, causing a diminished pressure as compared with that in front, which in each case is that of the atmosphere.

1855. C. F. Delabarre patented a steam pump for lifting water, ventilating mines, etc.

1858. Giffard patented his injector for feeding steam and other boilers, of which numerous modifications have been described and patented.

1872. Christiansen described the first water air pump on the injector principle, Fig. 4*a*. A is a piece of thick-walled indiarubber tubing which has been perforated at B by a hot wire and constricted at C by a small ring fitted over the tube. On inserting at B a short piece of bent glass tubing drawn out to a jet, and connecting the top end of A with the water supply under moderate pressure, air is drawn in through the bent tube and a considerable vacuum obtained.

1874. J. Lovett described an improved filter pump, *Chem. News*, May 15, 1874, p. 209.

1874—75. P. Casamajor on "Implements of Filtration," described a filter pump in the *American Chemist*, April, 1874, and *Chem. News*, June 27, 1875, p. 33.

1875—76.—Injector air-pumps were introduced and used by dentists at, or prior to, this date. Fisk's "Automatic Saliva Ejector" is described, and figured in an American price list of 1876.

Injector air pumps worked by steam have also been proposed for laboratory use by Lovett, Kochinke, Teclu, and others.

1875. Arzberger and Zulkowsky described the first form of their pump, *Ann. der Chem. u. Pharm.* Bd. 176, p. 327.

The dates and references to the other pumps are each given where known, with the table of tests relating to the pump.

The pumps which are now most frequently used in laboratories are those of the injector class. As certain errors are found in text-books regarding fluid motion in injectors, a few additional experiments may be quoted.

Mr. W. Froude, in his address to the Mechanical Section of the British Association at Bristol in 1875, showed that water under any head H, Fig. 5, passing through a contracted pipe, does not exert an excess of pressure on the converging surface which it meets (as is commonly supposed), but that the pressure is least at the contracted part, as shown by the levels in the gauge-glasses *a*, *b*, *c*, *d*, *e*. Further, he showed that if the pipe be much contracted the pressure can be still further reduced; so that if we have two cisterns A and B connected by such a contracted pipe, a portion of the pipe as at C, Fig. 6, may be removed without the flow of the liquid from A to B being interfered with; the water rising in the cistern B to within a slight distance of its level in A. At F, in the central line of the connecting pipe, the full head of pressure *h* is exerted, but there is practically no movement, while at C there is no pressure, but very rapid movement; and on trial it is found that the pressure and velocity of movement being convertible and complementary, the pressure at any point varies according to the square of the velocity at that point. In any given case the pressure observed, plus that which has been lost in producing velocity, is constant, and equal to the total head of water *h*, Figs. 5, 6, 7. If we modify Mr. Froude's experiment and cut off the pipe at E, Figs. 6, 7, the pressure at E is then simply the general pressure of the atmosphere, and the whole of the pressure due to the head of water in A has been changed into velocity; but the velocity at C must be greater than the velocity at E by as many times as the sectional area of the pipe at C is contained in its area at E. The velocity at C being so much greater than at E, the pressure must be less, and therefore less than that of the atmosphere. The tube G may be regarded as a gauge to show the minus pressure, and, if this gauge be supplied with mercury, the latter

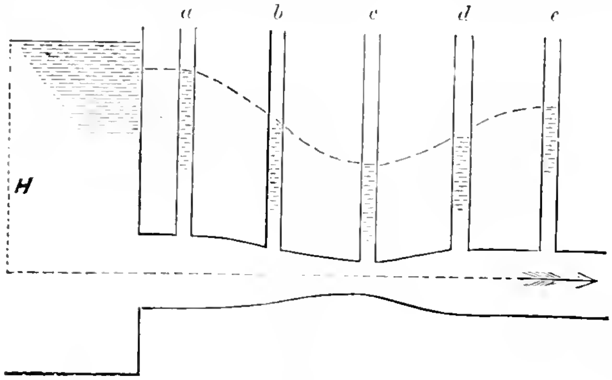

FIG. 5.

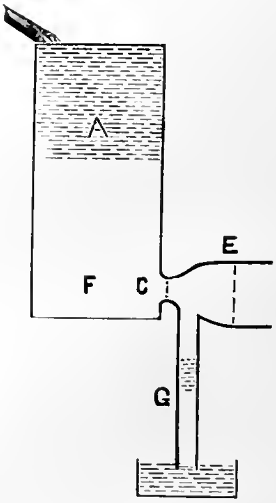

FIG. 7.

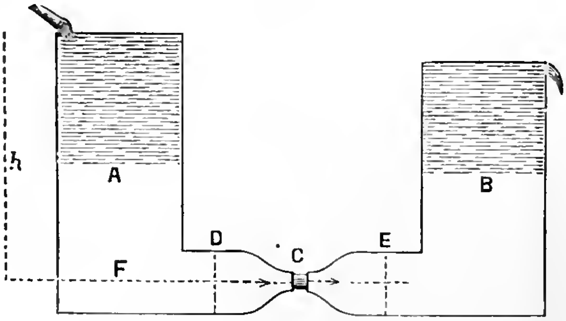

FIG. 6.

will, under favourable conditions, rise to near the height of the barometer.

In place of a head of water or other liquid, one may also use air, steam, or any gas under pressure, to obtain similar results, and with air or steam under high pressure, working one of these injector pumps, a good vacuum may be obtained.

On examining the various pumps of this class which have been invented, we find that in some, Figs. 11, 12, 14, 16, etc., the water enters by a jet placed immediately over a constricted tube, the narrowest part of which may be called the neck. I have measured the areas of the jet and of the neck in a considerable number of pumps from different sources, and find that the area of the neck is generally about twice that of the jet; or the diameter of the jet is to that of the neck as 1 : $\sqrt{2}$ or 1 : 1·4. This proportion differs somewhat from that given by Arzberger and Zulkowsky—viz., 1 : 1·22, but though the mathematical formulæ employed by these authors appear to me to be correct, yet the number of experiments quoted in the paper are far too few to *establish* the above ratio; and on applying more recent experiments to the same formulæ a ratio of the two diameters approximating to that of 1 : 1·4 is obtained. It, therefore, appears that in many cases the makers of these pumps have by trial or accident made use of dimensions which come near to those required by theory.

By taking the working part of an ordinary Sprengel pump as arranged by Bunsen, one can place within the upper part of the fall tube, close to the jet a smaller tube constricted in its upper part to form a neck, and projecting below a little beyond the Bunsen tube, so that the two can be connected air-tight by means of an indiarubber tube stretched and tied over both. By this means one obtains a very efficient injector pump, in which one can, by using neck-pieces more or less constricted, study the best working proportions. My experiments carried out in this manner point to the ratio of diameters of jet and neck 1 : 1·4 as probably the best.

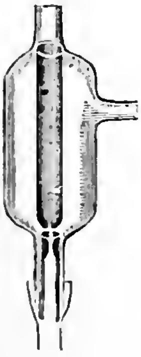

Fig. 8.

In this form of pump, Figs. 11, 12, 14, 16, 17, 18, 19, 20, 24, and 26, the air is drawn in all round the jet as it enters the neck and expanding mouthpiece; but the air may be drawn in on one side only, as in Figs. 21 and 22, or the air may be drawn in by a central tube, in which case the water fills the body of the pump, as in Figs. 13, 15, 23, 27, and 28. These variations make no difference whatever in the principle or working of the pump, but with the last-mentioned form—Fig. 13, made of brass to unscrew—one can insert in the neck small tubes of different sizes, and so alter the working of the pump. Generally, the smaller the neck the higher the pressure required to produce any given degree of exhaustion; and the wider the neck, up to a certain limit, the less the pressure. On the other hand, those pumps which work with low pressures require very much more water than those working with high pressures. On multiplying the weight of water used per minute by its head or pressure in feet, we obtain, in foot pounds (marked F. P. in the tables), the power required to produce the exhaustive effect in one minute's working of the pump. Compared in this manner, the low pressure pumps are much less efficient machines than the pumps working at higher pressures.

The pumps, Figs. 11, 12, and 15, have a trap at the bottom serving to break the continuity of the water current, and so avoid a kind of setting of water and air in particular parts of the outflow tube. by which the efficiency of the instrument might possibly be slightly diminished. In others the same effect is sought by bending the tubes, as in Geissler's, Fig. 19, or Bulk's, with the tube bent at right angles.

It is important to have the water supply much in excess of that required by the pump used. On turning the water tap full on, it should supply in one minute a quantity of water two to three times the maximum quantity required by the pump in the same time. Neglect of this point has led to some pumps being condemned unjustly.

The apparatus used in testing the various pumps is shown in Fig. 9, excepting that with the pumps requiring much water, larger water pipes had to be used. A is the flexible water-supply pipe, formed of sound rubber tubing, covered with a double thickness of strong canvas sewn over it. B is a strong iron bottle capable of standing any pressure up to or over 100 pounds per square inch, and having one tube going to the bottom, passing through the neck, and joining the water pipe by a T-piece. For the purpose required the larger this bottle is the better, but a good sound iron mercury bottle may be used. The bottle B being air tight and water-tight under pressure, and being also full of air when connected with the water pipe, the air cannot escape, but is compressed by the pressure of the water. At a pressure double that of the atmosphere the air will be compressed to one-half its volume (say at 15 pounds pressure), and the bottle will be half full of water; at 30 pounds pressure the bottle will be two-thirds full of water. Thus, when the water pressure varies, as it frequently does, in towns where there is much demand on the service, the bottle B, by its reserve of water under pressure, helps to keep the supply of water to the pump more constant, and may be said to act as a governor. The water taps, where there is a high water pressure, are generally plug taps, which do not permit the pressure from the bottle B to go back into the water main.

The glass tube C (connected by a T-piece with the water pipe) serves as a manometer, and contains within it a small tube, 30in. long, closed at the upper end, and dipping in mercury. This small tube is full of air, which by its compression, read off on the barometer scale adjacent, indicates the water pressure. D is a Bourdon's pressure gauge for the same purpose, which was used more especially when wider water tubes had to be employed. At *a* is a tap which, on closing it, shows the pressure on the closed pipes. I is a Geissler pump placed so as to show the working of the apparatus. J is the water outflow tube. The pump is connected, through the safety tube F, with the barometric gauge E, and with the receiver to be exhausted—which is the bottle H—having a capacity of 2·2 litres, and provided with a special tap similar to that at the bottom of the safety tube F (see Fig. 10). By turning these taps, either air can be admitted or the connection can be shut off. The safety tube F has a Bunsen valve fitted inside to the end of the tube G. To work the apparatus the water is turned on to the pressure required, the tap on the bottle H is turned to connect with the pump, and the tap at the bottom of F is turned open to the air. All being ready, this latter tap is turned round to shut off air and connect with the receiver H, at the same instant that the minute clock K is started. The clock K has a fly back action, and strikes the minutes, so that the observer can read off the barometric gauge E as each minute is struck, and record the results. After ten minutes, the tightness of the connections is tested by shutting off first the pump and then the bottle; and if the gauge E remains at a constant level, or so that the fall is within 1mm. in five minutes, the readings are accepted as approximately accurate. Part of the connections can also be tested separately by closing the tap *b*; and on then working the pump only F and the gauge E are exhausted, which, with a good pump, attains its limit within a minute. The absence of air bubbles when the end of the outflow tube dips in water shows that the connections between *b* and the pump I are air-tight.*

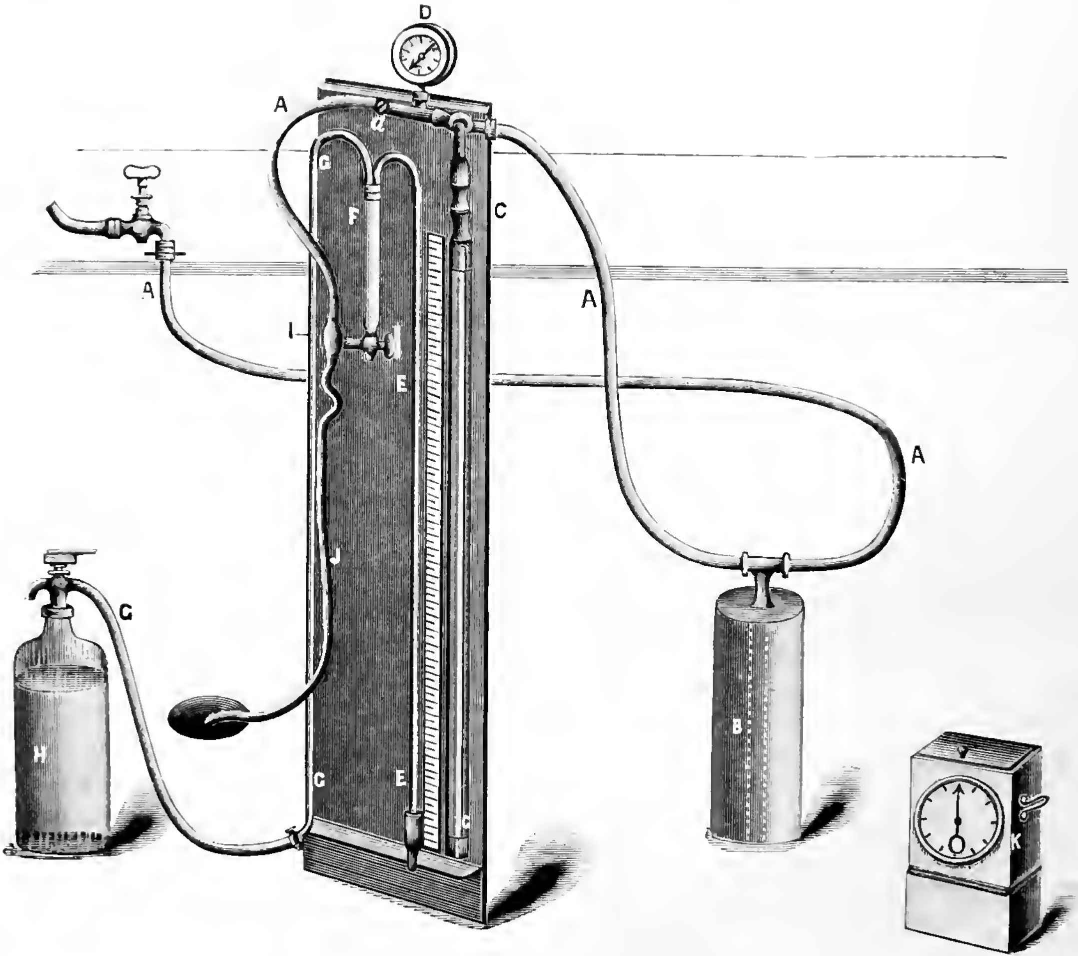

Fig. 9.

The above apparatus can be worked by one person, but it is more convenient to have two—one to watch the clock and give an eye to the water-pressure gauge, the other to watch the barometric gauge, and, if necessary, to keep his hand on the water-supply tap in case of fluctuations of pressure.

Fig. 10 shows the tap in full size which is fitted in various parts of the apparatus. It is made from an ordinary good gas tap, which should be specially ground, as they are never air-tight when sold. The little screw and washer at the bottom of the plug are first removed, and a hole bored from C into the ordinary through hole of the tap, which is then closed by solder on one side at D; then trimmed and reground, so that the hole in the plug is from the bottom to one side only. A short piece of tubing, F F, is then soldered on to the body of the tap as shown, and a pointer E soldered on the top of the plug to point which way it is open. When the plug is turned across in the ordinary position of a closed tap it is closed to both A and B; when the pointer points towards A it opens towards A, and if towards B to B. The tube F F is fitted air tight by means of a stopper in the bottle H (Fig. 9).

It is by means of these taps, which I devised about three years ago, that during that time one pump has been utilised to do all the exhaustion work of my laboratory. The pump is connected with a main pipe passing along the laboratory tables, and at each worker's place is a bottle similar to H (Fig. 9), which

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* To obtain the requisite tightness of taps and connections, I have found a lute, made by heating indiarubber with a small proportion of vaseline, of great service. The vaseline is melted over a very small burner in a porcelain basin, and the rubber (preferably good black rubber, though it may be old rubber that has lost its quality) added in small portions as it dissolves in the vaseline. The basin may be covered with a glass plate, and the slow heat used should cause scarcely any distillation of volatile products from the rubber. The lute I have used contained about 10 per cent. of vaseline to 90 per cent. of rubber.

is fixed below the table: the neck of the bottle, or better, the tube F F (Fig. 10), rising above the table. One end of the tap (say B) is connected with the vacuum main pipe by soldered lead tubing; the other end of the tap A is connected by a flexible tube with any filtering apparatus or other vessel to be exhausted.

In using this arrangement, it will be observed that all the vacuum supplied at A must come from the bottle below F F, and not from the main pipe, which is then shut off. When the vacuum is not required at A, the tap is turned round towards B, to raise the degree of exhaustion in the bottle. As there are a number of such bottles in the laboratory, they form together a vacuum reservoir of some capacity, available at once without waiting. If well fitted, the taps retain the vacuum for several days.

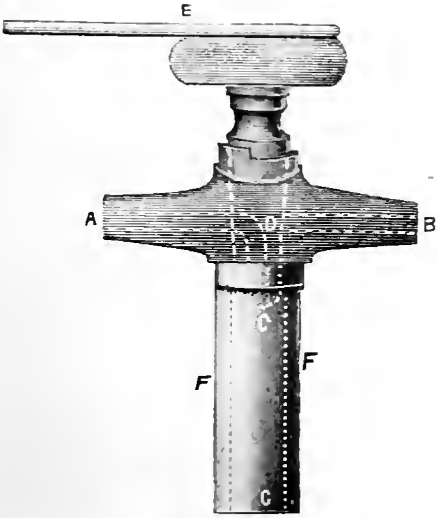

Fig. 10.

Explanation of the Tables.

In the tables which follow, the column below P. indicates the water pressure in pounds per square inch; F.P. is the product of the weight of the water used in pounds multiplied by its fall in feet; or, what is the same, its "head" in feet; F.P. therefore means ordinary foot pounds of power or energy spent in working the pump. The other columns give the readings of the barometric gauge in mm. of mercury during the successive minutes' working of the pump up to ten minutes. Thus, the pump shown in Fig. 11 gives, at ten pounds water pressure, after one minute's working, a vacuum, in receiver bottle H (Fig. 9), of 2·2 litres capacity, equal to 302mm. of mercury; and after ten minutes' working of the pump, a vacuum equal to 702mm. of mercury. The last column to the right states the quantity of water used per minute in litres.

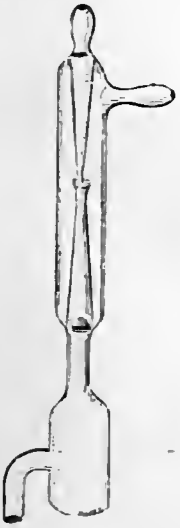

Fig. 11.

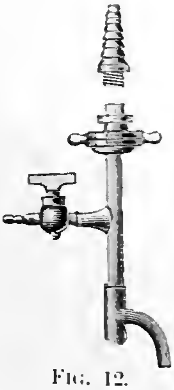

Fig. 12.

The results given are corrected to a common barometric column of about 760mm., and may therefore be compared with one another. Sometimes there is air in the water pipes, which introduces an error into these time tests; but the irregularity so introduced is generally noticeable, and is eliminated by repeating the tests. The greater number of the tests have been repeated several times.

The first minute's working gives, in my opinion, a fair test of the practical usefulness of the pump; and during the first minute the influence of slight possible leaks or imperfections in the testing apparatus is at a minimum.

The following factors may be useful:—

Pounds per square inch multiplied by 2·31 equal feet head of water.
Pounds per square inch divided by 14·7 equal atmospheres.
Pounds per square inch multiplied by 0·0703077 equal kilogrammes per square centimetre.
Pounds per square inch multiplied by 51·7 equal millimetres column of mercury.
Foot pounds multiplied by 0·138 equal kilogrammetres.

Fig. 11.—ALVERGNIAT FRÈRES' GLASS PUMP.

		Minutes Exhausted.											Quantity of Water used per Minute.	
P.	F.P.	1	2	3	4	5	6	7	8	9	10			
10	153	302	421	499	586	598	629	653	673	686	702	mm.	3	litres.
15	305	395	525	598	645	676	697	712	723	731	738	..	4	..
20	445	442	588	642	684	710	728	736	740	744	748	..	4·38	..
25	625	481	619	684	715	733	744	746	749	750	750	..	4·92	..
30	830	545	650	705	731	743	746	749	751	753	753	..	5·44	..
35	1033	564	679	723	738	746	749	751	753	—	—	..	5·86	..
40	1285	577	689	728	744	749	751	753	—	—	—	..	6·32	..

Used as a blower, this pump blows 5·6 litres of air per minute at 40 pounds pressure; or about a cubic foot of air in five minutes.

Best Results First Minute.—The results obtained from 20 to 40 pounds pressure are all good, but that at 20 pounds pressure is the best. As regards power, the best result is at ten pounds pressure.

The above pump was obtained direct from Messrs. Alvergniat; but another, obtained through Messrs. Townson & Mercer, of London, gave almost identically the same results.

Fig. 12.—ALVERGNIAT FRÈRES' BRASS PUMP.*

		Minutes Exhausted.											Quantity of Water used per Minute.	
P.	F.P.	1	2	3	4	5	6	7	8	9	10			
10	115	182	240	301	351	385	419	447	474	489	504	mm.	2·26	litres.
15	229	240	325	416	466	497	525	549	569	588	603	..	3·00	..
20	333	322	431	502	551	585	614	632	650	663	676	..	3·28	..
25	534	385	499	567	614	645	668	681	694	705	715	..	4·2	..
30	702	426	544	608	650	676	694	705	715	723	728	..	4·6	..
35	868	452	575	634	671	692	703	718	725	731	733	..	4·88	..
40	1033	468	598	650	681	702	718	725	733	736	738	..	5·08	..

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* Alvergniat Frères, 10, Rue de la Sorbonne, Paris.

Used as a blower, this pump blows, at 40 pounds pressure, 4·35 litres of air per minute; or a cubic foot of air in 6·5 minutes.

Best Results First Minute.—As regards quantity of water used, this pump gives nearly equally good results at 20, 25, 30, 35, and 40 pounds pressure; but the result obtained at 20 pounds pressure is slightly in advance of the others. As regards power used, the best result is at the lowest pressure—10 pounds.

Fig. 13.—ARZBERGER & ZULKOWSKY'S BRASS PUMP.

(Made by C. Gerhardt, of Bonn.)

Ann. d. Chem. u. Pharm. 1875, Bd. 176, p. 327.

P.	F.P.	Minutes Exhausted.										Quantity of Water used per minute.
		1	2	3	4	5	6	7	8	9	10	
5	117	223	325	377	433	446	487	517	539	559	576mm.	4·61 litres.
7	159	251	367	449	495	532	559	572	587	598	604 ,,	5·20 ,,
10	341	288	442	498	559	617	661	690	700	709	717 ,,	6·12 ,,
15	567	377	517	640	690	714	722	727	730	732	734 ,,	7·44 ,,
20	882	472	647	685	709	717	725	730	734	736	738 ,,	8·68 ,,
25	1210	535	664	700	719	723	729	734	739	740	741 ,,	9·52 ,,

Used as a blower this pump blows in one minute 4·363 litres of air at 25 pounds pressure; or a cubic foot in 6·5 minutes.

* *Best Results First Minute.*—For quantity of water at 5 and 7 pounds pressure; for power at 5 pounds pressure.

Th. Schorer, in 1878 (*Zeitsch. f. Anal. Chemie*, 1878, p. 177), describes a low pressure pump, which he claims was shown in 1873, in the Chemical and Physical Section of the German Association for the Advancement of Science.

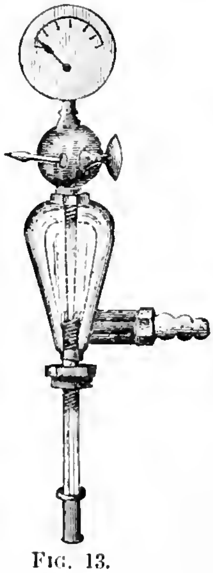

Fig. 13.

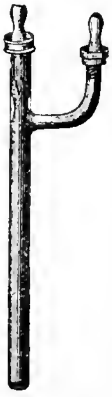

Fig. 14.

Fig. 15.

At 15 pounds pressure the author states that his pump requires 20 litres of water per minute. As ordinary water-pipe fittings do not often supply this quantity of water, I have not tested Schorer's pump. It is a pump adapted for very low pressures, ranging from 2 to 15 pounds, and using from about 10 to 20 litres of water per minute.

Fig. 14.—BENDIX' BRASS PUMP.

(From Lenoir & Forster, Vienna.)

P.	F.P.	Minutes Exhausted.										Quantity of Water used per minute.
		1	2	3	4	5	6	7	8	9	10	
10	150	226	242	245	—	—	—	—	—	—	—mm.	2·96 litres.
15	223	299	330	333	—	—	—	—	—	—	— ,,	3·58 ,,
20	427	356	413	416	—	—	—	—	—	—	— ,,	4·20 ,,
25	646	406	517	536	538	511	—	—	—	—	— ,,	5·08 ,,
30	793	442	577	621	642	655	658	—	—	—	— ,,	5·20 ,,
35	989	468	608	660	688	694	699	705	707	—	— ,,	5·56 ,,
40	1204	478	621	673	694	705	707	712	715	—	— ,,	5·92 ,,

Used as a blower this pump blows 4·65 litres of air per minute, at 40 pounds pressure; or a cubic foot of air in 6 minutes.

Best Results First Minute.—For quantity of water at 20 to 30 pounds pressure; for power at 10 pounds pressure.

Fig. 15.—BULK'S GLASS PUMP.

Described 1876, *Ber. d. Deutsch. Chem. Ges.* 1876, p. 1871, *Fres. Zeit. Anal. Chem.* 1878, p. 198.

P.	F.P.	Minutes Exhausted.										Quantity of Water used per minute.
		1	2	3	4	5	6	7	8	9	10	
10	96	160	205	229	252	263	273	283	294	296	302mm.	1·87 litres.
15	174	226	293	346	382	408	426	447	465	484	504 ,,	2·30 ,,
20	279	286	384	442	491	520	550	577	592	621	634 ,,	2·74 ,,
25	397	338	452	520	567	603	629	650	666	681	694 ,,	3·125 ,,
30	538	395	527	585	630	660	684	704	712	724	734 ,,	3·525 ,,
35	692	426	588	632	674	694	712	720	725	731	736 ,,	3·89 ,,
40	866	458	595	660	697	715	725	731	735	733	741 ,,	4·26 ,,

Used as a blower, this pump blows, at 40 pounds pressure, 2·65 litres of air per minute; or a cubic foot of air in 10·6 minutes.

Best Results First Minute.—For quantity of water at 30 pounds pressure; for power at lowest pressure.

Another pump of this pattern, from a different source, gave from 10 to 20mm. lower results. The position of the jet, and the proportions of the jet and constriction, are here very important. A Bulk's pump obtained from Vienna with bent tube at bottom (instead of the hole at the side, as described in the author's paper) gave very unsatisfactory results, and appeared to be out of proportion.

Fig. 16.

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* The bottom outflow tube being adjustable, this pump may, with a very large water supply, give quicker evacuations than the above. On the other hand, by screwing up the bottom tube to its utmost limit, this pump assumes a high-pressure character, and then works up to 40 pounds pressure, using much less water. See Tables A and B.

Fig. 16.—FINKENER'S GLASS PUMP.

Winkler's Industrie Gaze, I. p. 23.

P.	F.P.	Minutes Exhausted.											Quantity of Water used per minute.	
		1	2	3	4	5	6	7	8	9	10			
10	—	—	—	—	—	—	—	—	—	—	—	mm.	5·2	litres.
15	—	—	—	—	—	—	—	—	—	—	—	,,	5·92	,,
20	—	—	—	—	—	—	—	—	—	—	—	,,	6·68	,,
25	819	447	525	530	533	—	—	—	—	—	—	,,	6·68	,,
30	1165	551	621	637	610	643	—	—	—	—	—	,,	7·64	,,
35	1466	582	697	728	741	745	747	—	—	—	—	,,	8·21	,,

Used as a blower this pump blows 6·38 litres of air per minute, at 35 pounds pressure; or about a cubic foot of air in 4·4 minutes. At lower pressures than 25 pounds the pump works only very slowly, but using the gauge only without the receiver, the gauge rises to 260, 396, 515, 671 and 733mm., at pounds pressure 10, 15, 20, 25 and 30 respectively.

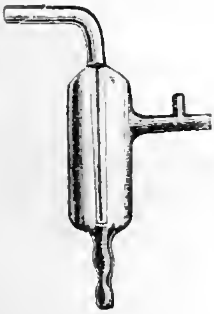

FIG. 17.

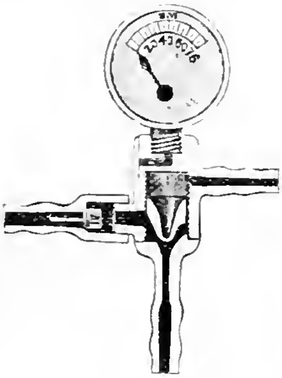

FIG. 18.

Fig. 17.—FISCHER'S GLASS PUMP.

Dingler's Polyt. Jour. 221, p. 136; 225, p. 105; 1877.
Zeitschr. f. Analyt. Chem. 1877, p. 312.

P.	F.P.	Minutes Exhausted.											Quantity of Water used per minute.	
		1	2	3	4	5	6	7	8	9	10			
10	89	203	293	348	377	408	432	452	468	481	494	mm.	1·75	litres.
15	167	247	374	455	499	528	549	567	580	593	608	,,	2·185	,,
20	254	286	426	523	575	616	640	660	679	689	691	,,	2·5	,,
25	357	322	473	572	634	676	702	718	728	733	736	,,	2·81	,,
30	473	380	528	616	671	705	723	731	738	741	744	,,	3·1	,,
35	610	408	556	642	686	715	733	738	741	744	746	,,	3·42	,,
40	724	449	585	679	720	741	751	754	755	756	756	,,	3·56	,,

Blowing power of the pump at 40 pounds pressure 5·15 litres of air per minute; or a cubic foot of air in 5·5 minutes.

Best Results First Minute.—For quantity of water used at 30 pounds pressure; for power used in foot pounds, 10 pounds pressure.

Fischer's glass pump, obtained from various sources, gave nearly constant results.

Fig. 18.—FISCHER'S BRASS PUMP.

(Made by DREYER, ROSENKRANZ & DROOP, of HANNOVER.)

P.	F.P.	Minutes Exhausted.											Quantity of Water used per minute.	
		1	2	3	4	5	6	7	8	9	10			
10	56	135	187	238	278	317	351	387	411	439	450	mm.	1·1	litres.
15	99	205	276	333	382	426	468	504	538	562	600	,,	1·3	,,
20	154	268	348	421	473	517	556	588	616	640	658	,,	1·51	,,
25	219	312	403	473	528	569	601	632	658	679	691	,,	1·72	,,
30	290	351	458	550	577	603	617	671	689	705	718	mm.	1·9	litres.
35	377	390	500	567	614	650	676	691	710	720	728	,,	2·12	,,
40	459	421	535	598	612	673	697	710	723	731	736	,,	2·26	,,

Used as a blower this pump at 40 pounds pressure blows 3·24 litres of air per minute; or a cubic foot in 8·7 minutes.

Best Results First Minute.—For quantity of water at 40 pounds pressure; for power at 10 pounds pressure.

This is a high-pressure pump with very small holes, and for the quantity of water used it is very efficient. When received from the makers this pump was fitted with washers of lead, which were not perfectly tight, especially at the higher vacua. The above results were obtained after inserting well greased leather washers in place of those of lead.

FISCHER'S BRASS PUMP.

(Made by DESAGA, of Heidelberg.*)

P.	F.P.	Minutes Exhausted.											Quantity of Water used per minute.	
		1	2	3	4	5	6	7	8	9	10			
10	89	226	294	315	320	—	—	—	—	—	—	mm.	1·76	litres.
15	174	291	408	439	447	450	—	—	—	—	—	,,	2·28	,,
20	305	364	437	502	520	530	533	—	—	—	—	,,	3·00	,,
25	407	390	507	579	614	629	636	640	645	647	650	,,	3·20	,,
30	519	416	541	593	660	681	692	699	705	708	711	,,	3·40	,,
35	641	439	564	637	676	699	711	718	723	725	727	,,	3·60	,,
40	773	491	606	671	707	720	729	735	741	743	747	,,	3·80	,,

Used as a blower, this pump blows, at 40 pounds pressure, 4·7 litres of air per minute; or a cubic foot in 6 minutes.

Best Results First Minute.—For quantity of water used at 40 pounds pressure; for power used at 20 pounds pressure.

This pump is of similar construction to that from Dreyer Rosenkranz and Droop, of Hannover, but it has wider holes and uses more water.

Another brass copy of the Hannover pump is also frequently met with in this country. One that I have tested from G. Mason & Co., of Glasgow, after slightly widening the hole and neck, used from 1·3 to 2·8 litres of water at the above pressures, and gave exhaustions in very nearly the same proportions as the above, but rather better for the quantity of water used.

FIG. 19.

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* Lent by Prof. Hummel, of the Yorkshire College, Leeds.

Fig. 19.—GEISSLER'S GLASS PUMP.

(Sent out about 1876. Also called AMERICAN PUMP.)

		Minutes Exhausted.										Quantity of Water	
P.	F.P.	1	2	3	4	5	6	7	8	9	10	used per minute.	
10	86	117	165	204	237	267	294	317	342	370	380mm.	1·7	litres.
15	156	162	234	283	328	367	400	429	455	478	500 ,,	2·04	,,
20	311	179	260	320	369	411	449	481	510	536	556 ,,	3·06	,,
25	444	205	293	369	424	468	507	539	567	590	608 ,,	3·26	,,
30	585	231	335	408	465	512	547	580	606	627	645 ,,	3·61	,,
35	664	252	361	439	497	541	575	608	629	647	666 ,,	3·70	,,
40	677	307	424	504	559	603	634	658	679	692	702 ,,	3·82	,,
45	897	329	450	528	582	624	653	680	694	705	745 ,,	3·92	,,

Used as a blower, this pump blows, at 40 pounds pressure, 1·76 litres of air per minute; or about a cubic foot of air in 16 minutes.

Best Results First Minute.—For quantity of water used at 45 pounds pressure; for power used at 10 pounds pressure.

Six pumps of this pattern, tested against each other, gave results agreeing with one another within about 25mm., and the agreement was still closer on taking into account the quantity of water used in each case

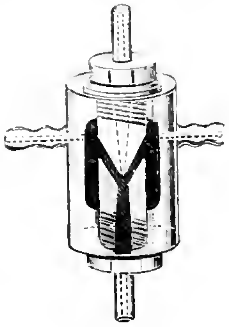

FIG. 20.

Fig. 20.—*BRASS PUMP DEVISED BY DR. KNECHT

(Of the Technical College, Bradford; late of the Polytechnikum, Zurich).

		Minutes Exhausted.										Quantity of Water	
P.	F.P.	1	2	3	4	5	6	7	8	9	10	used per minute.	
20	137	161	296	354	387	406	421	431	447	463	471mm.	1·35	litres.
25	182	252	316	387	416	442	461	478	492	507	515 ,,	1·435	,,
30	227	278	372	421	460	483	507	526	541	551	561 ,,	1·49	,,
35	294	286	393	452	489	518	537	556	569	580	590 ,,	1·65	,,
40	347	294	406	492	526	554	572	587	601	611	621 ,,	1·72	,,
45	442	299	429	518	549	577	598	613	621	634	644 ,,	1·80	,,
PUMP IN HORIZONTAL POSITION.													
40	265	265	372	434	484	518	541	558	577	592	606mm.	—	
PUMP UPSIDE DOWN.													
40	—	268	372	439	486	520	546	563	587	598	611mm.	—	

Used as a blower, this pump blows at 40 pounds pressure 0·9 litre of air per minute; or a cubic foot of air in about 31 minutes.

In proportion to the quantity of water, the best result is obtained at the highest pressure; but in proportion to the power used, the best result recorded is at 20 pounds pressure.

Fig. 21.—KÖRTING'S BRASS PUMP.

(First sent out about 1880.)

		Minutes Exhausted.										Quantity of Water	
P.	F.P.	1	2	3	4	5	6	7	8	9	10	used per minute.	
5	95	195	317	398	471	517	552	582	608	632	650mm.	3·72	litres.
10	238	333	460	547	590	627	658	679	692	702	710 ,,	4·68	,,
15	418	426	554	621	676	689	705	718	723	728	731 ,,	5·18	,,
20	654	499	619	673	699	715	723	728	733	736	738 ,,	6·1	,,
25	966	516	655	697	707	718	728	733	736	738	741 ,,	7·6	,,
30	1269	582	679	712	725	731	733	736	738	741	743 ,,	8·32	,,

Used as a blower this pump blows at 30 pounds pressure 4·15 litres of air per minute; or a cubic foot in 6·8 minutes.

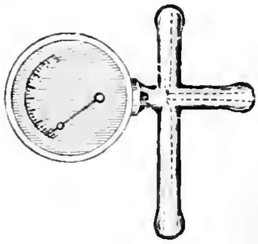

FIG. 21.

Best Results First Minute.—For quantity of water at 20 pounds pressure; for power used at lowest pressure.

Another pump of this make had rather wider holes, and consumed about 20 to 25 per cent. more water, but gave practically the same results as the above for each minute's exhaustion.

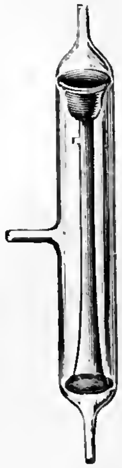

FIG. 22

Fig. 22.—MAWSON & SWAN'S GLASS PUMP, No. 1.

(Sent out about 1876—77.)

		Minutes Exhausted.										Quantity of Water	
P.	F.P.	1	2	3	4	5	6	7	8	9	10	used per minute.	
10	144	182	270	333	377	393	419	432	451	465	473mm.	2·25	litres
15	218	239	361	439	497	511	572	601	621	640	652 ,,	2·86	,,
20	337	273	406	494	562	606	640	660	676	689	697 ,,	3·32	,,
25	462	320	471	562	621	655	681	697	710	715	718 ,,	3·64	,,
30	610	351	520	614	660	686	705	712	718	720	723 ,,	4·00	,,
35	811	439	595	671	710	728	737	741	745	746	747 ,,	4·56	,,
40	968	458	619	689	720	733	741	744	746	747	749 ,,	4·76	,,

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* Lent by Dr. Knecht.

Used as a blower, this pump blows 3 litres of air per minute at 40 pounds pressure; or a cubic foot of air in 9 minutes.

Best Results First Minute.—For quantity of water at 35 and 40 pounds pressure; for power at 10 pounds pressure.

One of these glass pumps has been in common use in my laboratory since 1883, doing all the exhaustion work required. It still works as well as when first put up. The average water pressure at the laboratory is from 50 to 60 pounds in the closed pipes, so that 35 pounds can generally be obtained while the pump is working.

Fig. 23.

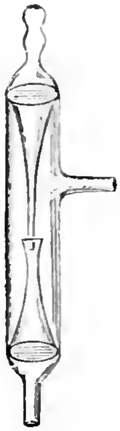

Fig. 24.

Fig. 23.—MAWSON AND SWAN'S GLASS PUMP, No. 2.

(Sent out about 1877—78.)

P.	F.P.	1	2	3	4	5	6	7	8	9	10	Quantity of Water used per Minute.
		Minutes Exhausted.										
10	124	128	200	255	296	333	361	387	413	442	465mm.	2·44 litres
15	198	179	260	315	364	400	439	483	504	530	556 ,,	2·6 ,,
20	286	202	302	372	432	478	514	549	585	595	616 ,,	2·81 ,,
25	399	247	361	445	504	551	590	619	640	658	679 ,,	3·14 ,,
30	537	289	419	504	561	608	642	668	686	702	715 ,,	3·52 ,,
35	818	432	567	637	684	712	731	741	743	746	749 ,,	4·6 ,,
40	1021	447	588	666	707	731	741	743	746	749	751 ,,	5·02 ,,

Used as a blower, this pump blows 2·92 litres of air per minute at 40 pounds pressure; or a cubic foot of air in 9·6 minutes.

Best Results First Minute.—For quantity of water at 35 pounds pressure; for power at 10 pounds.

Another pump of this pattern from a different source gave results nearer to those of the low-pressure pumps requiring much water.

P.	F.P.	1	2	3	4	5	6	7	8	9	10	Quantity of Water used per Minute.
		Minutes Exhausted.										
10	229	257	354	429	481	528	562	588	608	629	642mm.	4·52 litres.
15	393	312	421	512	569	614	642	663	681	697	710 ,,	5·16 ,,
20	586	334	492	582	637	671	691	710	718	725	731 ,,	5·76 ,,
25	859	395	546	629	676	702	718	728	733	736	738 ,,	6·76 ,,
30	1204	426	585	660	697	718	728	733	736	738	741 ,,	7·56 ,,
35	1445	450	608	668	710	723	731	736	738	741	744 ,,	8·12 ,,

Used as a blower, this pump blows 1·88 litres of air per minute at 35 pounds pressure; or a cubic foot of air in 15 minutes.

Best Results First Minute.—For quantity of water at 15, 20, and 25 pounds pressure—that at 25 pounds is slightly the best; for power at the lowest pressure.

Fig. 24.—MAWSON AND SWAN'S GLASS PUMP, No. 3.

(Sent out about 1879.)

In Germany sometimes known as "Volhard's Pump."

P.	F.P.	1	2	3	4	5	6	7	8	9	10	Quantity of Water used per Minute.
		Minutes Exhausted.										
10	70	130	171	211	242	273	299	328	352	374	395mm.	1·38 litres.
15	135	192	255	301	341	377	408	435	461	484	489 ,,	1·77 ,,
20	208	229	296	354	398	437	468	494	517	539	562 ,,	2·05 ,,
25	297	266	316	406	455	491	527	554	572	602	621 ,,	2·34 ,,
30	390	309	403	462	510	551	580	617	629	647	660 ,,	2·56 ,,
35	495	335	446	507	553	588	615	640	674	688	698 ,,	2·78 ,,
40	612	376	494	551	591	623	647	667	682	695	706 ,,	3·01 ,,

Used as a blower, this pump blows 2·25 litres of air at 40 pounds pressure; or a cubic foot of air in 12·5 minutes.

Best Results First Minute.—For quantity of water at 40 pounds pressure; for power at 10 pounds pressure.

Another pump, rather smaller, from a different source, had more of the high-pressure character.

P.	F.P.	1	2	3	4	5	6	7	8	9	10	Quantity of Water used per Minute.
		Minutes Exhausted.										
20	128	189	268	325	372	413	447	478	502	525	546mm.	1·25 litres.
25	175	224	309	375	426	471	507	536	564	585	606 ,,	1·378 ,,
30	253	263	359	429	481	523	559	588	614	634	653 ,,	1·66 ,,
35	313	294	403	473	525	567	601	627	650	671	686 ,,	1·76 ,,
40	381	320	431	510	562	601	632	658	679	694	705 ,,	1·875 ,,

Used as a blower, this pump blows 1·56 litres of air per minute; or a cubic foot of air in 18 minutes.

Best Results First Minute.—For quantity of water used at 40 pounds pressure; for power at 20 pounds pressure.

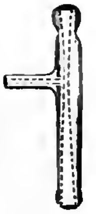

Fig. 25.

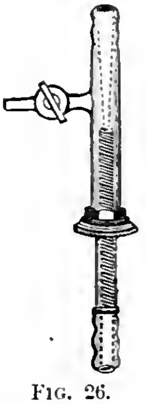

Fig. 26.

Fig. 25.—MUENCKE'S BRASS PUMPS.[1]

SMALL BRASS PUMP.

P.	F.P.	1	2	3	4	5	6	7	8	9	10	Quantity of Water used per minute.
		Minutes Exhausted.										
30	306	356	476	546	598	627	650	668	679	685	692mm.	1·97 litres.
35	381	390	507	580	621	650	676	686	697	705	712 ,,	2·14 ,,
40	468	413	536	603	645	673	692	703	712	715	723 ,,	2·30 ,,
45	551	432	554	616	658	684	702	712	720	724	728 ,,	2·44 ,,
50	625	458	580	610	676	699	712	718	723	728	731 ,,	2·46 ,,

---

* The pumps of this form vary much in their efficiency and consumption of water.

[1] Dr. Robert Muencke, 58, Luisenstrasse, Berlin, N.W.

The pump does not work under 30 pounds pressure.

Used as a blower, this pump blows at 30 pounds pressure 2·4 litres of air per minute; or a cubic foot of air in 12 minutes.

Best Results First Minute.—For quantity of water at 50 pounds pressure; for power at 30 pounds pressure.

Fig. 26.—MUENCKE'S ADJUSTABLE BRASS PUMP.

		Minutes Exhausted.											Quantity of Water used per Minute.
P.	F.P.	1	2	3	4	5	6	7	8	9	10		
15	220	18	179	313	361	377	390	—	—	—	—	mm.	2·88 litres.
20	330	356	460	199	504	506	509	—	—	—	—	,,	3·28 ,,
25	493	426	528	572	580	588	592	591	—	—	—	,,	3·88 ,,
30	622	486	598	645	665	676	684	686	688	—	—	,,	4·08 ,,
35	818	507	632	673	697	705	709	712	715	717	719	,,	4·60 ,,
40	984	535	655	697	712	718	722	724	726	728	729	,,	4·84 ,,

Used as a blower, this pump blows at 40 pounds pressure 4 litres of air per minute; or a cubic foot of air in 7 minutes.

Best Results First Minute.—For quantity of water at 40 pounds pressure; for power at 20 pounds pressure.

A great many experiments were made to obtain the best position by raising or lowering the bottom part of the pump. The above results are the best obtained.

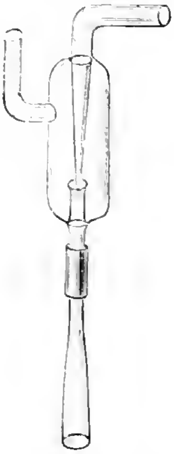

FIG. 27.

FIG. 28.

Fig. 27.—MUENCKE'S GLASS PUMPS.

(Both of these pumps have a low-pressure character.)

		Minutes Exhausted.											Quantity of Water used per Minute.
P.	F.P.	1	2	3	4	5	6	7	8	9	10		
10	226	276	380	458	512	559	592	621	647	665	684	mm.	4·44 litres.
15	418	338	465	551	611	653	681	702	715	725	733	,,	5·18 ,,
20	630	395	515	603	655	689	711	724	731	736	738	,,	6 20 ,,
25	890	429	562	631	681	708	720	733	736	738	742	,,	7·00 ,,
30	1220	458	593	644	702	720	731	734	737	740	744	,,	8·00 ,,
35	1516	486	616	681	744	728	733	738	743	744	745	,,	8·52 ,,

Used as a blower, this pump blows at 35 pounds pressure 3·3 litres of air per minute; or a cubic foot of air in 8 6 minutes.

Best Results First Minute.—For quantity of water at 20 pounds pressure; for power at 10 pounds pressure.

Fig. 28.—MUENCKE'S GLASS PUMP—MODIFIED FORM.

		Minutes Exhausted.											Quantity of Water used per Minute.
P.	F.P.	1	2	3	4	5	6	7	8	9	10		
5	127	234	335	406	458	497	530	556	577	595	611	mm.	5·0 litres.
10	305	307	434	515	572	614	645	668	684	697	717	,,	6·2 ,,
15	573	398	523	608	668	692	712	723	729	737	740	,,	7·48 ,,
20	882	473	601	671	705	720	728	735	738	740	742	,,	8·68 ,,
25	1251	515	629	686	715	729	734	737	740	742	744	,,	9·84 ,,

Used as a blower, this pump blows at 20 pounds pressure 2·76 litres of air per minute; or a cubic foot of air in 10 minutes.

Best Results First Minute.—For quantity of water at 15 and 20 pounds pressure; and for power at the lowest pressure.

Tables A (p. 75) and B (p. 76) are summaries from the preceding, with ratios calculated between the air blown or pumped out and the water used.

Table A shows results, with the pumps used as blowers, which may be also regarded as exhaustions, with a receiver of infinitely large capacity, or as the rate of exhaustion at the *exact instant of starting the pump* with any receiver of ordinary limited capacity. The rate of exhaustion varies as the exhaustion proceeds, but the first minute's working gives a useful result for most practical purposes. In the preceding tables given with each pump the exact capacity of the receiver and tubes exhausted was 2·28 litres, and Table B gives the results of the *first minute's working* with each pump, at various pressures, stated as before. On multiplying these readings of the mercury gauge by the factor 0·03, we obtain the volume of air pumped out in litres, from which the ratios of air and water volumes in the right hand column are calculated; also on dividing the readings by 760, or multiplying by 0·0013, we obtain the volume of air extracted, compared with that of the receiver taken as unity.

Besides the pumps named in the preceding tables I have also tested some others, including the Jagn and the Witt pulsation pumps. The latter are slower in their action than the injectors, as they do not work continuously like them.

The results given in the tables enable any one knowing the average pressure and quantity of water available in his laboratory to select the pump which will give either the quickest evacuation or the highest result in proportion to the quantity of water used.

Some, such as those of Alvergniat, Finkener, Körting, and Arsberger and Zulkowsky, give very high results at their maximum pressure, but use considerable quantities of water. Others give excellent results in proportion to the water used, such as those of Bulk, Fischer, Knecht, the small No. 3 Mawson and Swan pump, and the small brass pump of Muencke.

As mechanical machines doing duty for the energy supplied to them none of these instruments are very perfect; but the best in this respect are the pumps of Fischer, Körting, and the Muencke glass pump, each worked at the lowest pressures.

I have to thank many of the makers and dealers in apparatus for catalogues and information courteously supplied. Besides nearly all the firms in this country, many of whom have taken much trouble in the matter, I have also to thank the foreign firms, some of whose names are given under the various pumps. Professor A. Weinhold, of Chemnitz, kindly gave me some notes and references, and Professor Hummel and Dr. Knecht lent the pumps mentioned in the tables.

DISCUSSION.

The Chairman regarded Mr. Fairley's account of these various pumps, and his explanation of their action, as most lucid. Dr. Sprengel had revolutionised our ideas of physics by what was still known as the "Sprengel" pump, and since then great advances had been made in the construction and application of these apparatus. Considering how extremely convenient they had been found for laboratory purposes, he was surprised that they were not universally adopted, and that people should still be found with patience sufficient to endure the old class of apparatus. He looked forward with much interest to the appearance in the Journal of Mr. Fairley's details, because of their eminent thoroughness and clearness.

TABLE A.

TABLE OF THE BLOWING POWERS OF THE VARIOUS PUMPS.

Name of Pump.	Pressure in pounds per square inch.	Per Minute.		Ratio of Volume of Air to Water.	Price.
		Air blown in litres.	Water used in litres.		
Alvergniat Frères (glass)	10	5·9	6·32	0·93	2s. 6d. & 6 francs.
,, ,, (brass)	40	4·35	5·08	0·85	12 francs.
Arzberger and Zulkowsky (brass)	25	4·36	9·52	0·46	22 M.
,, ,, with outflow tube in lowest position	20	1·51	10·8	0·12	——
,, ,, in highest position	40	3·90	5·44	0·79	——
Bendix (brass).........................	10	4·65	5·92	0·79	5 Fl. (Austrian).
Bulk (glass)	40	2·65	4·26	0·62	1s. 6d.
Finkener (glass).......................	35	6·38	8·21	0·77	3s.
Fischer (glass).........................	40	5·15	3·52	1·46	4s. and 3s. 6d.
,, (Dreyer & Co., brass)	40	3·21	2·26	1·48	26·5M (with gauge)
,, (Desaga, brass)	40	1·73	3·80	1·22	,, ,,
,, (copy, maker unknown, brass)	40	2·90	2·75	1·05	8s. 6d.
Geissler (glsss)	40	1·76	3·53	0·50	1s. 6d.
Knecht (brass)	10	0·90	1·73	0·52	——
Körting (brass)	30	4·15	8·32	0·50	15s.
Mawson and Swan, (No. 1 glass)	40	3·00	4·88	0·62	4s.
,, ,, (No. 2 glass)	40	2·95	4·96	0·59	4s.
,, ,, (No. 3 glass)	40	2·25	3·01	0·75	4s.
Muencke (No. 971 glass)	35	3·30	8·52	0·39	2 M.
,, (No. 970 glass)	20	2·76	8·60	0·32	2 M.
,, (No. 948 small brass)........	50	2·75	2·86	1·12	2·5 M.
,, (No. 952 brass, adjustable with three-way tap)	40	4·00	4·72	0·85	6·0 M.

Mr. J. W. Leather said he would like to know whether Mr. Fairley had ever tried the experiment of a number of persons using the same filter-pump. It seemed to him that the thing might be practicable where a number of students were working together and only a small pressure was required—provided the pipes did not leak. But considering the number of joints that would be required and the generally defective condition of rubber tubing, he feared the joints would be found to leak rapidly. He certainly would not like to try it except as an experiment. The question might become serious if one person wanted to use the pump for working an apparatus for distillation in vacuô, or at a very low pressure—say about 10 millimetres—and another happened to be working the same pump with only a paper filter.

The Chairman said he had found by experience that with an ordinary Körting pump it was possible to have 15 branches at work simultaneously. Under such circumstances, no difficulty had been found in getting a pressure of half an atmosphere in each branch, notwithstanding that ordinary tubing and ordinary gas-cocks were used. He therefore thought no difficulty need arise in dividing a vacuum.

Mr. Leather replied that that was no doubt quite true; but what he wanted to point out particularly was the fact that the practice of distillation in vacuô was a common thing now, and it was absolutely necessary in manipulating some organic substances to distil under a pressure of about 10 or 15 millimetres only. He feared that under such circumstances the practice suggested by Mr. Fairley might have awkward results.

The Chairman invited Mr. Fairley to state to the meeting what his experience of such distillation had been.

Mr. Fairley was sorry to say he had not had much experience in the use of the air pump for the purpose of distillation in vacuô. But as regarded joints, tubes, taps, and so on, he had had considerable experience, and he was satisfied that it was possible to make and keep any ordinary gas-taps air-tight. The rubber tubing which he preferred was the kind used by photographers for working pneumatic shutters, which was quite strong enough to resist atmospheric pressure.

TABLE B.

TABLE OF THE FIRST MINUTE'S WORKING OF THE PUMPS (EXHAUSTING THE RECEIVER OF 2·2 LITRES CAPACITY).

Name of Pump.	Pressure in pounds per square inch.											Ratio of Volume of Air Pumped out to Water used.
	5	10	15	20	25	30	35	40	45	50		
Alvergniat Freres (glass)	—	302	395	412	481	515	564	577	—	—	mm.	Varies from 0·27 to 0·29
,, ,, (brass)	—	182	210	322	385	426	452	468	—	—	,,	,, 0·24 to 0·29
Arzberger and Zulkowsky (brass)	221	286	374	468	530	—	—	—	—	—	,,	,, 0·14 to 0·16
,, ,, with outflow tube in lowest position	—	330	419	507	562	—	—	—	—	—	,,	,, 0·14 to 0·16
,, ,, in highest position	—	156	213	273	342	478	497	512	—	—	,,	,, 0·17 to 0·28
Bendix (brass)	—	226	299	356	406	442	468	478	—	—	,,	,, 0·22 to 0·25
Bulk (glass)	—	160	226	286	338	395	426	458	—	—	,,	,, 0·24 to 0·32
Finkener (glass)	—	—	—	—	447	551	582	—	—	—	,,	,, 0·21
Fischer (glass)	—	203	247	286	322	380	408	419	—	—	,,	,, 0·33 to 0·35
,, (brass, by Dreyer & Co.)	—	135	205	268	312	351	390	421	—	—	,,	,, 0·35 to 0·54
,, (brass, by Desaga)	—	226	261	364	390	416	439	491	—	—	,,	,, 0·36 to 0·37
,, (brass, copy by ?)	—	143	226	265	283	312	346	380	—	—	,,	,, 0·30 to 0·40
Geissler (glass)	—	117	162	179	205	234	252	307	329	—	,,	,, 0·21 to 0·25
Knecht (brass)	—	—	—	161	252	278	286	296	299	—	,,	,, 0·35 to 0·54
Korting (brass)	195	333	426	499	546	582	—	—	—	—	,,	,, 0·15 to 0·23
Mawson and Swan (No. 1 glass)	—	182	239	273	320	331	439	458	—	—	,,	,, 0·23 to 0·28
,, ,, (No. 2 glass)	—	138	179	202	247	289	432	447	—	—	,,	,, 0·16 to 0·28
,, ,, (No. 3 glass)	—	130	192	229	266	309	335	376	—	—	,,	,, 0·28 to 0·36
Muencke (No. 971 glass)	—	276	338	395	429	458	486	—	—	—	,,	,, 0·18 to 0·19
,, (No. 970 glass)	335	431	528	501	629	—	—	—	—	—	,,	,, 0·19 to 0·21
,, (No. 918 small brass)	—	—	—	—	—	356	390	413	432	458	,,	,, 0·53 to 0·56
,, (No. 952 adjustable brass with three-way tap)	—	—	—	356	426	486	507	535	—	—	,,	,, 0·31 to 0·34

ENGLISH-GROWN TOBACCO.

BY ARTHUR WINGHAM.

I DESIRE to introduce to the notice of chemists the results of a few analyses and experiments in connection with what may probably become a new industry in this country—viz., tobacco-growing. It is a subject which is being seriously discussed, and in which a great amount of public and scientific interest is being shown. The results obtained and here recorded are purely of a scientific nature, and tend to throw considerable light on the subject, as far as they go, and have been obtained by experimenting on some samples of English tobacco grown by Lord Harris at Faversham. The work has been carried on in the Chemical Laboratory of the Royal School of Mines and Normal School of Science.

The English samples examined were of four distinct varieties, and were consequently arranged into four lots, which were numbered 1, 2, 3, 4, and examined separately. The following table shows the average measurements and weights of leaves :—

	Length.	Breadth at broadest part.	Weight.
No. 1.	22 inches	14 inches	12·0 grammes
,, 2.	16 ,,	9 ,,	5·4 ,,
,, 3.	20 ,,	7 ,,	9·7 ,,
,, 4.	20 ,,	9 ,,	8·3 ,,

No. 1 was of a uniform moderately-deep dull-brown colour. Rather thick and tough.

No. 2 was of a light brown colour, partly green, and thin and somewhat slender.

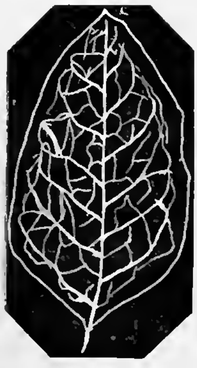

FIG. 1.

FIG. 2.

No. 3 was deeper in colour than No. 1. Thicker also and tougher.

No. 4 was somewhat similar in shape to No. 1, but lighter colour and thinner, although moderately tough.

All the leaves were damp and unfermented.

Before experimenting with them they were dried at 100° C. until no further loss in weight took place.

PERCENTAGE OF WATER.

No. 1	21	No. 3	22
„ 2	26	„ 4	20

For the purposes of comparison some samples of foreign tobacco were taken, and worked side by side with the English samples, and it would be as well to introduce them here. Unfortunately, these were all fermented leaves, it being impossible to obtain any that had not undergone fermentation. These samples were three in number, and were numbered 5, 6, and 7.

FIG. 3.

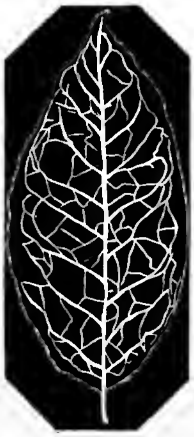

FIG. 4.

No. 5. American leaf strips (Kentucky). Size, 24in. by 10in. This leaf closely resembled No. 1 in appearance and structure, and No. 4 in size. Deeper in colour than any English sample, and reddish-brown. Moderately strong aromatic odour.

No. 6. American Western strips. Size, 18in. by 8in. This leaf was almost exactly the same in appearance and structure as No. 3. Deeper in colour, but not reddish brown. Dark dull-brown, similar to No. 3, but deeper. Slight aromatic odour.

No. 7. German. Size, 15in. by 6in. Very dark in colour, almost black. Thin leaves, not very strong. Veins tough and stringy. Strong odour, but not aromatic.

The samples 5, 6, and 7 were selected—Nos. 5 and 6 on account of similarity to English leaves, and No. 7 as being of European growth. They were also dried at 100° C.

The dried leaves of the seven samples were then remeasured, and the weights notified, and from these data a rough idea of the relative weights of the seven samples was obtained, by calculating the weight in grammes of one square foot. These results are only approximately accurate, owing to the difficulty of measuring the area of such irregular shapes as those of tobacco leaves. They are, however, useful and of interest. The following are the results :—

WEIGHT IN GRAMMES OF ONE SQUARE FOOT OF LEAVES DRIED AT 100° C.

No. 1	2	3	4	5	6	7
13·4	7·5	11·5	8·8	7·5	8·6	8·8

It will be seen that in the English samples Nos. 1 and 3 the weights per square foot are nearly double those of Nos. 5 and 6, to which they respectively correspond in appearance, etc. During the process of fermentation leaves undoubtedly lose weight, and very considerably so, but whether they would lose so much as the difference above is very doubtful. The samples were then broken up, the mid-ribs removed, and the remainder crushed up into a coarse powder, and thoroughly mixed, to obtain a proper homogeneous sample. It was this perfectly dried sample at 100° C. that was taken in all cases for analysis and experiment, and all results expressed in percentages of leaf, refer to the leaf as being in this condition, the only one which could be relied upon for constancy.

The amount of ash was first determined, with the usual precautions, and gave the following results :—

PERCENTAGE OF ASH.

No. 1	2	3	4	5	6	7
25·28	22·87	21·19	23·63	16·19	21·41	19·63

In every case the ash was white. In burning the English samples it was found necessary to continue the heating from the first, or they would not burn, and the carbon at a dull-red heat burnt off very slowly. In fact, it was with difficulty that the last traces were oxidised. No self-supporting combustion took place at all. On first heating, an oil distilled off, which burnt with a very luminous flame, especially so in No. 3, which also burnt altogether more readily than the others. The foreign leaves, on the other hand, burnt off very readily, and when once ignited continued to burn for some time without continuation of the heat. The exact causes of this difference in burning properties will not be discussed here.

From the above results it will be seen that the ash in the English tobacco is very high. This is of importance, as showing that the soil has been highly manured, and that the plant has been probably forced. This is rather unfavourable, and assuming that the leaves lose weight in fermentation, the percentages of ash in the fermented leaves would be still higher. Taking twenty per cent. as the probable loss in weight during fermentation, the resulting figures would then be in

No. 1	2	3	4
31·6%	28·6%	26·5%	29·5%

—unusually high results. The highest ash recorded in connection with tobacco leaves is not over 23·0 per cent., and the average is very much below this.

PERCENTAGE COMPOSITION OF ASH.

	No. 1.	No. 2.	No. 3.	No. 4.
Potash (K_2O)	8·02	10·15	7·38	9·09
Soda (Na_2O)	4·42	4·84	4·15	4·64
Lime (CaO)	41·02	38·66	43·16	41·26
Magnesia (MgO)	3·96	3·61	3·92	3·36
Chlorine	28·02	26·95	28·52	27·01
Carbonic Acid (CO_2) (by diff.)	11·85	12·60	9·69	10·95
Sulphuric Acid (SO_3)	1·95	3·72	1·55	3·80
Phosphoric Acid (P_2O_5)	2·61	2·78	2·86	3·31
Silica (SiO_2)	1·13	2·76	1·89	2·72
FeAt	nil	nil	nil	nil
	106·31	106·07	106·12	106·11
Deduct ox. eq. for Cl	6·31	6·07	6·12	6·11
	100·00	100·00	100·00	100·00

A complete analysis of the ash was then made of the English samples, which gave the results shown in table at foot of preceding page.

The usual methods of analysis were employed, and therefore need not be detailed.

The ashes of the foreign samples were not analysed. There are many already recorded.

The figures obtained above are very important and useful, and in one or two cases rather remarkable. The most important constituents are the alkalis and the lime. The low percentage of potash, and the high percentage of lime, speak very badly for the quality of the ash, which should contain a much larger proportion of potassium to lime. The high percentage of chlorine is a most remarkable result, and one also detrimental to good quality. The low percentage of carbonic acid is no doubt due, to a certain extent, to the excess of lime over potash, a certain amount of caustic lime being produced at the dull-red heat required to burn off the carbon. Sulphuric acid is fortunately low, and the phosphoric acid is much below the average. Taken altogether, the ashes in the four samples, although varying in percentage in the leaf, seem to be practically the same. Nos. 1 and 3 seem to go side by side in what little difference there is, and the other two are also very close to each other. It will be remembered that Nos. 1 and 3, as also 2 and 4, showed a similarity in weight per square foot.

The total nitrogen was then estimated. The method employed was the combustion method with copper oxide in vacuo. To ensure complete combustion of the organic matter present the substance was mixed with an excessive amount of copper oxide in a fine state of powder, and ground down in the mortar with it, then placed in the combustion tube with the copper roll and burnt in the usual manner. The following are the results :—

PERCENTAGE OF TOTAL NITROGEN.

No. 1	2	3	4	5	6	7
4·62	4·16	4·67	4·65	4·33	3·52	4·24

The total amount of nitrogen is of no particular assistance in deciding as to the quality of a tobacco, but is still of interest, as showing the amount taken up by the plant from the soil. What is present in the case of the English samples appears to be all organic nitrogen, as the leaves were tested most carefully for nitrates, and not a trace could be found. This observation applies to the fleshy part of the leaves only, as the veins contained small traces of nitrates and the mid-rib considerable traces. Nitrates were found in the fleshy part of the American samples, however, although in very small quantities.

The condition in which the nitrogen existed was not thoroughly investigated ; but sufficient was done to cast very serious doubt on the existing ideas of the changes by fermentation and the causes of the combustibility of tobacco.

This subject is being pursued, and I hope at some future date to refer again to it.

The amount of soluble matter in the leaf was next determined. This was done by heating a weighed quantity with distilled water for one hour to a temperature of 80° C. on a steam-bath, filtering off the solution, washing the residue, drying it at 100° C., and weighing it. The following figures were obtained :—

	No. 1	2	3	4	5	6	7
Soluble extract %	58·00	58·64	56·55	57·11	45·76	39·70	38·27
Residue	42·00	41·36	43·45	42·89	54·61	60·30	61·73

The results agree very well in the case of the first four samples, but the percentages of soluble extract are very high. It is recorded, in connection with foreign tobaccos, that the highest extractive obtained in this way was not over 55·0 per cent., and the average is about 10 per cent. lower, so that the extractive in the above four samples is excessive, and tends to confirm the previously-expressed opinion that the plants have been forced.

The amount of ash contained in the dried leaves after extraction with water was next ascertained, as also the amount of nitrogen, with the following results :—

PERCENTAGE OF ASH AND NITROGEN IN THE RESIDUE FROM AQUEOUS EXTRACT.

	No. 1	2	3	4	5	6	7
Ash	10·89	11·40	11·71	11·61	13·22	18·78	11·11
Nitrogen	4·13	3·06	4·25	3·29	3·45	3·21	4·45

It is here worthy of note that the dried residual, or washed leaves, burnt free from carbon much more readily than the original leaf. The above results were calculated into the percentages on original leaf by allowing for soluble extract, and the amount of ash, as also nitrogen, extracted by water was obtained by difference.

PERCENTAGE OF ASH EXTRACTED BY, AND INSOLUBLE IN, WATER.

Ash	No. 1	2	3	4	5	6	7
Extracted (by diff.)	20·71	18·16	16·11	18·65	9·27	10·09	10·72
Not extracted	4·57	4·71	5·08	4·98	7·22	11·32	8·91
	25·28	22·87	21·19	23·63	16·49	21·41	19·63

These results are very important ones, and leave very little doubt as to the artificial nature of the plant. The leaves are immature. The amount of mineral constituents not extracted by water, and which are consequently those forming part of the leaf itself, is exceedingly low in all the English samples, while the amount extracted by water is very high ; thus showing the superficial nature of the mineral constituents.

The high figures above in the four English samples, showing the soluble mineral constituents, no doubt account, to a large extent, for the high percentage of soluble extract of the original leaf.

The amount of soluble and insoluble nitrogen is given in the following table :—

PERCENTAGE OF NITROGEN EXTRACTED BY, AND INSOLUBLE IN, WATER.

Nitrogen	No. 1	2	3	4	5	6	7
Extracted (by diff.)	2·89	2·90	2·82	3·24	2·45	1·59	1·50
Not extracted	1·73	1·26	1·85	1·41	1·88	1·93	2·74
	4·62	4·16	4·67	4·65	4·33	3·52	4·24

It will be seen that a similar result, in a less marked degree, is obtained here, as in the case of the mineral constituents—a higher ratio of soluble nitrogen to insoluble in the case of the English samples than in the case of the foreign. The insoluble nitrogen may be taken to roughly represent the albumenoid nitrogen, as the determination of the albumenoid nitrogen in three of the above samples proved it to be so.

An experiment was next conducted with a view to ascertain the amount of internal combustion that took place when the leaves were heated without contact with air. Unfortunately, these experiments did not prove so simple as was anticipated. Weighed quantities of each sample were placed in small combustion tubes, closed at one end and drawn out at the other, and connected with a Sprengel pump. When a vacuum was obtained the tubes were heated to very dull redness, about the same temperature being employed in each case. The gases which were produced were collected and measured. These gases were found to be mixtures of $CO.CO_2.N$ and hydrocarbons. They were not completely analysed, but the object of the experiment was kept in view, and the oxides of carbon were determined. The CO_2 was absorbed by potash, and the CO by cuprous chloride. In this way was obtained the amount of carbon oxidised within the leaf itself. The following are the results:—

CUBIC CENTIMETRES OF GASES COLLECTED FROM ONE GRAMME OF LEAF BURNT IN VACUO.

No. 2	3	4	5	6	7
99·9	91·8	101·7	119·0	137·9	136·1

PERCENTAGE OF CARBON OXIDISED BY HEATING IN VACUO.

Carbon	No. 2	3	4	5	6	7
Oxidised into CO_2	3·38	3·30	3·63	4·46	4·70	4·33
,, ,, CO	0·56	0·19	0·59	0·80	0·89	0·82
Total	3·94	3·79	4·22	5·26	5·59	5·15

The results of these experiments point in the direction anticipated—viz., that the amount of carbon oxidised in the leaf itself is greater in the foreign and fermented tobacco than in the English and unfermented. A larger quantity of total gas is given off, and the amount of both CO_2 and CO is greater. This may be due to the difference of constitution of the leaves, especially between fermented and unfermented, but it may also arise, and probably does so, from the presence of nitrates to a small extent, and more so to the presence of substances introduced at the time of curing. However, too much importance must not be attached to these figures at present. The experiment requires further investigation and probable modification, before results of definite value can be obtained. By some such experiment it might be possible to measure the internal combustibility of tobacco, and this would be an important test. The above experiment tends to show that this can be done, and it is mentioned here as a preliminary experiment of some interest.

Taking the whole of the results into consideration, the opinion may be expressed that they are not, by any means, all unfavourable. It would be out of place at the present time to discuss the possibility of tobacco-growing in this country being a financial success, and it would be presumptive on the above few results to attempt to prognosticate. The object of these analyses and experiments has been to show the comparative qualities of English and foreign tobaccos. This object has been attained, as far as the present samples are concerned, with the result that some of the most serious faults have been laid bare. If the causes of these faults are prevented and guarded against, there is no telling what the result may be. The English leaves are very heavily handicapped, on account of not having undergone the process of fermentation and curing, and consequently, at present, cannot be fairly judged as a tobacco. What the action of fermentation, storing, etc., will be upon them, it is not easy to say. One thing is pretty certain; that is, that the leaves would improve, and they might produce a good tobacco, at any rate better than some of the inferior qualities imported. It must not be forgotten that in the above experiments they have been compared with good foreign samples.

The leaves are favourable as to size and general appearance, but they lack body. They fail in being immature, but the reason for this is known, and it might be remedied. As regards burning, they will not stand the test applied for cigar tobacco. The ash also, as shown above, is not of the most desired composition, and this is a matter of very considerable importance.

The one great point, however, is the fermentation. The exact changes which take place during this process are at present little known. One or two things are evident—that loss of weight takes place, due to oxidation of carbon and probable elimination of nitrogen, and that the mineral constituents remain unaltered, but increase in percentage as the fermentation goes on. These facts would produce in the case of the English samples an abnormal quantity of ash, and it is obvious that an organic substance, being to a degree loaded with mineral constituents which do not lend any aid to the combustion, but on the other hand tend to retard it, will not burn so freely as a similar substance containing less of those constituents. This is evidenced to a certain extent in the interesting fact notified above, that the leaves which had been digested with hot water, and from which four-fifths of the mineral constituents had been removed, burnt much more readily than the original leaf. Comparing these leaves with one another, No. 3, or the long narrow leaf, is decidedly the best, and seems to have thrived better under the circumstances than the others. It is the heaviest in weight and lightest in ash, and moreover burns better than the others. No. 1 is also a heavy leaf, but it is not of such a good quality.

It must not be forgotten that these remarks apply only to the present samples, which were all grown by Lord Harris, and must not be taken as including all English-grown tobacco. I am at present engaged in carrying out similar experiments for Mr. C. De L. Faunce De Laune, on some tobacco grown at Sittingbourne, and I hope to have the pleasure of laying before this Society still more satisfactory results.

My thanks are due to Dr. Hodgkinson for enabling me to conduct the necessary experiments, and also to Mr. D. A. Louis.

Erratum.—In the Discussion on Mr. Trachsel's paper, page 633, December number, 1886, 4th and 5th lines from the end of Mr. C. T. Kingzett's remarks, *for* "90 per cent. of sodium hyposulphite, and only about 10 per cent. of sodium carbonate," *read* "10 per cent. of sodium hyposulphite, and only about 90 per cent. of sodium carbonate."

Liverpool Section.

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Meetings will be held at University College Laboratory, Brownlow Street, on March 2, April 6 (Annual Meeting), and May 4, and the following papers have been promised:—

Mr. V. C. Driffield, "On Boiler Management."
Mr. C. Longuet Higgins, "On the Manufacture of Potassium Chlorate by means of Magnesia."
Mr. J. W. Macdonald, "On the Manufacture of Arrowroot in St. Vincent, West Indies; its Uses and Adulterants."

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

A Meeting was held in the Chemical Theatre of the University College, Brownlow Street, on Wednesday evening, February 2, 1887.

PROFESSOR CAMPBELL BROWN PRESIDING.

After the minutes had been read and passed, the Chairman announced that he had placed on the table various samples of salol, and the materials from which it is made, which he thought would prove interesting to the members; also a Zeiss's mineralogical microscope containing several improvements, and a collection of starches from various plants yielding starch.

The Secretary read Dr. Archbold's paper, "On the Manufacture of Starch."

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THE MANUFACTURE OF CORN STARCH IN AMERICA.

BY GEO. ARCHBOLD, M.D.

The term "Corn Starch" is exclusively applied to starch made from maize or Indian corn. There is no industry in the United States which has grown so rapidly, and concentrated itself into a small circle of factories, within the last half-century, as this industry. There are now twenty-two factories engaged in the manufacture of starch from Indian corn, and located in six different States, the largest being that at Glen Cove, Long Island, known as the Glen Cove Manufacturing Co. This is probably the largest in the world, there being used each day 336,000lb. of Indian corn in the manufacture of starch.

There are also several glucose factories in different States which also extract starch from Indian corn; but as it is never dried, but immediately converted into glucose or grape sugar, I do not include the latter as starch factories proper.

The number of *wheat starch factories* in the United States does not exceed eight or ten of any magnitude; and careful investigation shows that most of them have no larger capacity than 50 to 100 bushels per diem.

This would indicate a gradual falling into disuse of wheat starch, with a preference to that made from Indian corn.

Cereals containing Starch.—The following is a list of the principal starch-producing cereals, and the percentage yield of starch, according to the published analyses of Krocker (*Ann. Chem.* lviii. 212):—

Wheat Flour	65·21
Rye	61·26
Oats	37·93
Barley	64·63
Buck Wheat	43·80
,, **Meal**	65·05
Indian Corn	65·88
,, **Meal**	77·74
Rice	85·78
Beans	37·71
Peas	38·81

Potatoes yield on an average 18 per cent. of starch. These percentages of starch appear very high; however, they represent high grades of the cereals which seldom or never find their way into the starch factories. During my own experience of over six years in the analysis of Indian corn used in the starch factories, I very seldom found the quantity of starch to exceed 58 per cent. The following analysis of maize represents the average of many samples analysed in the course of one year's working:—

Water	11·20
Starch	51·80
Cellulose	16·40
Gum and Sugar	2·90
Gluten	8·20
Ash	4·80
Fat	4·70
	100·00

I have found from experience that the above represents correctly the quality of corn used in the manufacture of starch.

The following is an average of 114 of the analyses of Indian corn from various parts of the United States, as given on pages 215—217 of the report issued by the Department of Agriculture, Washington, 1883. Assuming 54 per cent. of the 70·69 per cent. of carbohydrates therin stated to be starch, then we have a fair idea of the composition of the Indian corn used in these industries:—

Water	10·01
Ash	1·52
Oil	5·20
Carbohydrates	70·69
Fibre	2·09
Albumenoids (N = 1·67 per cent.)	10·16
	100·00

Process of Manufacture.—The process universally adopted is that known as the alkaline or "sweet process," and which is adapted to the extraction of starch from maize better than any other process known, with one exception, and that is the "sulphurous acid process," which latter has some objections which will be explained later on. However, this much may be said of the SO_2 process in its favour—that it not only gives a larger yield and starch of a very high grade, but much more of the waste material—gluten, etc.—is recovered in a marketable condition; and now that the manufacture of SO_2 has become a staple branch of industry, especially in Great Britain, there is no reason why certain mechanical difficulties, or rather objections, should not be overcome, and this process become as general as the "alkaline."

The reason why the alkaline process is called the "sweet process" is to distinguish it from the "sour or acid process" adopted for the extraction of starch from wheat. This latter consisted in macerating wheat or wheat flour (thoroughly incorporated with water) until the alcoholic fermentation, produced at the expense of the sugar of the wheat and part of the starch converted into fermentable sugar, had thoroughly oxidised or converted the said sugar into acetic acid, which generally requires from three to four weeks. The gluten of the wheat was then readily dissolved, and the starch liberated and separated by mechanical means, and further purified by washing in water. (For full particulars of this old "sour process," and which is still universally adopted in America with very little modification by wheat starch makers, see Muspratt, article "Starch," vol. ii. p. 950; "Ure's Dictionary," vol. iii. p. 745.)

In the treatment of maize this process is impracticable, inasmuch as the gluten of this grain is not so easily soluble in acetic acid solution as in the case of wheat and cereals of a like description, and the time required in its maceration, to obtain a similar result in dissolving the gluten, would not only impair the quality of the starch, but much loss in quantity would be the result.

In extracting starch from maize by the "sweet process," six operations are necessary, of which the following brief synopsis will give you some idea, before I enter upon further details:—

1. The maize is subjected to a cleansing process by means of powerful fans or blowers called "winnowing." This cleans the grain from superfluous bran, dirt, cob, etc. In this process there is generally a loss of over 1¼ per cent. of the grain, from the above bran, dirt, and pieces of cob, etc., being removed.

2. The clean grain is now placed in tanks called "steeps," and covered with water at a temperature ranging from 70° to 140° F., according to the experience of the manufacturer. These steeps vary in capacity, holding from 1000 to 6000 bushels each. This process requires from three to ten days, or until the grain is sufficiently soft to grind.

3. The grinding process, which is generally accomplished by means of burr-stone mills and iron rollers.

4. The straining process, in which the ground corn

is washed and strained through a series of revolving sieves with a current of water. In some factories horizontal square shaking sieves are used.

5. The regrinding of the magma and collection of the impure starchy matter.

6. The treatment with caustic alkali, and separation in the vats called separators.

As it is of the utmost importance to the after treatment of the impure starch with the solution of caustic alkali in the vats named "separators," that as much of the oil and mineral constituents of the corn be removed as is possible, and the nitrogenous matter surrounding the starch of the grain, such as gluten and albumen, be thoroughly softened, so as to be brought to a condition to be acted upon by the alkali, the process of steeping the grain is one of great importance, and various methods have been adopted. In most factories the corn is allowed simply to remain in contact with the water for a period of eight or ten days, or until the putrefactive fermentation has set in, and the corn soft enough to grind. During this period much sulphuretted hydrogen is given off, thereby creating a most offensive odour in the neighbourhood of the works, and even permeating the entire city when winds are favourable. Another process of softening the grain is that known as the Mack process, which is used in Germany in treating rice and maize for starch, and which consists mainly in treating these cereals, in a properly constructed iron tank, with water (with or without alkali), and gas or air pressure. The inventor claims that, by the aid of compressed air, the cereals soften quicker, and yield from 6 to 8 per cent. more of the finished products, thus saving time, plant, and chemicals. When water without the addition of alkali is used with the grain, a tank so constructed, lined with lead or non-corroding material, might be used with advantage. For full particulars of this process see *Dingl. Polyt 256*, 35.

A similar process has been patented in this country since the publication of Herr Mack's process, but it is doubtful if the process will come into general use. It remains to be proved what influence such treatment of the grain would have on the physical condition and appearance of the finished products. The most rational system of this treatment of maize is that used in the Glen Cove Starch Works, previously referred to, and is the system known as the Durgen system. In this factory there are three steeps or tanks, each holding 5500 bushels of corn, which, at 56lb. per bushel, represent 310,800lb. of corn in each tank. Through each of these tanks there is a continuous stream of water heated to a temperature of 130—140° Fahr., which flows for three days at the rate of about 10,000 gallons into each tank per day, after which the corn is sufficiently softened for the grinding process. It has been estimated that no less than 315lb. of solid matter per day is extracted from all these tanks of grain, and which may be divided into—

128lb.	Oil and other organic substances.
61lb.	Albumenoids.
126lb.	Ash of corn and constituents of the water.
315lb.	

In this wet and softened condition the grain is conveyed to the grinding-room, where it is first ground in burr-stone mills, and from thence passed through heavy iron roller mills, when it is carried by wooden spouts and hoppers to the straining department, generally situated on the floor underneath the mills. These strainers consist, first, of large revolving sieves on a slight incline. The first series are of brass wire, and sixty meshes per square inch; the second are of fine bolting silk cloth, such as we find in flour mills. The ground pulpy mass falls with a stream of water into the first series, and then through the second into collecting tanks underneath. The mixed fine and coarse magma which falls from the end of these sieves is then conveyed to the mills, reground, and again passed through these sieves with a stream of water as before, until the water ceases to come through milky. The magma thus exhausted of its starch is then conveyed to a separate room, and, in some factories, dried, and sold as cattle food, or, in its moist condition, as "swill," for hog food. The magma (mixed), as taken from the sieves, has the following average composition:—

Water	62·27
Ash	·27
Oil	1·31
Carbohydrates	28·90
Fibres	1·58
Albumenoids	5·67
	100·00

The above milky fluid, washed from the magma and collected in the tanks underneath the sieves, as above stated, is now allowed to rest or subside for some hours, when the supernatant liquid is allowed to run to waste. The residue, washed and agitated with clean water, is again allowed to repose, and the supernatant liquid run to waste. This second washing is necessary, as, in warm weather especially, the suspended impure starch is apt to turn sour, which would interfere with subsequent operations. The deposited impure starchy matter is now pumped up in a semi-liquid condition into large vats, called "separators," which are generally on the top floor of large factories—this impure starch consisting chiefly of starch and gluten, cellulose and fat.

These so-called separators are huge wooden vats, of a cylindrical form, several feet high, and about the same in diameter, provided with a series of plug-holes in the sides, arranged towards the bottom in equal distances (generally six to twelve inches), and the vat is provided with a mechanical stirrer with necessary gearing. In all well-regulated factories there is generally a series of such vats. The impure starchy matter being pumped into these vats, is diluted with clean water and the agitators put in thorough motion; and here is added cautiously, by degrees, a solution of caustic soda of a gravity 7—8° Baumé until the milky liquid has changed to a greenish yellow colour. The agitation is then continued for some hours, so that when a sample taken from the vat or separator in a glass beaker separates into two layers, the bottom layer dark coloured, and the upper pure white, being the starch.

It may be here remarked that the glutenous or nitrogenous matter of corn consists of two kinds—one which is dissolved by a solution of caustic alkali, the other which is precipitated, and is of a dark yellowish-green colour. The separation being complete, the machinery is stopped and the separated starch and glutenous matter is allowed to deposit, and the supernatant solution of gluten, oil, etc., is allowed to run to waste, and the deposited starch and glutenous matter washed and agitated with water, and allowed to stand at rest for fifteen to twenty minutes to allow the insoluble gluten to subside, when the first plug is drawn, and the starch suspended in the water is allowed to flow into a properly arranged gutter to vats underneath; then the next plug, and so on until the last plug has been drawn. The plugs are replaced and the vats again filled with water, and the operation repeated as before. This operation, called the syphoning process, is generally repeated three times, and the three runnings of starch are collected in three separate vats forming the three grades of starch of the factory. The deposited matters, nearly exhausted of starch by the above means, are all collected and run over what is called the inclined table, which is a series of wide gutters, side by side, sixty feet long, with a fall of from three to six inches at the lower end. The deposited matters are allowed to flow evenly and slowly with a stream of water, the light materials running off the end to waste, while the starch deposits in the gutters.

The starch (1, 2, and 3) syphonings, as above stated, being collected in different vats, are allowed to repose, the supernatant liquid being run to waste ; and then the starch is well agitated with water—in some cases, at this stage, it is necessary to resyphon as before.

During these operations in summer, when the atmosphere is hot, it is necessary to keep the starch in this semi-liquid state cool, and large lumps of ice are kept floating in the vats.

These three grades of factory starch, produced as above, being clean, are again agitated with water and allowed to flow through a fine sieve of bolting cloth into oblong tanks of wood, called "settlers"—the cloth retaining any fibre or glutenous impurity while the finer cells of starch run through with the water. The starch now deposits in these tanks hard and firm on the bottom, while the water can be run off clear to the surface of the starch.

The next stage of the manufacture is to collect this deposited starch in moulds : these moulds are oblong boxes with a perforated bottom. A piece of muslin is damped with water, and packed in the bottom and sides of these boxes, so as to form a perfect lining of the damp muslin. The moulds so prepared are all arranged on stands side by side, and the deposited starch dug out of the settlers and firmly packed in these moulds to the brim, and as the moisture drains, and the starch subsides in the moulds, more starch is added until it ceases to further settle ; in this condition it is allowed to remain for some hours, when the moist starch (which now contains some 60 per cent. moisture) is turned out on to a table, and the oblong block cut through into equal and convenient sized blocks or squares. These pieces, or squares, are then placed on an absorbing medium, or floor, which is generally made of porous brick covered with a layer of plaster of Paris cement ; this floor is heated and dried by means of a series of steam pipes underneath. After being exposed on this warm absorbing surface some hours, the starch contains over 45 per cent. moisture, and is ready for the crusting process. That is, the blocks are placed side by side on a rack, shelf, or shelves, in a kiln, and allowed to remain therein, exposed to a heat of 120° to 130°, until they assume a yellowish brown crust on the outside (this crust generally varies from ⅛in. to ¼in., more or less, in thickness), when they are taken out, and the crust removed —when the interior is perfectly white, the heat having removed the impure matter to the outside. In this form it is wrapped in paper, and again returned to the kiln, and exposed to a temperature of 156° F. to 176° F. and allowed to remain therein exposed to such a degree of heat for a term of three to seven days, or even two to three weeks, according to the nature and size of the crystals required (the pieces of starch of commerce are called crystals in factory language). If the higher temperature and short period in contact therewith be used, small pipe crystals are the result. If the lower temperature and longer time, the starch is obtained in larger chunks and more irregular. These various forms of lump starch are in great demand in the American market.

The starch, as it comes from the kiln in this form, and when taken from the paper, falls into these numerous pieces and forms. Sometimes a large, roundish piece in the centre (called a boulder) still retains its moisture as steam, and is of a fine nature, but, on being thrown amongst the hot starch, assumes the same character as the rest.

Starch from the kilns is practically dry, containing from ½ to 1 per cent moisture, but, on exposure to the air, again takes up moisture, and then retains its commercial condition with 15 per cent. water as moisture.

A sample of starch, taken in the evening, practically dry from the kilns—*i.e.*, containing ½% H_2O—was allowed to remain in the office till the following morning in an open box, was found to have absorbed 5 per cent. moisture, which it had gained from the atmosphere. The larger the pieces, the larger the percentage of moisture will be absorbed. And, even exposed in a comparatively dry store-room in barrels for a length of time, the moisture absorbed varies from 10 to 15 per cent., adding to the original weight of starch. This fact is taken advantage of by some manufacturers as a source of revenue.

The most careful manufacturer, with the most perfect machinery and arrangements, never obtains more than 28lb. on an average of starch per bushel of corn of 56lb., being 50 per cent. of the above average analysis of corn.

The loss of starch by this so-called "sweet process" is invariably 4 per cent., and in some instances known to me, the loss exceeds 8 per cent., which proves carelessness or unskilled workmanship.

The above sketch of the alkaline process describes that which is universally used by the starch makers in the United States with very little variation. The scrapings, crustings and sweepings from the floor, together with the starch collected on the inclined tables, or gutters, called "tailings," are in some factories worked with subsequent batches of starch. In other cases, and I venture to say many, this is dried, ground, and placed in the market as corn flour, "starch flour," or farina. Lately, a quantity of the latter was handed to me for analysis, which had been bought as "potato farina," and invoiced as such by a sausage manufacturer in Syracuse, N.Y. Microscopic and chemical analysis revealed its true nature, as an article unfit for human consumption, being full of microscopic animalculæ, etc.

As previously stated, it is of importance in the early stage of the treatment of the corn to remove as much as possible of the oil and mineral constituents of the grain by steeping, in order that the starch may be rendered as pure as possible, and, as an incidental product, to save all the refuse that can with economy be prevented running to waste. However, in my experience as chemist in a large factory, and past experience in similar factories as to which I have been consulted, careful scientific investigation has proved that, as a rule, not more than 13·7lb. of actual dry refuse matter as hog food is recovered in the treatment of corn, per bushel of 56lb., the 56lb. of corn being represented as follows :—

Starch recovered	**28·000lb.**
Dry refuse as food	**13·700**
Bran (in clearing process)	**0·728**
Original H_2O of corn	**5·626**
	48·054
Actual loss	**7·946**
Total	**56·000**

The above figures show an actual loss of practically 8lb. of the solid constituents of the corn, and which may be divided among the various constituents of the corn as follows :—The above 13·7lb. recovered as *actual* dry food is generally recovered as containing 62 to 80% moisture, and sold as such, seldom in a dry state, and taking the analysis given in a previous part of this paper, which is a very correct average of commercial "starch feed," it is shown to contain 62·27% H_2O, therefore the above 13·7lb. would represent 35 pounds per bushel of moist refuse recovered from 1 bushel of corn as hog food.

The wasted matter is, therefore, divided among the constituents, as follows :—

As showing the distribution of the loss among the various constituents of the corn, the following table is calculated to 2775 bushels, at 56 pounds to the bushel, or 155,400 pounds of corn, which is about the average daily consumption of corn in an institution known to the writer—

	Corn per cent.	CORN IN POUNDS.	Food per cent.	Food in Pounds Recovered.	Total Loss in Pounds.
		2775 bushels at 56lb. = 155,400lb., less 2000lb. dirt = 153,400lb.			
Water	10·01	15,401½	62·27	62,510	2,031½
Ash	1·52	2,331½	0·27	300	2,031½
Oil	5·20	7,977	1·31	1,305	6,672
Carbohydrates *	70·69	108,138½	28·90	29,015	1,693½
Fibre	2·09	3,206	1·58	1,610	1,596
Albumenoids	10·46	16,045½	5·67	5,730	10,315½
	100·00	153,400	100·00	100,500	22,308½
* Starch .... =	50	77,700	trace	trace	trace

The above table will give some idea of the loss of solid matters other than starch, in a factory of large dimensions, and which is entirely caused by running away with the various waste waters, a glance at the quantity of albumenoids thus wasted—over 10,000 pounds daily in the above instance, and, so far as my own experience in the connection with such factories, the above gives a fair and average idea of the waste of valuable products.

This quantity of nitrogenous matter one would imagine could easily and profitably be recovered, and utilised as a source of nitrogen, ammonia, etc., in its crude form. Some years ago, the author tried to interest starch manufacturers in this direction, he having been offered the highest market value, by respectable manufacturers of fertilisers and others, but through want of technical knowledge and comprehension on the part of the manufacturers of starch, received no encouragement, they preferring to allow it to run to waste.

In a factory, then, claiming to consume annually 56,000,000lb. of corn, what must be the loss? As explained in the previous part of the paper, it is due to the existing ignorance of the processes involved in the manufacture of starch, on the part of stockholders and others interested in such factories.

Chemical and Optical Properties of Starch.—According to "Watts's Dictionary Chem." v. 408: "Starch is a white shining powder, soft to the touch, grating between the fingers or the teeth, sometimes consisting of amorphous masses, but more frequently of granules recognisable by the microscope." These granules are of various "diameter [from $\frac{1}{30}$ to $\frac{1}{600}$ of a line (Fritzsche); from 0·185 to 0·002 millimeter (Payen)] and various form, have commonly a small eccentric nucleus, surrounded by layers arranged concentrically one over the other. These envelopes increase by the successive deposition of new layers within the old ones, so that each layer is younger and less compactly aggregated than the one which immediately surrounds it, and since the layers are for the most part of variable thickness they cause the granule to deviate gradually in form from the originally spherical nucleus and assume for the most part an ovoid form. According to Maschke, the starch globules appear like bundles of three concentric bladders, with light and dark rings, the light rings being formed of insoluble, the dark of soluble starch, and enclosing the centre cavity of the innermost bladder, which is either empty or filled with amylone."

The starch granules from corn have a diameter of 0·030 millimeters, the specific gravity being 1·5 at the normal temperature. Starch of inferior quality has generally a "golden or yellow tinge" when broken, which indicates the presence of gluten. Some years ago commercial starch from corn was said to be (U.S.A.) of this latter tinge. However, the inroads of science upon ignorance have dispelled this idea. Regarding the chemical composition of starch, there can be no doubt but that the conclusions arrived at by Salamon (*Jour. f. Prakt. Chem.* 1883, page 28) are correct, and that the empirical formula of starch is $C_6H_{10}O_5$, or some multiple of it $xC_6H_{10}O_5$, and which the author has had an opportunity of proving during considerable work on corn starch, which he hopes to communicate to the Society in a subsequent paper, supplementary to the present.

Commercial Starch.—Experience has proved that three grades of starch may be extracted from corn, differing only in their degree of purity, or freedom from the other constituents of the grain, and from these three grades are put up the various brands upon the market under a variety of names, and for a variety of purposes.

Upon the removal from the drying kilns, starch will seek and find an equilibrium of H_2O with the surrounding atmosphere, which may be readily understood as follows :—

	Starch.
Starch dried at 100° C. in vacuo (is completely dry)	=100%.
" " 15·5 " (contains 10% H_2O)	=90
" " 20 in air containing 0·6% H_2O = 18·6% H_2O	=81·2
Starch dried in air saturated with moisture = 35·7% H_2O	=61·3

Experience thus bears out the statement of the late Dr. Muspratt: "When starch, which has been dried in moist air for several days, is exposed to the circulation of a dry atmosphere, it parts with a further quantity of H_2O, which reduces the percentage of this ingredient to 18 per cent. Thus dried it constitutes the average commercial starch." The following analyses of two samples of starch will give some corroboration of this. No. 1 represents a sample of maizena (pure corn starch), as taken from the kiln and placed in the desiccator after being weighed. No. 2 is a sample of same starch taken from a package put up for commercial use, from a store :—

	No. 1.	No. 2.
Starch	98·5	90·6067
Fibre	0	0·0
* Ash	0·3	0·2758
H_2O	1·2	9·1175
	100·0	100·0000

The above represents a very high grade of starch for cooking purposes, and the highest that can be obtained commercially ; and the longer such starch is exposed to the atmosphere the more H_2O it would absorb, which would corroborate Professor Muspratt's statements—namely, that starch exposed to the atmosphere contains 180 in 1000 of H_2O. Certain manufacturers in the U.S.A. have made a claim (based on the analysis of their starch by a food analyst in London) that "their starch contains 99·8 per cent. of chemically pure starch." Such a standard of purity could not exist commercially. Even assuming that the starch was dried in vacuo at 100° C., the amount of ash would be nearly 0·5 per cent. ; and a careful study of the above facts relating to the absorption of H_2O from the air, etc., show that such an analysis would be an utter impossibility, and more especially with a starch after a voyage across the ocean.

On the technology of this important industry I will treat at greater length on "The Composition of the Various Commercial Starches of America," in my subsequent paper.

DISCUSSION.

The CHAIRMAN said they had heard a very interesting paper, but there were one or two points on which he thought they might be enlightened. The "grade of starch" was a commercial phrase, which he thought might with advantage be explained. It might refer to the size of grain, or to the composition, or simply to the colour. There was a mania on the part of commercial people for some particular colour in many articles—for instance, "whiteness." Now "whiteness" did not always indicate the purity of an article. The whiteness of cream would not indicate that it was pure. The "grade" of starch might be measured by its whiteness, and this whiteness might be obtained at the expense of its good qualities. They were told in the paper how the different grades were obtained, but he would like to know what was meant by a *grade* of starch? Another thing which struck him was that in choosing the substance for the manufacture of starch many things were preferable that were really of less actual feeding value than others. They would reject beans and lentils, which were really very much more valuable substances than some of those which held more starch, because, in fact, the value of albuminous matter for feeding purposes was very much greater than starch. Starch was an essential constituent of food, and was a less costly one than the albuminous ingredients. Maize was comparatively rich in albuminous constituents ; it was not so rich as beans and peas, but was much richer than rice or wheat. Therefore, for economical purposes, it was not desirable that the preservation of the starch should be the great sole object of the manufacturer.

Dr. KOHN asked what led Dr. Archbold to doubt that $(C_6H_{10}O_5)n$ was the correct formula for starch? It had, he thought, been perfectly clearly established.

The CHAIRMAN, in proposing a vote of thanks to the writer of the paper, stated that a report of the discussion would be submitted to Dr. Archbold, and his replies would subsequently appear in the Journal.

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ON THE DETERMINATION OF SULPHUR IN PYRITES.

BY JAMES W. WESTMORELAND, F.I.C.,

Associate of the Royal School of Mines, London.

ALTHOUGH much has been written within the last few years regarding the estimation of sulphur in pyrites, yet at the present time the comparison of the results obtained by various operators is far from satisfactory, and this will not occasion surprise when the details of the methods used in various assay offices and laboratories are examined.

The following process was in use some time ago in a copper assay office, where sulphur tests are made :—The ore was powdered in a wedgwood mortar, dissolved in nitric acid, with the addition of a little hydrochloric acid, diluted with rain water and filtered, excess of solution of barium chloride added to the filtrate, the precipitated barium sulphate collected on English blotting paper, washed with rain water, ignited and weighed. The acids and rain water contained a notable amount of sulphur, while the blotting paper allowed some barium sulphate to pass through its pores ; and when it is stated that the operators did not know that silica (sand) was insoluble in hydrochloric acid, the extremely valuable nature of the results will be apparent. Tests made in this way were used to check the vendors' assays (made in a somewhat similar manner) on 1600 to 2000 tons of pyrites per month ; and the settlements were at least one per cent. above the truth. Sulphur at this time being 6d. per unit, the loss to the buyers varied from £40 to £50 per month.

The following assays of samples of pyrites, in which my results are compared with those of another operator, will show the extremely variable character of these tests :—

SULPHUR ASSAYS IN PYRITES.

J. W. W.	Vendors' Assays.	Settled Produce.
48·23 48·36	49·7	—
48·81 48·76	50·2	—
49·03 49·15	50·3	—
48·49 48·52	(49·7) (49·5)	— —
48·82	—	48·2
49·20 49·18	48·1	48·2 (!)
49·11	—	48·2 (!)
49·26	—	48·6
49·21	48·8	48·5
49·15	49·3	49·0
49·31	48·9	48·6
49·63 49·64 49·58	49·0	48·8 (!)
48·91	48·2	47·9 (!)
		Referee.
46·72 46·74	48·0	46·8

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* Ash chiefly phosphates of the grain.

The following are assays of one month's deliveries of pyrites :—

Vendors' Assays.		Settled Produce.	J. W. W.
49·7	49·2 or refer.	49·0	48·83 48·79
49·9	49·5 or refer.	49·2	49·18 49·15
49·8	—	49·3	49·12
49·7	49·5 or refer.	49·2	49·10
49·5	—	49·1	49·06
49·4	—	49·0	49·37
49·8	49·2 or refer.	49·1	49·00 49·06
49·8	—	49·4	49·28

While my results on the above series of samples are, as a rule, much below those of the vendors' assayers, in another series with another analyst my principals received a letter from buyers stating that my results were considerably higher than those made on behalf of the vendors, who would probably be complaining to their analyst of the low results he returned. On investigation it transpired that the vendors' assays were returned on the ore as received, while my assays were reported on the dry ore without this fact being stated on the certificate. More recent assays, however, have shown that his results were still seriously below mine, and it became the practice to return a produce 0·50 per cent. below my results on these samples :—

Vendors' Analyst.	J. W. W.
48·8	49·70..49·61
48·7	49·11

The principal methods which have been suggested for the estimation of sulphur in pyrites, are noticed in Dr. Lunge's "Treatise on the Manufacture of Sulphuric Acid." Although Teschemacher and Smith pointed out the necessity for the removal of all nitric acid, before precipitation with barium chloride (*Chem. News*, vol. xxiv. p. 61—64), and the inaccuracy is also referred to by Deutecom (*Chem. News*, vol. xlii. p. 317; *Zeits. Anal. Chem. 1880*, 313), I believe precipitations in nitric acid solutions are made by some assayers at the present time.

Recently, the paper by Dr. Clark, taking exception to the results obtained by a modification of Dr. Lunge's "old process" (*Jour. Soc. Chem. Ind.* 1885, p. 329), and in which he proposes to decompose pyrites by heating in a muffle with magnesia and sodium hydrate, has revived the controversy regarding the accuracy of various methods; and communications from Drs. Clark and Lunge appear in this Journal, 1885, pp. 449, 573, 724. Dr. Lunge objects to any fusion process on the ground that any sulphur present as galena or heavy spar would be estimated, but is silent on the subject of sulphur combined with zinc, which he states ("Sulphuric Acid and Alkali," i. p. 108) is of no use to the alkali manufacturer. I agree with Dr. Clark, that with the cupreous pyrites used in England the whole of the sulphur combined with lead and lime is estimated by either of Dr. Lunge's methods, and some experiments I have made confirm the opinion that the low results obtained in some laboratories were due to the large amount of hydrochloric acid used in washing the sulphate of barium precipitate.

Mr. Pattinson has shown (*Jour. Soc. Chem. Ind.* 1885, p. 724) that the results of Clark's method and Lunge's "new method" are concordant. I hope to show that the results obtained by Lunge's "old process" ("Sulphuric Acid and Alkali" i. p. 102) agree closely with those given by the new process ("Alkali Makers' Pocket Book," p. 82), which is, therefore, a needless elaboration. The new method is also liable to losses caused by an extra filtration and washing, and by sulphur retained in the peroxide of iron precipitate, while sulphur is liable to be introduced by the ammonia and hydrochloric acid used for acidifying. In the majority of the papers dealing with the estimation of sulphur there are no experiments given in which substances of known composition are operated on, concordant results only being quoted, which may or may not have been affected by a constant error which has escaped detection.

Being aware that in many cases where an amount of crystallised barium chloride slightly in excess of that required by theory had been used as the precipitant in solutions of pyrites, the filtrates from the $BaSO_4$ precipitate were in a state of unstable equilibrium, and would give precipitates either on the addition of dilute sulphuric acid or solution of barium chloride, I made a series of experiments with protosulphate of iron, double sulphate of iron and ammonia, ammonia iron alum, and pure recrystallised sulphate of ammonia, using 55 grains of crystallised barium chloride to 5 grains of sulphur approximately present (5 grains sulphur requires 38·1 grains $BaCl_2$, 2aq.). The results of the precipitations from ferrous solutions confirm Teschemacher and Smith's statement that the percentages so obtained are above the truth, while the other tests give results as a rule slightly under the theoretical percentage. The experiments were made by dissolving the salts, diluting to 20oz. bulk of water, boiling, adding gradually the hot solution of barium chloride, and allowing the solutions to stand overnight. In all cases the acids and water used were tested to make sure no sulphur was present in them.

SULPHUR EXPERIMENTS: 55 GRAINS CRYSTALLISED $BaCl_2$,2aq. USED TO 5 GRAINS SULPHUR APPROXIMATELY PRESENT.

Protosulphate of Iron—$FeSO_4$,7aq.—		
Theoretical percentage of sulphur	11·51	—
By direct precipitation as ferrous salt	11·629	11·633
By precipitation after oxidation, evaporation to expel nitric acid, etc., as in pyrites assays	11·473	11·491
By precipitation after oxidation with permanganate of potassium	11·518	11·538
Double Sulphate of Iron and Ammonia-$FeSO_4$,$(NH_4)_2SO_4$,6aq-		
Theoretical percentage of sulphur	16·326	—
By direct precipitation as ferrous salt	16·352	16·337
By precipitation after oxidation, evaporation to expel nitric acid, etc., as in pyrites assays	16·242 16·248	16·193 16·190
By precipitation after oxidation with permanganate of potassium	16·313	16·372
Ammonia-iron Alum—$(NH_4)_2SO_4$.$Fe_2(SO_4)_3$,24aq.—		
Theoretical percentage of sulphur	13·278	—
By direct precipitation	13·197	13·203
Sulphate of Ammonia—$(NH_4)_2SO_4$.--		
Theoretical percentage of sulphur	24·24	—
By direct precipitation	24·201 24·282	24·312 24·201
Average	24·249	

More recently I have made experiments by dissolving recrystallised sulphur, recently fused and powdered, in pure redistilled nitric acid, adding the relative proportions of iron, copper, lead, and zinc, and treating the solutions so obtained as pyrites assays :—

BY PRECIPITATION FROM FERRIC SOLUTIONS: LUNGE'S "OLD PROCESS."

	Grains.	Grains.
Sulphur taken	4·985	4·988
Iron	4·24	4·61
Lead	0·10	—
Copper	0·32	0·30
Zinc	—	0·10
Sulphate of barium	36·28	36·25
equal to sulphur	4·982	4·978

BY PRECIPITATION AFTER SEPARATION OF THE FERRIC OXIDE BY AMMONIA, ETC.: LUNGE'S "NEW PROCESS."

	Grains.	Grains.	Grains.	Grains.
Sulphur	4·997	5·000	5·012	5·019
Iron	4·38	4·38	4·23	4·60
Lead	—	0·10	0·10	—
Copper	—	—	0·32	0·26
Zinc	—	—	—	0·10
Sulphate of barium	36·335	36·225	36·32	36·55
equal to sulphur	4·990	4·975	4·988	5·010

To test the effect of excess of barium chloride on the weight of the precipitate obtained, I made the following experiments on samples of pyrites:—

By precipitation with 55grs. crys. $BaCl_2$.	48·21
„ 65 „	48·24″ S.

			Mean.
By precipitation with 55grs. crys. $BaCl_2$.	46·46	46·36	46·41
„ 75 „	46·44	46·55	46·49
„ 95 „	46·50	46·59	46·51

In the above experiments the precipitates were allowed to stand overnight; the same sample was also tested by precipitation with 55 grains crystallised chloride of barium, and filtration after standing thirty minutes; two experiments gave

46·29 and 46·44; mean 46·36 per cent. sulphur.

I have referred previously to the solubility of sulphate of barium in hydrochloric acid; the following experiments show the necessity for extreme care in the use of HCl when washing this precipitate. Thus, while filtrates from precipitations of pyrites solutions (10 grains pyrites, 55 grains crystallised barium chloride) remained quite clear, or gave only traces of a precipitate on the addition of more barium chloride; when much hydrochloric acid was used in washing the precipitate, the washings, although remaining quite clear on standing, gave, on the addition of barium chloride solution, a precipitate the quantity of which varied with the amount of acid used; and this occurred not only with pyrites assays, but with experiments made with sulphate of ammonia. The quantity of precipitate obtained was much greater than could be accounted for by assuming that other sulphates were precipitated with the sulphate of baryta, and were removed from it by the excessive use of hydrochloric acid, while the fact that the *total* amount of barium sulphate obtained in duplicate experiments was the same with limited and excessive use of acid, supports the view that sulphate of baryta was dissolved and reprecipitated by the addition of barium chloride. Two portions of sulphate of ammonia, containing approximately 5 grains of sulphur, were taken, dissolved in water, slightly acidified with HCl, and precipitated with 55 grains crystallised barium chloride. After standing overnight one of the precipitates was washed in the usual manner, dried, ignited, and weighed. After removing the supernatant fluid from the other precipitate it was washed with an ounce of boiling water, which was, after settling, passed through the filter. The precipitate was then treated with 400 measured grains of strong hydrochloric acid, and twenty ounces of boiling water added, the precipitate well stirred up, and after settling the clear fluid decanted; twenty ounces of boiling water were then poured over the precipitate, and after settling passed through the filter, to which the precipitate was then transferred, washed, dried, ignited, and weighed. The washings of this second experiment were then treated with barium chloride, and the precipitate washed, dried, etc., as usual. The sample of sulphate of ammonia contained a little free acid, which will account for the results being slightly above the theoretical percentage:—

	Grains.		Grains.
Ammonium sulphate taken..	20·56	......	20·591
Sulphate of barium washed with water	36·515	washed with acid	35·625
Sulphate of barium from acid washings	—	......	0·93
Total barium sulphate	36·515	......	36·555
Equal to sulphur per cent. ..	21·39	......	21·37

Pyrites Assays.—In the following tests of pyrites Lunge's old and new processes were conducted as he describes, but employing 10 grains of pyrites and 55 grains crystallised barium chloride for each test, also allowing the solutions to stand overnight. The experiments in which the barium sulphate precipitates were treated with hydrochloric acid were conducted as described above.

Lunge's Old Process.	New Process.	After treatment with HCl.	$BaSO_4$ from Washings. Grains.	Total Sulphur per cent.
50·11 50·10	50·08	48·61	1·105	50·12
44·95	44·98 44·88	43·57	1·005	44·95
49·29	49·25	48·01	1·045	49·41
50·11 49·95	50·10	—	—	—
49·18	49·15	—	—	—
49·12	49·32	—	—	—
48·91	48·78	—	—	—
49·73 49·66	49·57	—	—	—
49·59	49·57	—	—	—
49·07 *49·05	49·05	—	—	—

In concluding this portion of my paper I would refer briefly to the following points: I find it is impossible to expel all the nitric acid from pyrites solutions on the first evaporation (Lunge: "Sulphuric Acid," i. p. 102); on treating the residue with HCl considerable effervescence and evolution of nitrous fumes results, necessitating precautions to avoid loss; and the great difficulty of completely removing all the sulphur from the peroxide of iron precipitated by ammonia. This precipitate should always be dissolved and tested for sulphur, although generally the amount is small. Some operators I believe dissolve pyrites in nitrohydrochloric acid, decomposing the excess of nitric acid by repeated additions of hydrochloric acid and boiling, precipitating from this solution with barium chloride. My experience is that it is impossible to expel the nitric acid completely, and that tests made in this manner are liable to serious error.

With regard to the percentage of available sulphur in pyrites, Dr. Lunge objects to the sulphur equivalent to the lead, zinc, and lime present being estimated as available, stating ("Sulphuric Acid and Alkali," vol. i. p. 108) that lead and zinc sulphates are hardly or not at all decomposed at the temperature of a pyrites burner; and on p. 245 of the same volume he states that burnt ores always contain some sulphate of iron. On examining the analysis of burnt ores by Gibb, quoted by him on p. 589, it will be found that the Tinto, Tharsis, and Mason's burnt ores contain more sulphur as sulphuric acid (SO_3) than suffices to combine with all the oxide of copper, lead, zinc, and lime present. An analysis of San Domingo burnt ore, by Phillips, also shows that more sulphur is present than suffices to form sulphates with all the copper, lead, zinc and lime.

Burnt Ores:—

	Tinto.	Tharsis.	Mason's.
SO_3 per cent.	6·10	5·25	5·80
SO_3 required by PbO, CuO, ZnO, PaO	5·19	3·71	3·87

San Domingo Ore. Analysis by Phillips:—

Total sulphur per cent.	3·66
Sulphur required to form sulphates with Cu, Pb, Zn, and CaO	2·59

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* The addition of tartaric acid to solutions of ferric salts before precipitation with barium chloride has been recommended to prevent oxide of iron precipitating with the barium sulphate; 50 grains of tartaric acid were added in this experiment, but without any influence on the result.

In an analysis of burnt ore from Norwegian pyrites the figures are—

SO_3 per cent.	6·56
SO_3 required by PbO, CaO, CuO	3·69
SO_3 to ZnO	2·87

6·46 per cent. ZnO present requires 6·38 per cent. SO_3; in this case it is evident some of the sulphate of zinc has been decomposed. If the analysis of burnt ores from Spanish pyrites referred to above are examined, it will be found that the sulphur required to form sulphates with the lime and lead present is relatively small, while the zinc requires a much higher percentage. This is also evident in the following analysis of average samples of pyrites recently made by me—

	(*a*)	(*b*)	(*c*)	(*d*)	(*e*)
Lead	1·38	0·85	1·01	0·53	0·07
Zinc	0·177	0·762	1·06	1·85	—
Lime	0·27	0·183	0·21	0·21	1·03
Sulphur required by lead and lime	0·37	0·21	0·29	0·22	0·59
Sulphur required by zinc	0·23	0·32	0·52	0·91	—

a, *b*, c, *d* are Spanish pyrites, *e* is a sample of Italian ore with 15 per cent. of sulphur.

The quantities of sulphates of lead and lime present when operating on ½ gramme or 10 grain assays of pyrites are so small that there can be little doubt that all the sulphur is estimated as sulphate of barium, and in my opinion the better plan would be (in cases where the pyrites is returned after burning to copper extractors) to deduct the percentage of sulphur found in the burnt ores (making a correction for the lesser weight of the latter) within certain agreed limits from the total percentage; the alkali maker would then without doubt pay only for the actual sulphur of service to him. In other cases an allowance might be made, based on the percentage of lead, lime, and zinc in the ore.

With regard to the various discrepancies I have enumerated, it has been suggested that they form a strong argument in favour of the proposed uniform methods of analysis. While admitting that certain methods—for instance, the bichromatic process for iron assays—are the most accurate, yet I think great caution should be used in recommending that a single method be adopted, especially if it is not free from fault. To illustrate this I may refer to Lunge's "Alkali Makers' Pocket Book," pp. 82, 83, 84. The methods detailed for the estimation of copper and zinc in pyrites are not above criticism, while the process given on p. 84 for the estimation of sulphur in burnt ores would certainly indicate that present as sulphates of lead and lime. The introduction of these standard methods will also probably reduce the status of the chemists employed, and lead to work being done by rule of thumb instead of being thoroughly understood, while it is giving valuable information to people who are too idle or incompetent to investigate the accuracy of the various processes themselves, with the result that if any variation occurs in the material operated on, serious errors are likely to occur and escape detection. I would also point out that while the general principles of the methods which should be used in the estimation of sulphur have been known for years, most serious errors have occurred and escaped detection up to the present time, for which no other excuse than gross carelessness can be given.

In conclusion, I will submit that the results of Lunge's old and new methods for the estimation of sulphur in pyrites are concordant, and express the total percentage in Spanish pyrites; that a moderate excess of chloride of barium should be used when precipitating sulphate of baryta, and that great care should be taken in the use of hydrochloric acid when washing this precipitate.

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Notices of papers and communications for the meetings to be sent to the Local Secretary.

ON THE TREATMENT OF SOAPMAKERS' LEYS FOR RECOVERY OF GLYCERIN.

BY ALFRED H. ALLEN, F.I.C., F.C.S.,

President of the Society of Public Analysts.

The applications of glycerin are constantly extending. Besides being employed in pharmacy and medicine, it is also used extensively in the manufacture of toilet soaps, for filling gas-meters in situations liable to be exposed to great cold, and for various other purposes. But by far the largest application of glycerin at the present time is in the manufacture of nitro-glycerin, which is used for making dynamite and blasting gelatin to the extent of a good many tons daily.

At present the greater part of the glycerin of commerce is obtained by saponifying fats under high pressure with water and a limited proportion of a base. This process yields a high quality of glycerin, but the fatty acids, which are the primary objects of the manufacture, produce inferior soaps to those obtained by directly saponifying fats with caustic soda.

When the latter method of soap-making is employed, it is usual to separate the soap from its aqueous solution by adding common salt, the soap being practically insoluble in brine of a certain strength. Hence there is obtained, as a waste product, a strongly-saline liquid, containing a certain proportion of glycerin, and it is the treatment of this spent ley that forms the subject of the present paper.

Spent soapmakers' leys have a very variable and complex composition. They usually contain water; glycerin; chloride, sulphate, and carbonate of sodium; a small quantity of caustic soda; and very variable amounts of suspended or dissolved soap, and resinous, fatty, albuminous, and colouring matters. In addition to the foregoing, which may be considered the normal constituents of leys, a number of other troublesome impurities exist in the products of certain works. Thus, at Widnes, tallow and other fats are saponified by means of causticised black-ash liquor, instead of by finished caustic soda. The resultant "Lancashire leys," obtained in salting out the soap, are exceedingly impure, and consequently very difficult to deal with. Besides the foregoing constituents, they contain a considerable quantity of hyposulphites (thiosulphates), besides sulphides, sulphocyanides, cyanides, ferrocyanides, etc. The sulphur compounds, in particular, are very objectionable, for if not removed they cause the production of volatile organic sulphur compounds during the distillation which all recovered glycerin has to be subjected to, and the distilled product is unfit for the purposes of the dynamite manufacturer.

The recovery of the glycerin from soap leys in a state sufficiently pure for conversion into nitroglycerin is a problem which has exercised the faculties of a number of inventors. The history of the subject up to the end of 1881 was discussed by Mr. Charles Kingzett in an interesting paper read at an early meeting of the London Section of this Society (this Journ. *1882*, 78). This paper and the records of the Patent Office constitute almost the entire literature of the subject up to the present time.

As stated by Mr. Kingzett, a study of the specifications relating to glycerin-recovery shows that "it is very much easier to obtain a patent than to make a discovery." Reviewing the different processes described by the patentees, Mr. Kingzett classifies them as designed to effect the following objects: "1. To remove or destroy albuminous or soapy matters, together with any residual soap in the spent leys. 2. To facilitate the removal of the salt, either by employing means to diminish the solubility of the chloride of sodium, in cases where that substance is used, or to substitute another which may be more readily and profitably removed. 3. To economise the cost of concentrating the leys to that point at which the glycerin may be at once employed for certain purposes in its then crude condition, or still further purified by distillation."

To effect the first of these objects, it has been proposed to acidulate the leys, and some inventors then add tannin, gelatin, albumin, alum, chromium salts, iron salts, pyroligneous acid, etc. Stearic acid is employed by one inventor (Bang, No. 4593, 1883), while another proposes to convert the concentrated glycerin into a glyceride by heating it with oleic acid. O. C. Hagemann treats the leys with lime to causticise the alkaline carbonate, and then boils with rosin to convert the resultant caustic soda into a rosin soap, which is removed.

To get rid of the common salt, Clolus (No. 681, 1881) has proposed to saturate the previously concentrated liquid with hydrochloric acid gas, subsequently getting rid of the latter by means of lead oxide or a current of air; while F. Versmann concentrates, and treats the liquid with carbonic acid, by which acid carbonates are formed which are comparatively little soluble in glycerin. Both these inventors recommend dialysis as a further means of separating the salts from the glycerin, and the same principle has been employed with some measure of success by H. Fleming. (Ger. Pat. 13,953, 1880.)

Other inventors (Eng. Pat. 1562, 1881) employ sodium sulphate instead of common salt for precipitating the soap; then neutralise the leys with sulphuric acid, and evaporate and separate the sodium sulphate. In another instance (Eng. Pat. 1728, 1882), the ley is acidulated with sulphuric acid, and after concentration the salts are separated from the glycerin by means of alcohol or wood spirit.

Some inventors obtain a product rich in glycerin by using spent leys instead of water for dissolving the alkali requisite for saponifying fats, while another evaporates the ley till salt begins to deposit, and uses the liquid instead of fresh brine for precipitating soap from solution.

The use of immiscible solvents, such as petroleum spirit or amyl alcohol, for separating impurities from glycerin, both before and after distillation, is proposed by some inventors, while fatty acids are preferred by others.

Of course modifications exist in the details of glycerin-recovery, but the method of treating leys now commonly used is substantially as follows:—The liquid is acidulated, heated by open steam, and the precipitated fatty and resinous matters separated. The clear liquor is neutralised with soda-ash, filtered and concentrated in open pans. The evaporation is continued till the boiling-point reaches 270—280° F. The salt which separates continuously during the process of concentration is removed by perforated ladles, and then usually washed with brine, and dried by means of a hydro-extractor. The liquid is further concentrated till the boiling-point is as high as 300° F. The crude glycerin thus obtained varies greatly in quality. The density is sometimes as high as 1·36, and the proportion of mineral matter usually ranges from 7 to 14 per cent. A considerable proportion of it consists of sodium chloride; but if sodium sulphate has been used for precipitating the soap the proportion of sulphates in the crude glycerin will be correspondingly high.

In any case, the crude glycerin requires to be distilled, which is effected in specially-contrived apparatus with the aid of superheated steam. A second and third distillation are sometimes necessary, and in some cases the distilled product obstinately retains impurities which unfit it for conversion into nitro-glycerin. I am informed that in Germany a good distilled product is obtained from crude glycerins which have not hitherto been satisfactorily worked in this country.

As already stated, the impurities in Lancashire leys are exceptionally troublesome to deal with, and the most notable systematic attempt to purify the product is that patented by Mr. O. C. Hagemann (Eng. Pat. 8051, 1885). After treating the leys with lime, and subsequently boiling with rosin in the manner already described, the inventor neutralises the liquid with a mineral acid, and then adds ferric chloride as long as a precipitate is produced. The precipitate consists mainly of fatty matter and Prussian blue, and is said in the patent to have a marketable value. After separating the precipitate, the purified liquid is treated with hydrochloric acid, heated, and air blown through it for some time. This treatment causes the decomposition of hyposulphites, etc.; but to complete their destruction a solution of bleaching powder is next added until free chlorine is found in the liquor, when the precipitated sulphur is removed and the ley neutralised and concentrated. This process is by no means perfect, though yielding a much improved product.

The treatments with lime and rosin have been abandoned, and I believe the blue precipitate has not hitherto been found to have a marketable value; while purification by bleaching powder has formed the subject of a previous patent. But these are negative objections. A graver one is that the process leaves untouched the sulphocyanides which are present in very considerable quantity in Lancashire leys, and which are perhaps the most objectionable impurity.

It was primarily with a view of removing the sulphocyanides that I was led to devise a method of treating leys, which forms the subject of a patent recently obtained by Mr. B. Nickels and myself, and the process appears to have satisfactorily solved one of the most difficult problems connected with the subject.

Although most, if not all, of the heavy metals form ferrocyanides which are insoluble in neutral or faintly acid liquids, the metallic sulphocyanides are mostly soluble. Thus, whereas solutions of iron, zinc, tin, lead, and copper are all available for removing ferrocyanides from leys containing them, copper solutions alone are capable of precipitating the sulphocyanides. Hence, it occurred to me that copper salts might be advantageously employed for the purpose in question, and a further consideration and experience of their behaviour has shown Mr. Nickels and myself that they possess a variety of attributes which render them curiously well adapted for purifying soap leys. Thus, on adding a solution of a copper salt to soap leys previously rendered neutral or faintly acid, the sulphocyanides are wholly precipitated, and with them are also thrown down any sulphides, cyanides, ferrocyanides, or silicates ; together with albuminous, resinous, fatty, colouring, and a variety of other organic matters. The precipitate settles with great facility, and the filtered liquid is obtained nearly colourless.

If a cupric solution be employed, which in practice is always the case, more or less oxidation of the hyposulphites occurs, owing to the fact that the precipitate consists of cuprous sulphocyanide.

The reaction between a soluble sulphocyanide and a cuprous salt is a simple case of double decomposition, the insoluble white cuprous sulphocyanide being instantly precipitated ($Cu_2Cl_2 + 2NaCNS = Cu_2(CNS)_2 + 2NaCl$). When a soluble sulphocyanide is treated with a cupric salt in concentrated solution, the sparingly soluble black cupric sulphocyanide is first precipitated, and this gradually changes more or less completely into the white cuprous salt. Similarly, when a cupric salt and a soluble sulphocyanide are mixed in solution so dilute as to prevent the precipitation of cupric sulphocyanide, a white precipitate of cuprous sulphocyanide is gradually formed. It is evident that the reduction of the copper to the cuprous condition involves the simultaneous oxidation of a portion of the sulphocyanide. The odour of hydrocyanic acid developed and the formation of a sulphate in the liquid indicate qualitatively the nature of the change, and I have proved by quantitative experiments—(*e.g.*, verification of the ratio :—$6CuCNS : H_2SO_4$)—that the following equation represents the main reaction which occurs :—$6CuCl_2 + 7NaCNS + 4H_2O = 6CuCNS + 7KCl + 5HCl + H_2SO_4 + HCN$.

It would appear from these considerations that the presence of a moderate proportion of a hyposulphite is a positive advantage when sulphocyanides are to be removed from leys, and that if not present in sufficient quantity, the cautious addition of a suitable reducing agent should be practised. When a cupric salt is mixed in neutral or slightly acid solution with sodium hyposulphite, and the liquid is boiled, a sulphide of copper is well known to be precipitated. In the cold no precipitation occurs, but the copper is reduced to the cuprous state, showing that the hyposulphite undergoes oxidation in some manner with conversion into one or more of the thionic acids, but I have not yet ascertained the exact reaction. Oxidation to sulphate is unfortunately very partial.

Whether the copper solution should be added to the leys in the exact quantity necessary to remove the precipitable matters, or whether an excess should be employed, is a detail which experience will quickly decide. As a rule a supplementary treatment with bleaching powder or other oxidising agent will have to be resorted to in order to destroy the remainder of the thionic acids, and if excess of copper has been employed it must be subsequently removed from the liquid by sulphuretted hydrogen, an alkaline carbonate, metallic iron, or other suitable means, either at once or after more or less concentration.

The employment of copper for the purification of soap leys, however perfect chemically, would not be available in practice but for the great facility with which the copper can be recovered from the precipitate. This advantage is peculiar to the use of copper. If compounds of iron, zinc, lead, or tin be employed, the metals are practically irrecoverable from the precipitates. But a copper precipitate merely requires to be dried, ignited in the air, and treated with acid, for the original solution to be re-formed. Or, if preferred, the precipitate, whatever its composition, can be sold to the copper-smelter with the assurance that it will command a price strictly proportional to the copper present. Further, the copper solution obtained by treating spent cupreous pyrites in the wet way (as practised by the Tharsis Company) is eminently suitable for precipitating soap leys, and hence the copper can, under favourable circumstances, be recovered from it without the employment of scrap-iron.

If, however, it be desired to treat the copper precipitate to re-form the cupric solution, a certain modification is desirable in practice. This is owing to the presence of ferrocyanides in the leys, which become precipitated as cupric ferrocyanide, and hence the oxide of copper produced by roasting the precipitate contains an admixture of oxide of iron. To avoid this it will be preferable in many cases to subject the ley to a preliminary treatment. That is, it should be acidulated with hydrochloric acid and treated with the salt of some metal forming an insoluble ferrocyanide. A solution of ferric chloride or sulphate is perhaps the most convenient, as the formation of Prussian blue and subsequently of the red ferric sulphocyanide is so readily observed ; but solutions of zinc, tin, or lead are also available. The bulky precipitate of albuminous and fatty matters mixed with ferrocyanides having been separated, the subsequent addition of a cupric solution causes the complete precipitation of the sulphocyanides as a grey or nearly white cuprous sulphocyanide. This may be ignited, as already described, and the resultant cupric oxide redissolved to produce a cupric solution for treating a fresh quantity of leys ; or it may be employed for the production of a soluble sulphocyanide by double decomposition. Sulphocyanides of sodium, barium, magnesium, etc., are readily produced in this way, while the copper is left in the form of cuprous oxide and can be at once dissolved in hydrochloric acid,* and employed for treating more leys.

I have been induced to dwell at some length on the subject of the removal of sulphocyanides, because the process by which we have succeeded in effecting it is possessed of considerable theoretical interest. The practical value of the process cannot yet be said to have been completely demonstrated, but a series of experiments on a manufacturing scale have been for some time in progress at the works of Messrs. N. Mathieson & Co., of Widnes, and the results so far obtained have been so highly encouraging as to leave little doubt of ultimate success. On the table are a series of specimens representing the operation at various stages as actually carried out on a large scale. The salt recovered is of very satisfactory quality, presenting a marked contrast to that ordinarily obtained from Lancashire leys. So far the character of the glycerin produced on distillation has not been definitely ascertained, but it is confidently anticipated that the very perfect removal of the sulphur compounds effected by the process will enable a very superior distilled product to be obtained.

Although copper salts are of exceptional value for

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* The cuprous chloride formed is insoluble in pure water, but is dissolved by hydrochloric acid, and is also readily soluble in a liquid containing common salt.

the purification of leys containing sulphocyanides, it must not be supposed that other leys are not materially improved by treatment with copper. On the contrary, I have met with concentrated leys produced in a soap works, where finished caustic was used for saponifying, which were so impure as to be absolutely refused by the distiller. A simple treatment with copper sulphate caused the precipitation of an enormous quantity of impurity, and a change of the crude glycerin from a deep brown tarry semi-fluid to a sherry-coloured liquid of the viscosity of pure glycerin. This improvement is not surprising when we consider that copper forms highly insoluble compounds with fatty acids, resinous matters, albuminous substances, and a number of other organic bodies. In all instances where ferrocyanides are absent, the copper may be recovered as pure oxide by simply igniting the precipitate, so that the expense attending the process is very moderate.

Although Mr. Nickels and I believe that we may fairly claim to have effected an improvement in the treatment of soap leys for the recovery of glycerin, the subject is still far from being exhausted. None but those who have worked practically with leys have any idea of the enormous quantity of salt which has to be separated. It does not appear that the substitution by the soap-maker of the sulphate of sodium for the chloride usually employed materially assists the subsequent operations, so that the removal of the salts still remains to be effected. The fact is often overlooked that glycerin has a far greater solvent power than water for many substances, and hence the problem becomes further complicated. By dialysis the proportion of salts can be materially reduced, and H. Fleming states that by this means a first-class quality of crude glycerin can be obtained, which is practically free from salt, and a second grade which is as good as that which has not been subjected to the process. Much of the salt can doubtless be removed by dialysis, but the operation is by no means perfect, and only a portion of the glycerin is claimed to be recovered in a nearly salt-free condition. In fact, Mr. B. Nickels has found that by continuing the operation, using a diaphragm of parchment-paper, all the glycerin can be caused to dialyse, while certain troublesome resinous impurities remain behind. On the other hand, Fleming has patented the use of a guttapercha membrane, which he states is traversed by salt, but is impermeable to glycerin. I am not aware how far this statement has been found to bear the test of experience. In any case, it is evident that much still remains to be accomplished in perfecting the recovery of a high quality of glycerin from soap leys.

DISCUSSION.

The CHAIRMAN: The subject of Mr. Allen's paper is one of very great importance, particularly from a technical or practical point of view. Unfortunately, it is one I am not at all familiar with. There is only one question which presents itself to my mind, and that is—What occasion is there for the removal of the impurities referred to? I do not quite understand what harm is done by the sulphur compounds if they are not removed.

Mr. DAVIS: I think that in suggesting the sale of the copper precipitate to the smelter, Mr. Allen has rather overlooked the direct commercial value possessed by cupreous sulphocyanides. This has now acquired considerable importance as the starting-point of various metallic sulphocyanides now extensively used by dyers. In fact, for several years past, I have purposely manufactured the sulphocyanide of copper from the crude sulphocyanide of ammonium obtainable from gas liquor, and can confirm Mr. Allen's experience as to the necessity of using a reducing agent if the whole of the sulphocyanide was to be precipitated and no hydrocyanic acid formed. I employ ferrous sulphate as the cheapest reducing agent available. Now that chemists are on the look-out for new sources of sulphocyanides, I think Mr. Allen's process, by which sulphocyanide of copper is obtained as a secondary product in the purification of soap leys, is likely to prove of great value. I am surprised that Mr. Allen doubts that hyposulphites are oxidised to sulphates by cupric salts, as I am in the habit of precipitating copper by sodium hyposulphite, which becomes converted into sulphate.

Mr. DREYFUS: I just wish to correct Mr. Davis with respect to his statement that he was the first to make sulphocyanide of copper. I believe the late Mr. James Higgin made sulphocyanide of copper some eighteen years ago on a large scale, and sold it to calico printers. About twelve years ago I manufactured this article myself, and sold it to the calico printers as a substitute for sulphide of copper in aniline-black printing. I understood Mr. Allen to say that in Germany they had succeeded in making good glycerin by distilling the crude product, a thing which has not been successfully done in England. Is it not possible that in Germany they obtained this result by distilling *in vacuo?*

Dr. GROSSMANN: I have listened with great interest to Mr. Allen's paper, but must say that I have been greatly disappointed at one serious omission, and that is, that Mr. Allen has not given us an analysis of the liquors which result from the manufacture of soap, and which are used for glycerin making. In dealing with a commercial process, it is, of course, of the utmost importance to know exactly the composition of the compounds which have to be worked up. Now, Mr. Allen tells us that the quantity of sulphocyanide in the leys is very considerable, without giving us any data. This does not agree with my personal experience, for to my knowledge the quantity of sulphocyanide in black-ash liquors after boiling down is comparatively small—in fact, black-ash liquors, after boiling down to the utmost concentration, would contain about one or one-and-a-half grms. sulphocyanide of sodium per litre; equal to about one-tenth per cent. by weight. These figures refer to a time when black ash was made in the ordinary way, but since then the tendency has been to reduce the cyanide in black ash, and several patents have been taken out to effect this, one by Messrs. Pechiney & Weldon, and another for treating the liquors from black ash by Messrs. Gaskell, Deacon & Co. It is, therefore, now comparatively easy to reduce the cyanide below the figures which I have mentioned, and I may be excused for saying that with a little attention to the black-ash process, the difficulty in treating the soap leys as regards cyanides could be reduced to a minimum. The question whether it might not some day pay alkali makers to increase the quantity of ferrocyanides and sulphocyanides in their liquors for the purpose of manufacturing these products, thus turning what is now a source of annoyance into a source of profit, is a separate question altogether. But, even in that case, we must not forget that where the liquors have been used for soap making they contain organic and other substances which will be thrown down with the sulphocyanide of copper, and contaminate any product consequently made from it. There will also, in my opinion, always be a considerable loss of copper arising from different causes, and, among others, from the fact that the copper smelter does not pay for the actual quantity of copper, but for the quantity which he will obtain on smelting as indicated by the dry assay, and certain impurities in the precipitate may affect this point to a considerable extent.

Mr. **Thomson**: I understood Mr. Allen to say that the Germans had succeeded in producing glycerin free from colour from soap leys, but that up to the present time this had not been accomplished in England. I believe the French were the first to produce pure glycerin from soap leys. Some years ago I visited the works of M. Clolus, in Paris, and he then showed me some glycerin quite free from colour, which had been prepared by him from soap leys.

Mr. **Allen**, in reply to the Chairman, said: The sulphur compounds cause the formation of volatile sulphuretted organic compounds during the subsequent distillation of the glycerin, and render it unfit for conversion into nitro-glycerin. With regard to Mr. Dreyfus's remarks, what I stated was that in Germany they obtained a product of fair quality by distilling a certain crude glycerin which had not hitherto been successfully distilled in England. The crude glycerin in question was not always obtained from Lancashire leys. I did not intend to imply that a colourless or fairly good distilled glycerin could not be manufactured in England, as it is done very largely, by several firms. Some of the best samples of distilled glycerin, so far as colour is concerned, behave in an unsatisfactory manner on nitration. I am delighted that so high an authority as Mr. Davis should think that the precipitate of cuprous sulphocyanide obtained in his process is likely to have a direct value in the manufacture of other sulphocyanides. I fancied that hitherto Messrs. Gossage cared very little what proportion of sulphocyanides had been present in the black-ash liquors, while, I might remind Dr. Grossmann, that was not the same thing as finished caustic soda. I don't know the proportion of sulphocyanides actually present in the specimens of leys before us, as the bottles are just in the condition in which they were sent me by Messrs. N. Mathieson, but you can see that the precipitate of cuprous sulphocyanide is very considerable. I have assayed several specimens of Lancashire leys, and have found them to vary very considerably in the proportion of ferrocyanides and fatty matters present. The samples I have examined contained not less than one gramme per litre of sulphocyanogen (CNS). This does not at first seem a very large amount, but if it existed in leys containing five per cent. of glycerin, it is evident that the crude glycerin obtained on concentration will contain something like two per cent. of sulphocyanogen, and much smaller proportions than this were found highly objectionable on distillation. I cannot agree with Dr. Grossmann as to the result of the assay of a copper precipitate. In the Cornish dry assay the first operation was usually to roast the ore, and if that were done with cuprous sulphocyanide, or any mixture of that with ferrocyanides, albuminous matters, etc., there would be no difficulty in getting out nearly all the copper by dry assay. In cases where ferrocyanides are present it will probably be found desirable, first of all, to treat the leys with acid and an iron salt, by which means a large amount of fatty and albuminous matters may also be removed, while the precipitate subsequently obtained will consist of approximately pure and nearly white cuprous sulphocyanide.* In other cases it will, doubtless, be found simpler to precipitate everything together by the addition of a cupric solution, roast the precipitate, and re-dissolve the resultant oxide of copper in acid. Treatment with the copper solution removes an astonishing quantity of impurities even from leys produced in soap works where only finished caustic soda is used. The copper treatment can be practised at almost any stage of the concentration, but, so far, the operations on a large scale have been conducted on the leys after evaporation to the point at which salt began to deposit. With regard to Mr. Davis's remarks about the oxidation of hyposulphites, I am myself accustomed to precipitate copper in that way, and the re-action which occurs in a boiling solution is generally represented as follows: — $CuCl_2 + Na_2S_2O_3 + H_2O = CuS + Na_2SO_4 + 2HCl$. Has Mr. Davis verified this, and found complete oxidation to sulphate? In the cold, no separation of sulphide of copper occurs, and I fear the change to sulphate, even in the presence of excess of copper, is not complete. I wish it were, as it would obviate the necessity of a supplementary treatment of the leys with bleaching solution, but that after all is a simple matter.

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ON THE INFLUENCE OF MASS ON THE COURSE OF CHEMICAL DECOMPOSITION, WITH ESPECIAL REFERENCE TO TECHNICAL PROCESSES.

BY G. H. BAILEY, D.SC., PH.D.

It is not without some diffidence that I bring before you a subject which, strictly speaking, is more scientific in character than technical; but to those engaged on a large scale the subject is a matter of importance, and if I can accentuate in some degree the desirability of a more definite knowledge of this subject, I shall be satisfied; and perhaps in the discussion there are some who may be able to point out examples of this action which have occurred in the course of their experience.

I propose, by way of introducing the subject, to say a few words about the work and views of Berthollet, which, although not accepted in their entirety at the present day, yet form the basis for the dynamical study of the course of chemical reaction.

Berthollet looked upon decomposition as depending chiefly on mass, and considered that such variations as did occur arose from physical causes, such as volatility or insolubility. Take the case of silica. The affinity of silica for bases is only about 1 per cent. of that of nitric acid, and yet silica expels nitric acid from sodium nitrate at higher temperatures, and, where a large excess of silica is used, even at moderate temperatures. This arises from the greater volatility of nitric acid. Again, hydrochloric acid in excess, though a volatile acid, decomposes silicates with the separation of insoluble silica, the direction of the reaction in this case being determined by the factor of insolubility.

It is a well-known fact that silicates are decomposed by alkaline carbonates, and yet some recent results, published by Bunsen, show that carbonic acid at ordinary temperatures will decompose glass, the decomposition in his case having proceeded to the extent of 6 per cent. Similarly, experiments have been tried on the solvent action of aqueous solutions of carbonic acid on the Thomas-slag with a view to utilising the phosphates contained in that slag, and it has been found that it is to a considerable extent dissolved; in fact, Meyer was able to dissolve more than half the lime and phosphoric acid out of such a slag containing 54 per cent. of lime and 22·2 per cent. of phosphoric acid.

One can readily see why silica ought to be avoided in the balling process, and similar caution is required

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* The precipitate obtained on a large scale was found, after washing and drying, to contain 97 per cent. of cuprous sulphocyanide.

in other processes where higher temperatures are employed. This caution applies with equal force to processes, whether carried out on the large scale or merely as experimental trials, where glass or porcelain are used, and patents could easily be pointed to in which reactions attributed to other causes arise really from the material of which the apparatus is constructed. The second point of Berthollet's views has received more attention in recent times, and it is with this we chiefly concern ourselves.

When two substances are brought together, the reaction which takes place between them is not final and determinate, but its extent is defined by the temperature, by the mass, and by other influences. When, for instance, we bring together barium hydrate and sulphate of soda, we have formed sulphate of barium and caustic soda, but the reaction is always accompanied by a reverse reaction, in which the caustic soda reacts on the barium sulphate, reproducing barium hydrate; so that at any given time we have present, not barium sulphate and caustic soda alone, but all four of the products, and the relative quantities of these depend largely on the masses present.

The New York Oxygen Company produce hydrogen by heating together anthracite and slaked lime. The operation is finished in a very short time, and on passing an excess of steam over the residue in the retorts the reverse action sets in and the slaked lime is reproduced. We can then proceed to submit the materials to the second operation for producing hydrogen, and this may be continued many times without renewing the materials. Whatever other factors come in, there can be no doubt that the excess of steam used in this case controls the direction which the reaction may take. A further instance comes from practical experience in caustic soda making. It has been found that a 2 per cent. solution of carbonate of soda will yield 99·4 per cent. caustic; a 10 per cent. solution, however, gives only 97·2 per cent. caustic; and a 20 per cent. solution gives only 90·7 per cent. caustic. The reaction here is between water, carbonate of soda, lime, and calcium carbonate; and we have a second instance very much resembling the case of the barium hydrate, and where the mass of water defines the course of the reaction.

Interesting examples of the same kind might be obtained from the experiments that have been done in the lixiviation process, the most interesting of which are due to Kolb. He finds that the amount of carbonate obtained increases with a large excess of water, but that the sulphides also increase under these conditions, and this latter more especially when the process of lixiviation occupies considerable time. If such experiments are worthy of being carried out in the complete manner that they have been in this instance, it is worth while to make similar investigations of other processes with a view to determine in precise terms the effect of mass.

Where reactions are made use of in which the chemical affinity is small we have the results of mass action most pronounced; and to take a case right on the borderland of chemistry, where chemical affinity is extremely small, we may consider the case of solution of gases. Dalton and Henry showed that, supposing the co-efficient of solubility of a gas be determined in the case of pure gas, the co-efficient is not the same when the gas is mixed with other gases, but is directly proportional to the quantity of the gas present.

Thus, though the co-efficient of solubility of N_2O_3 in sulphuric acid is large, yet when this gas is mixed with large quantities of nitrogen and oxygen, that co-efficient is reduced very considerably; and taking ·01 per cent. as that contained in the gases passing into the air from a sulphuric acid chamber, the co-efficient of solubility is reduced to one ten-thousandth of its former value. From this it is evident that it is not practicable to prevent entirely the loss of nitre in the process of the manufacture of sulphuric acid by means of absorption.

It is quite possible that similar considerations may apply to a large number of cases where chemical combination of a loose kind takes place, and that in such cases also the extent to which the combination takes place is determined by some similar law of which we are at present ignorant, and dependent on the relative masses of the reacting substances. Thus, by far the greater part of the oxidation process of the sulphuric acid takes place in the first chamber; after that, the sulphurous acid is very slowly oxidised, and, in any case, partially escapes oxidation. We have indeed at the later stages of the process sulphurous acid, oxygen, and N_2O_3 mixed according to recent research, large quantities of sulphuric acid, and moisture in the form of vapour. If any process could be devised which would accelerate the rate of deposition of the sulphuric acid, this would no doubt accelerate the oxidation process, and render it more complete. Such considerations enter into various branches of the industries, where rule-of-thumb forms at present a very considerable element; and where chemical agency seems to have so little to do with the process, we cannot blame the manufacturer for adopting certain more or less empirical rules. But the reasonable mode of procedure would be to determine definitely what the action of mass is in such processes, and then it might be possible to work on more economical principles, and attain better results.

The recent papers by Messrs. Liechti and Suida tend to throw considerable light on the mordanting process from this point of view, and form a most valuable contribution to this branch of inquiry. Similar considerations will, no doubt, be found to bear in the ill-understood process of hardening mortars and cements, and in other similar cases. What is mainly wanted is, then, information of a definite character derived from the study especially of operations on a large scale; and such observations may fairly be expected from the technical chemist. Finally, to look at the subject in a more rigid manner, we should say that the course of a chemical reaction is determined by the degradation of energy which takes place, and is modified by the facilities which present themselves for bringing about contact between the molecules. Experiments have been made in this direction by Menschutkin, Bertholet, Guldberg, Waage and others, more especially on the latter of these two factors, and an example or two may make their method clear. If there be present p molecules of, say, ethyl alcohol, and q molecules of acetic acid, we write usually $p=q$, and give as the equation representing the reaction—

$$C_2H_5OH + CH_3CO_2H = CH_3CO_2C_2H_5 + OH_2.$$

The reaction in reality, however, does not attain completeness, and must be, from the dynamic point of view, looked upon as occurring between all the four substances taking part in it. The extent of the reaction and the point of equilibrium at which the relative amounts of the reagents cease to change will depend largely on influences external to chemical, especially on mass. Where $p=q$, 0·665 parts of acetic ether will be produced, where $q=2p$, 0·828 parts, and where $q=12p$, 0·933 parts. Menschutkin has made similar observations on a large number of alcohols, and achieved most valuable results. To take a second case.

On bringing together sulphate of barium and water in the relations of 1 in 500, and adding one molecule weight of potassium carbonate at 100°, until reaction came to a standstill, it was found that 0·176 of the barium sulphate had been transformed into carbonate. When two parts of potassium carbonate were used, the transformation took place to the extent of 0·395, and when three-and-a-half parts were used, to the extent of 0·719. We recognise here, then, the reaction in which barium sulphate, potassium carbonate, barium carbonate, and potassium sulphate enter in. If we increase the mass of any one of these four bodies, we influence the course and extent of the reaction. What would be the effect, now, of adding excess of potassium sulphate? We should expect that its influence would determine, in a great measure, the re-formation of barium sulphate; and, as a matter of fact, where the 0·25 parts of potassium sulphate were added, the amount of barium carbonate obtained, instead of being 0·395, was only 0·200; and where 0·5 of K_2SO_4 was introduced, only a trace of barium carbonate was found.

Gladstone found that the extent of the reaction which occurred between ferric salts and sulphocyanides depended on the masses used. I may also mention that Gladstone and Tribe found that there was a definite and simple relation between the concentration of the acid and the extent of its action.

In conclusion, I have to thank Dr. Hurter for one or two valuable suggestions in connection with this paper.

DISCUSSION.

Mr. Irwin: Anyone who had much to do with chemical operations would have often come across instances in which mass had a great deal to do with the result of those operations. One case especially had come under his notice in the extraction of benzol from coal-gas. Regarding this operation it was usual to say that the lighter boiling benzol might be extracted from the gas by absorption with a liquid of higher boiling-point, say xylol or cumol, in which it would dissolve. This statement, however, was only true in a sense, for it depended entirely upon the relative quantity of benzol in the gas to the xylol employed for its absorption. Take, for instance, Manchester gas, which contained about three gallons of benzol per 10,000 cubic feet. If a small quantity of this gas was allowed to bubble through several consecutive flasks containing xylol, all the benzol would leave the gas, and xylol in smaller quantity would take its place, and the former would become saturated with the latter substance. If, however, this gas were now passed through a similar number of flasks containing benzol in excess, the benzol would again gradually take the place of the xylol until the gas contained none of the latter, but was saturated with the former substance. Of course, this was really a physical operation, but it seemed to the speaker a good illustration of what Dr. Bailey had wished to indicate in his interesting discourse.

Mr. Thomson: Dr. Bailey mentioned as an example of the influence of mass, the action of silicic acid on potassium nitrate. He said when these were heated together the feeble silicic replaced the nitric acid. He could not make out whether he meant, by heating, actual fusion of the silica with the potassium nitrate, or whether the silica was boiled in a water solution of the nitrate. If he meant the former, the speaker could not see how the question of mass, as he applied it, had anything to do with the reaction. So far as he could judge, Dr. Bailey had given them no new facts in connection with the influence of mass on chemical action, nor had he suggested any new method of procedure by which one could measure the influence of mass so as to distinguish what was due to it, and what was due to the influences of temperature or other external agencies. With regard to his explanation of what mass had to do with mordanting of cloth, it did not seem to his mind satisfactory. Another suggestion which he gave as an example of the influence of mass was the production of hydrogen and calcium carbonate when steam was passed over anthracite coal covered with lime at a red heat. The coal decomposed the steam, forming hydrogen, carbonic acid, and carbonic oxide. The carbonic acid would, of course, combine with the lime if the temperature were not too high; and if it did so, it was evident that by simply raising the temperature higher the calcium carbonate would become dissociated and its carbonic acid liberated, whether the steam continued to pass over it or not. How this experiment illustrated Dr. Bailey's suggestions as to the action of mass on chemical action he could not see.

Mr. Dreyfus wished to compliment Dr. Bailey on the selection of his paper, and hoped that many more of a similar nature might be brought before the Society. He thought it was very desirable that many researches like the one investigated by Dr. Bailey should be extended to other substances. Dr. Bailey had stated that silica, in the presence of nitrate of soda and by the action of heat, would give nitric acid. He hardly thought that this action was to be attributed to the action of the mass, but could be easily explained by the well-known law, that a fixed acid, like silicic acid, displaced the more volatile acid, like nitric acid, by the action of heat. With regard to Messrs. Liechti and Suida's paper on Mordanting, referred to by Dr. Bailey, not having read it, he could not say what had been published in such paper about the action of mass in mordanting, but he could say that mordanting was a very simple operation, and that the results obtained with mordants depended entirely upon the saturation of such mordant. He might give as an example the following facts which came under his notice many years ago. When madder and garancine were used for dyeing reds, at that time a very strong mordant, about 12° T., was printed on the cloth and fixed in the usual way; it was then dyed up with a certain quantity of madder and soaped in the usual way. Unless such a mordant was thoroughly saturated with the colouring matter, the colour would come off in the soaping and give a very poor and uneven red; whereas if, instead of using such a strong mordant, a much weaker one was used, it took far less colouring matter to saturate it, and yet the red produced stood the soaping perfectly, and was deep, bright, and fast. It was his opinion that the mordant should form a saturated lake with the colouring matter in the case of dyeing with madder or alizarin, and if such a saturation had taken place the red produced would be a fast red. It should be the study of the colourist to see how far he could reduce his mordant in strength and still obtain this result.

Dr. Bailey said that what he wished more especially to do was, not to bring into notice the action of mass in a general way, but the necessity that existed for arriving at definite information as to its influence. If we bore in mind that such influence did take place we should be able to explain reactions which we came across in practical working, and which otherwise presented difficulties to us, and might probably be guided towards the realisation of reactions which otherwise were not attainable. He failed to see the force of Mr. Thomson's objection to the process of the New York Oxygen Company, as it seemed to him that considerations of temperature argued rather in the contrary direction to that which Mr. Thomson would require. Mr. Irwin's example was an interesting one, and no doubt numbers of such cases were constantly occurring unnoticed.

Newcastle Section.

Chairman: P. P. Bedson.

Vice-Chairman: J. C. Stevenson, M.P.

Committee:

Alfred Allhusen.
G. T. France.
John Morrison.
F. S. Newall.
John Pattinson.
J. B. Payne.
H. R. Procter.
B. S. Proctor.
W. W. Proctor.
W. L. Rennoldson.
C. T. Richardson.
T. W. Stuart.

Local Secretary and Treasurer: J. T. Dunn, 115, Scotswood Road, Newcastle.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held in the College of Science, Wednesday, January 12, 1887.

PROF. P. P. BEDSON, D.SC., IN THE CHAIR.

DISCUSSION ON MR. RIDSDALE'S PAPER ON AN "APPARATUS FOR COLOUR TESTS," READ AT THE NOVEMBER MEETING, (POSTPONED FROM DECEMBER).

Mr. Ridsdale, at the invitation of the Chairman, added that his apparatus, though designed for use in a special process, was applicable to any colour-testing where the tints to be compared were not too deep. With reference to the speed of testing, he had mentioned in the paper that a test could be completed in 35 or 40 minutes; this, however, was by no means the possible rate of merely making comparisons. In winter time, by about three in the afternoon it was frequently too dark to compare colours, and after that time perhaps ten or a dozen samples would accumulate: in the morning these could all be started at the same time, and got ready for comparison in say 45 minutes, and then the mere comparison did not occupy more than half a minute each.

In answer to a question by Mr. John Pattinson, Mr. Ridsdale stated that the apparatus could be obtained from Mr. Robson, Linthorpe Road, Middlesborough.

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DISCUSSION ON MR. JOHN PATTINSON'S PAPER ON "THE RATE AT WHICH BLEACHING-POWDER LOSES ITS AVAILABLE CHLORINE," READ AT THE NOVEMBER MEETING.

The Chairman asked whether the method of examining the powder in the casks was such as to ensure uniformity in the samples, or whether any stratification might have taken place in the casks, so that samples taken from different layers might have different compositions; also, whether the hygrometric state of the air in the cellar had been recorded? He remarked that the decomposition was obviously not all attributable to the effect of carbonic acid, but must be largely ascribed to the instability of the ClO group, which broke up, giving off either chlorine or oxygen.

Mr. Pattinson said that in packing the casks great care was taken to secure uniformity throughout; the casks were then laid on their sides, and samples taken by boring successively holes around the circumference of a circle on the end. He had not taken hygrometric observations, but as the casks were in a cellar, and the temperature was low, the air was probably pretty damp. With reference to an observation of the Chairman's, as to the disappearance of the chlorate being very remarkable, Mr. Pattinson said he had no explanation to offer, but the fact was well ascertained that while fresh bleach contained chlorate, old bleach frequently contained none. As to the low percentage of carbonic acid, which had been remarked on by Mr. Rennoldson when the paper was read, he had since repeated the determinations, and confirmed the results.

Mr. Stuart also remarked on the small amount of carbonic acid in the samples, and said that the results of Mr. Pattinson's experiments at higher temperatures would be awaited with interest by bleaching-powder manufacturers.

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ON A GRAVIMETRIC METHOD OF ESTIMATING TANNINS.

BY HENRY R. PROCTER, F.C.S.

In the absence of any exact knowledge of the structure or equivalents of most of the tannins, it has long been desirable to have some method of determining by weight the actual quantity of matter in any tanning material capable of absorption by hide, independent of its nature or chemical constitution, or of any more or less arbitrary numerical factors. Some crude attempts at this were early made by Bell Stephens, by tanning thin pieces of raw hide in the liquor, and after drying, determining the gain of weight. No practical method could, however, be founded on this procedure, not only on account of the extreme slowness and imperfect character of the absorption under such conditions, but from difficulties connected with the uniform drying of the hide, and the large quantity required in proportion to the tannin present. A more hopeful effort in this direction was the "tan-tester" of Müntz and Ramspacher, which in various modifications consisted of a sort of small filter press, by means of which the liquid to be tested was forced through a piece of wet raw hide. By evaporating equal portions before and after this treatment, and weighing the residues, the loss of tannin was to be determined. In lieu of evaporation, a picnometrical determination was also employed, similar in principle to that of Hammer, and based upon the determinations which he had made of the specific gravity of solutions of gallotannic acid. Unfortunately, though admirable in principle and simple in execution, the method failed in practice, giving, in two careful sets of test-analyses undertaken to prove it by Mr. Evans and myself, discrepancies exceeding 30 per cent. of the total tannin present. These variations were caused on the one hand by the water present in the raw hide, which was necessarily of considerable thickness; and on the other by the great difficulty of ensuring the complete absorption of the tannin after a small volume of the solution had been passed through. A third source of error was also noted, which is common to all methods which employ hide or hide powder as an absorbent of tannin (and therefore both to Professor von Schroeder's modified Löwenthal method, and to the process I am about to describe), and which depends on the fact that hide is swollen by gallic and other acids, which are retained with considerable energy for the time, though probably expelled by tannin as the tanning process goes on. In the tan-tester, also, if much acid were present, the hide became so swollen that it was impervious to the liquids, and continued filtration was impossible.

Much attention has recently been devoted to the preparation of pure and very finely-divided hide powder, primarily for the absorption of tannin for the Löwenthal process; and among others, Mr. F. Simand, assistant at the Vienna *Versuchsstation für Lederindustrie*, has prepared very pure forms, both of hide power and of the gelatinous tissue of porous bones, which gave up to cold water nothing affecting permanganate in the Löwenthal test, and only a very minute portion of total soluble matter, not exceeding 36 milligrammes, from 5grms. This great freedom from soluble matter enabled Simand to make very fair determinations of the total absorbable matter of several tanning materials, but a great obstacle to success was the necessity of employing only very dilute tanning solutions to avoid hardening the hide powder and preventing further absorption. Early this year (*Dingl. Polyt. Jour.* 260, 564—568; *Chem. Soc. Jour.* Abstract, 1886, 1088), Messrs. Simand and Weiss published a very ingenious modification of their earlier method, by which this difficulty was completely overcome, and very much stronger infusions could be employed. Instead of adding the hide powder all at once, four or five small successive portions were employed at intervals of 6 or 8 hours, of which the earlier ones removed a large portion of the tannin, and so enabled the later ones to complete the absorption. Very satisfactory analyses are obtained by this method, and the principal drawbacks are the rather considerable time required and the consequent liability in hot weather to putrefactive action and increased solution of the hide powder.

It recently occurred to the writer that, building on the processes just described, a combination might be formed which should unite the rapidity of Müntz's with the exactness of Simand's method. The idea was that in filtration through a column of dry hide powder, the upper layers would absorb most of the tannin, and that from the large surface exposed a very complete and rapid separation would be obtained, and this in practice has proved to be the case. A very efficient apparatus for the purpose may be improvised from the lamp chimneys used in the common round-wicked German petroleum lamps, which are contracted just above the base of the flame, and cylindrical for the remainder of their length. A disc of cork is perforated with the cork-borer, and made slightly cup-shaped on its two faces. A piece of linen is then stretched over it, and it is pressed down the chimney till it rests on the contracted neck. 5grms. of hide powder are weighed into the tube, and, shaken down, will occupy a space of about 50cc. The tube is now cut off, allowing only length for the insertion of a cork, which may press slightly on the powder, as it contracts in volume when wet. This cork is perforated and hollowed like the first, and after being covered with linen is pressed into the tube. A short piece of quill-tubing fitting the hole in the cork, and which may be fitted by a second (notched) cork into a flask or broad bottle, completes the apparatus. If the liquid to be filtered be poured direct into the tube, it will be found in most cases that it will force a channel down one side of the glass, and so escape perfect absorption. This may be prevented by upward filtration; but to avoid this complication, the following mode may be adopted:—The filtering tube is inverted, broad end downwards, into a beaker of 100cc. capacity, which is filled with the liquid till it rises into the hide powder. If the tube be left an hour or two in this position, the hide powder will become gradually moistened for some distance; and if the tube be now reversed, and the enlarged end filled with the solution, the filtration will proceed evenly and steadily. In practice I have employed a solution of extract, etc., containing tannin equal to 10 or 12grms. per litre, though I do not know that this is the highest limit of strength admissible. Of this, 50cc. carefully filtered through paper, are evaporated at 100° C., to determine the total soluble solids. If total solids be determined by drying a portion of the original sample, the difference between the two determinations will give the insoluble, and this mode of procedure (suggested by Simand and Weiss) is preferable to a direct one, which from difficulty of filtration is often tedious or impossible. If now 50cc. of the hide filtrate be also evaporated, the residue of the hide powder, less a small correction for solubility amounting in the sample I am using to about 40 milligrammes, will be the "extractive" or soluble matter not tannin. I have found nickel crucibles very satisfactory for these evaporations, which proceed much more rapidly than from porcelain, though for ignitions they are inferior to platinum.

I have satisfied myself that the filtrates, made as described, are perfectly free from tannin, and tested by the Löwenthal method they show a lower result of "non-tannin" than those by any other method of absorption with which I am acquainted. At the same time it is obvious that tanning extracts, and even the purest commercial tannins, contain matters which are partially removed by the filter, probably as sand, and other chemically neutral filters will remove more or less of certain colouring matters and salts. Thus, in testing a sample of Schering's tannin ph. gr. (recommended by Von Schroeder as the purest German tannin), the first 5cc. were equivalent to only 0·5cc. of permanganate (1grm. per litre), while 5cc. taken after running about 70cc., required 2·3cc. If this were reckoned out as gallotannic acid it would amount to from 1·3 per cent. to 4·3 per cent. of the total employed, but it was shown by testing with ammonia sulphate of copper that there was probably none, and, at most, much less than 1 per cent. of the original tannin present, and the reaction was due to gallic acid. Other tanning materials which do not yield gallic acid, still contain other bodies which similarly affect the results. As I have already stated, gallic acid is pretty freely absorbed by hide, a 1 per cent. solution losing 78 per cent. of the total. This unfortunate peculiarity completely condemns hide powder for rigid scientific work where gallic acid is present, and makes it desirable in the analyses of such materials as sumach, galls, and myrabolanes to employ the Löwenthal method with precipitation with gelatin and salt, using the proportions advised by Mr. Bertram Hunt (this Journal, *1885*, 266). I am in hopes, however, of overcoming the difficulty, either by some method of removing the gallic acid or preventing its absorption by the hide.

In order to ascertain whether neutral bodies, such as are found in tanning materials, are withdrawn from solution by the hide filter, experiments were made with glucose and dextrin. 50cc. of a solution of commercial glucose, containing 0·6grm. of the air-dry substance left 0·506grm. after drying at 100° C. An equal quantity, after passing through the hide filter, left 0·594grm., thus having apparently taken up 0·088grm. from the hide. As only about 0·04—0·05grm. would have been dissolved under similar circumstances by distilled water, it seems as if glucose had the power of increasing the solubility of hide; a point deserving investigation, both from the analytical and the technical standpoints; since glucose has been frequently used for the removal of lime from hide, for which purpose any solvent power on the hide itself would be fatally objectionable.

Dextrin appears quite indifferent, the gain of weight in passing through the hide filter being 0·045grm., or practically the same as with distilled water.

In order to apply either this process, or that of Simand and Weiss, successfully to the analysis of solid materials, much stronger infusions are required than for the Löwenthal method, and it becomes a difficult problem to obtain them, and, at the same time, to secure complete exhaustion. To accomplish this, Messrs. Eitner, Simand, Meerkatz, and Weiss* have been jointly investigating the application of the principle so often employed in the estimation of fats—viz., that of continuous exhaustion by the same body of liquid, by aid of the return-flow condenser. They have proved (what a tanner would scarcely, *à priori*, have expected) that even materials so easily changeable as sumach and valonia suffered no material loss of tannin absorbable by hide, even by prolonged boiling, though the colour was decidedly darkened. Their experiments do not seem to have embraced gambier, which Hunt† found to lose considerably by boiling in contact with air. Having satisfied themselves that prolonged boiling was admissible, they have constructed an apparatus similar in principle, though differing in detail, from the well-known Soxhlet's tube, which they find to work satisfactorily.

Since distilled water is neither expensive or poisonous, like the more volatile fluids employed for fats, it is questionable whether, for any small number of analyses, the use of so comparatively complicated and expensive an apparatus is either necessary or desirable, though for an institution like the Vienna Leather Industry Research Station it is undoubtedly very convenient, enabling many exhaustions to go on at once with little attention. Probably excellent results would be obtained by boiling the sample for, say, half-an-hour, with as small a quantity of water as practicable, draining off the strong liquor, and completing the exhaustion with hot water, which should be evaporated to small bulk in a flask, and added to the strong liquor before making up the required quantity. This would have the incidental advantage of avoiding prolonged boiling of the greater part of the tannin. A convenient and simple apparatus for the purpose might be improvised by fitting a rather wide-tubed funnel into a flask with a cork, and slipping a smaller one inside it containing the tanning material, in a filter. The flask being placed over the gas, evaporation and washing the residue might go on simultaneously, while the material would be retained at boiling temperature by the escaping steam.

M. Eitner and his colleagues give a series of analyses in the paper referred to, both by the Löwenthal and the hide powder methods, which show that even for the same material there is in most cases no constant relation between the permanganate value and the absorbable tannin, the relation being affected even by the age and growth of the sample. This is only what might have been expected, when we consider that most tanning materials are natural mixtures containing more than one tannin in varying proportions. On this ground Eitner has entirely discontinued the use of the Löwenthal method in the Vienna Laboratory in favour of the Simand-Weiss. Until, however, some satisfactory plan is hit upon of separating the gallic acid, neither this nor the modification I have described can be regarded as wholly satisfactory, at least for such materials as are apt to contain this acid.

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* "Der Gerber," 296, 2 (Jan. 1, 1887).
† This Journal, **1885**, 263.

ON THE ESTIMATION OF SULPHUR IN PYRITES.

BY G. LUNGE.

In the *Analyst*, November, 1886, p. 209, Mr. J. C. Welch publishes a process for assaying iron-pyrites for sulphur, available for sulphuric-acid manufacture, for which he claims advantages in speed and accuracy over that process which is generally associated with my name. I have no intention of entering into a controversy upon the point, whether Mr. Welch's process is really "cleaner and nicer," and altogether less troublesome than mine, as I think that may be safely left to the judgment of every one for himself. As far as the greater rapidity of work is concerned, I fail to see how Mr. Welch's process could be carried out in less time than mine, even assuming the necessary apparatus to have been put up, and the oxygen to have been prepared beforehand, failing which conditions, that process must evidently take a very long time indeed. But I should not trouble the Society with any utterance on that process, if Mr. Welch did not represent it as more *accurate* than a process which he calls mine, but with which I have nothing to do, and that upon the strength of some experiments which are altogether inconclusive. This error I feel bound to point out.

Mr. Welch says: "Professor Lunge claims that his method, by means of the decomposition of the pyrites by strong nitric acid, is the best for the estimation of available sulphur, as any lead sulphide which might be present, as galena, would be oxidised to insoluble sulphate of lead." In order to refute this he procured some lead sulphide, "sold as pure," which he treated with fuming nitric acid, whereupon he found in the filtrate from 1·263 to 2·389 per cent. of sulphur, which the nitric acid must have taken up from the lead sulphide. It is not clear whether the percentage is calculated upon 100 lead sulphide or 100 total sulphur, but this is really not very important, as he did not prove that the sulphur really came from PbS, not from some of the impurities adhering to the article "sold as pure." We shall see presently that even pure PbS would probably have yielded some, but very little, sulphur.

In another experiment Mr. Welch treated 1grm. of pure lead sulphide, prepared by himself, from which he obtained by the nitric acid treatment barium sulphate equal to 1·918 per cent. of sulphur. But according to his own statement, he obtained from 1grm. of the same sulphide by his process of ignition in oxygen 1·390grms. of "lead sulphate," whilst 1grm. of lead sulphide theoretically yields 1·293grms. of sulphate, according to Mr. Welch's, but in reality only 1·268 (Pb = 206·39, O = 15·96, S = 31·98). Hence this "pure" lead sulphide must have been very impure indeed, even if we assume that 1·390 is a misprint for 1·290. Since presumably the sulphur of any other metals present in his "pure" lead sulphide would be dissolved in the treatment, Mr. Welch's experiments are refuted by his own figures, and most certainly cannot claim to have shown me to have been in error.

But the matter does not end here, for Mr. Welch has made some further altogether unaccountable mistakes. In the first instance he chooses to associate a method with my name which is the very method I opposed when bringing out my own. This was done at a meeting of the Newcastle Chemical Society, in December, 1885, and this opposition was repeated in my "Manufacture of Sulphuric Acid and Alkali," vol. i. p. 102, from which, probably most chemists have taken my method, which has subsequently been adopted, after careful examination, by the German Association of Alkali Makers, as binding upon buyer and seller, and which is hence repeated in the "Alkali-Makers' Pocket-Book," English edition by Lunge and Hurter. I say there: "The solution has frequently been made, by Fresenius' prescription, by means of red fuming nitric acid, which it is sometimes difficult to obtain free from sulphuric acid, and which is unpleasant to handle. . . . The author has always found the best, safest, and cheapest way to be that by aqua regia, made from one part of fuming hydrochloric acid and three or four parts of nitric acid of sp. gr. 1·36 to 1·4." Later on I made a special study of the action of acids on pyrites, which completely confirmed and even enlarged the above; and as I am not aware of my investigation having been more than quite cursorily reported in English (it was printed in the *Chemische Industrie*, 1882, p. 76), I beg leave to quote my results, as obtained, with various descriptions of iron pyrites :—

(*a*) Nitric acid of sp. gr. 1·48, yellow, and strongly fuming, does not act at all in the cold, and but slowly at the heat of a water-bath; the decomposition is imperfect.

(*b*) Nitric acid of sp. gr. 1·465, yellow, strongly fuming behaves exactly like the former.

(*c*) Nitric acid of sp. gr. 1·42, chemically pure, colourless, after a few seconds causes a violent reaction without any external heat being applied; much heat is given off, and in a few minutes the decomposition is complete, no sulphur being separated as such.

(*d*) Nitric acid of sp. gr. 1·40, yellow, behaves just like the former.

(*e*) A mixture of three parts strong hydrochloric acid and one part of nitric acid of sp. gr. 1·42 does not act in the cold; on the water-bath there is soon a reaction, but the decomposition takes a long time.

(*f*) A mixture of one part strong hydrochloric acid and three parts nitric acid of sp. gr. 1·42 causes a strong reaction after a few seconds, with considerable evolution of heat, and after a few minutes the decomposition is complete, without any separation of sulphur.

This last mixture, which is identical with that mentioned in my book, was thus found to be the very best; next to it comes nitric acid of sp. gr. 1·40 to 1·42, which, however, necessitates several times evaporating with hydrochloric acid; *"fuming" nitric acid, which is imputed to me by Mr. Welch as being part of "my process," was found by me the least suitable of all.*

Hence, if Mr. Welch really wanted to oppose my process, he ought not to have made his experiments with fuming nitric acid, but with the mixture prescribed by me, the decomposing power of which for lead sulphate would evidently differ from that of nitric acid by itself. This alone would dispose of his experiments as being beside the mark, but there is more positive argument against them as well.

My method of assaying pyrites, as described in my Alkali treatises, had been attacked by Fresenius, as not possessing sufficient accuracy. This led me to re-investigate the whole matter in a fundamental manner, and to send my paper to Fresenius himself, who requested me to make some further experiments, and then published the whole in his *Zeitschrift für Analytische Chemie*, 1880, vol. xix. p. 419—431, without a word of opposition, thus tacitly acknowledging the correctness of my work, which, indeed, has never been impugned since that time. One of the subjects mentioned by me in the appendix, as tested from Fresenius' suggestion, was the action of the liquid on lead sulphate. I did not, however, proceed in the manner preferred by Mr. Welch—that is, working under conditions which never occur in practice—namely, acting on "pure" lead sulphide with fuming nitric acid, but I made my experiments to conform exactly with the conditions of an ordinary pyrites test—viz., adding some lead sulphate to a solution of ferric sulphate, precisely corresponding to that which is obtained in my process when acting on iron pyrites, evaporating to dryness, boiling with very dilute hydrochloric acid, filtering, and weighing the undissolved lead sulphate. I thus proved that so little lead sulphate entered in solution, that the error caused by it in an ordinary pyrites test would not have exceeded a few hundredths of a per cent. of sulphur.

In consequence of Mr. Welch's attack I wished to once more investigate this matter; but in order to preserve all possible freedom from bias I requested one of my demonstrators, Mr. Mohler, to perform the experiments in question from my directions. A solution was made of 2grms. crystallised ferrous sulphate = 0·2302grm. sulphur. To this was added 0·7grm. pure sulphuric acid, corresponding to 0·2286grm. sulphur. The liquid, containing 0·4588grm. sulphur, was heated with 10cc. of pure concentrated nitric acid, in order to oxidise the ferrous sulphate to ferric sulphate. To this was added about one decigram of pure lead sulphate (prepared by precipitation, thorough washing, and drying at 100° for several hours), exactly weighed (0·1020grm. in one case, 0·0876grm. in another case). The whole was evaporated in the water-bath till all the nitric acid had been driven away, and now in every way corresponded to the condition in which an ordinary pyrites test would be at the end of the decomposition, starting from one grm. of 45 per cent. pyrites, containing a few per cent. of galena. When the whole had been brought to dryness, it was heated up to 90° or 100° with 100cc. of water and 1cc. of concentrated hydrochloric acid, kept hot for 10 minutes, filtered, and washed till there was no more acid reaction whatever. The undissolved lead sulphate was again dried under exactly the same conditions as before (the filter-paper having been previously treated in the same way), and the weight determined. The residue in the first case amounted to 0·0979grm., in the other to 0·0820grm. This means that in the first case 0·0041grm., in the second 0·0056grm. $PbSO_4$ had been dissolved. The mean is 0·005grm. $PbSO_4$, or 0·0005grm. S. In other words, the quantity of lead sulphate dissolved was so slight that the sulphur imported from it into the pyrites test would not influence the percentage return to a greater extent than 0·05 per cent. of sulphur—a quantity altogether vanishing beside the usual discrepancies of testing pyrites, which even in the most skilful hands, and with the very best analytical methods, often amount to 0·25 per cent.

I have thus proved the following facts :—

(1.) Mr. Welch's experiments were made with impure lead sulphide, and are hence inconclusive.

(2.) They would have been so, even if the lead sulphide had been pure, since Mr. Welch worked under conditions expressly repudiated by me, and in no possible way representing *my* process.

(3.) Positive experiments, made by me in 1880, and now by Mr. Mohler, prove that in the conditions actually present in testing pyrites—viz., in solutions containing exactly as much iron, sulphuric acid, hydrochloric acid, and water as are formed in my testing process, the solubility of lead sulphate is so slight as to make it unnecessary to take it into account for all practical purposes.

Meeting held Wednesday, February 9, at the College of Science.

PROFESSOR BEDSON IN THE CHAIR.

ON NEW OR PERFECTED METHODS FOR THE DETECTION AND ESTIMATION OF ORGANIC BODIES, BASED UPON THEIR OXIDATION BY POTASSIUM PERMANGANATE.

BY JOHN HENRY SMITH, PH.D. (ZURICH),
Associate of the Royal College of Science, Dublin.

PART I.

The utility of potassium permanganate as a reagent in both qualitative and quantitative analysis has long been recognised. The ease with which titrations in volumetric analysis are performed, the speed with which these are accomplished in the case of potassium permanganate, and the decided colouration of the titrated solution, even when highly diluted, in the presence of the smallest excess of the reagent, combine to render this body a particular favourite with chemists. Still, the best of friends has his faults, and $KMnO_4$ is no exception. Certain well-known restrictions must always be observed in its employment, and many substances upon which it is known to exert a greater or less oxidising action have been hitherto subjected to the same only as a qualitative test, owing to the incompleteness of the action, or to the formation of intermediate manganese compounds, whose composition has been only imperfectly investigated, but is generally considered to be of a variable character.

To such a class belong organic bodies generally, oxalic acid being the only one which has surrendered itself to complete oxidation, under the ordinary conditions of working. I know of no other organic body which has been completely oxidised by $KMnO_4$ under conditions which would allow of the quantity of oxygen absorbed in the reaction being even approximately estimated. Several attempts have been made, I am aware, but the general conclusion derived from them has been that the oxidation is incomplete, and too variable, even when working under conditions as equable as possible, to found even a relative method of estimation upon the reaction. W. Lenz[*] succeeded in oxidising grape sugar to the extent of 54 per cent., and glycerin to 24 per cent.; but he states that the results vary with the quantity of permanganate solution first added, under otherwise exactly the same conditions.[†] The same conclusion had long been arrived at, in regard to the employment of this reagent for the estimation of the organic matter in potable water.

I have carefully investigated the deportment of potassium permanganate while undergoing the process of reduction, have ascertained the cause of the fluctuations in the recorded results, and have succeeded in nullifying the same, thereby being enabled to found certain reliable methods, generally applicable to the detection and estimation of organic bodies.

Considering the large extent to which such bodies enter into English chemical industry, and the importance of possessing more accurate and rapid methods for their valuation, I need hardly apologise for bringing the results of my experiments before the notice of this Society.

It will probably prove most interesting and instructive, if I adhere generally to the order of the experiments which prevailed in the course of the investigation.

DIRECT TITRATIONS WITH $KMnO_4$.

No results having a practical bearing were obtained from the titration of organic bodies in the usual manner; the oxidation was incomplete in the case of every body examined, excepting, of course, oxalic acid, and not even sufficiently constant to form any reliable method of comparison.

The chief value of these experiments lies, therefore, in their corroboration of the results previously obtained by other experimenters, and in their more emphatic demonstration of the utter untrustworthiness of the permanganate method of estimating the organic matter in drinking water, even as a comparative method, and working under conditions generally assumed to be similar; and assuming, further, that the organic impurity present is of the same nature in the samples under comparison. Some of the general results obtained are of sufficient importance, however, to be quoted here.

In alkaline solutions, a direct titration cannot be effected at any temperature, on account of the production of soluble green salts of manganic acid, or of insoluble manganese compounds.

In exactly neutral solutions, organic bodies, with few exceptions, are incapable of decolourising a drop of permanganate solution, even at a temperature approaching ebulition. Even oxalic acid remains unoxidised when exactly neutralised. Tannin is, however, an exception to the rule. It may be titrated to the extent of about 62 per cent. of the total oxidation possible at 100° C., before any manganese is precipitated; but the dark yellow colour which the solution assumes renders it impracticable to employ this reaction as a quantitative one. Tartaric and citric acids may also be titrated to a slight extent in boiling neutral solutions, the former to 1 per cent., and the latter to 2½ per cent. of the total oxidation. This is probably due to the slight solubility of the manganese precipitate in exactly neutral solutions, which we know is the case with MnO_2.

The behaviour of organic bodies in sulphuric acid solutions, when acted on by $KMnO_4$, is very varied. As a rule, the oxidation proceeds so slowly in the cold, that a protracted waiting is required for the discolouration of each drop of permanganate solution, extending frequently to hours. Even oxalic acid is no exception to this rule. With citric acid (which may be titrated as rapidly as oxalic acid in hot solutions), twenty minutes were required to decolourise 0·2cc. of normal $KMnO_4$ (1cc. = 0·01grm. Fe).

As the temperature rises, the speed of decolouration increases. Most bodies, however, even at the boiling temperature, are exceedingly slow in reducing traces of permanganate, and in *all* cases which I have examined—excluding oxalic acid—a point arrives in the titration, before the oxidation is perfect, at which a brown manganese precipitate is formed. Although I am persuaded that there is a theoretical point in the reaction corresponding to the appearance of this precipitate—apart from the tediousness of the operation—I have never found the observed period sufficiently constant to found a process of estimation upon the reaction. The chief reason for this irregularity is, that as the theoretical point is approached the formation of the precipitate becomes easier, and its solution more difficult; and two drops of permanganate added at once, or a slight lowering of temperature, might produce it permanently, where two consecutive drops, or a constant high temperature, would have prevented its formation.

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[*] Zeits. Anal. Chem. 21, pp. 34—41.

[†] Unfortunately, I have neither been able to consult the original paper for these conditions, nor to obtain them from the author, to whom I wrote.

With tannin, which can be titrated with great rapidity, the precipitate occurs after about 66 per cent. of the total oxidation, corresponding nearly to the absorption of 16 atoms of oxygen per molecule. With tartaric and citric acids, which may also be titrated rapidly at the boiling temperature, precipitation occurs when about 69 and 73 per cent., respectively, of the oxygen required for perfect oxidation has been absorbed; corresponding to an absorption of 3½ and 6½ atoms of oxygen, respectively, per molecule. A precipitate was formed with formic acid after addition of 4 per cent. of the total oxygen, this possibly being due to impurity. With acetic acid, glycerin, cane sugar, alcohol, ether, and probably the vast majority of organic bodies, the precipitate is formed on the addition of a few drops of $KMnO_4$ solution, after more or less prolonged boiling.

The amount of free acid present does not make that difference in the speed of oxidation which might be expected. Indeed, oxalic, tartaric, and citric acids may be titrated with comparative ease, at a high temperature, in virtue of their own acidity, until this has been neutralised, when the action stops. The equation—$K_2Mn_2O_8 + 8H_2C_2O_4 = K_2C_2O_4 + 2MnC_2O_4 + 10CO_2 + 8H_2O$ represents the oxidation of oxalic acid until it is rendered neutral. It is seen that $\frac{5}{8}$ths or 62·5 per cent. of the total oxidation has been effected at this stage. In several experiments 64 per cent. could be oxidised before manganese was precipitated. The excess was probably due to a trace of acid in the permanganate. I endeavoured to establish a method for estimating the acidity or alkalinity of $KMnO_4$ solutions, by oxidising standard oxalic acid therewith to about 50 per cent., and determining the free acid remaining in the solution with standard KHO. In this endeavour I was not successful. The point at which the potash commences to attack the manganous oxalate is not sufficiently definite, either with litmus or phenolphthalein as indicator (methyl-orange could not be employed), in boiling or in cold solutions. No better results were obtained by adding excess of KHO, and titrating back.

In the titration of tartaric and citric acids, without addition of external acid, three cases are possible. Either the oxatyl radicals themselves, or another part of the acid may be first oxidised, the COOH in the latter case being employed in neutralising the K_2O and MnO liberated, or both these actions may occur. The equation already given represents the first case; the second may be represented thus:—$K_2Mn_2O_8 + 3H_2C_2O_4 = K_2C_2O_4 + 2MnC_2O_4 + 3H_2O + O_5$. Here we find that acidity equivalent to 3 molecules of oxalic acid is sufficient for an oxidation demanding 5 atoms of oxygen, while an equivalent of 8 molecules was necessary in the former case. Each oxatyl radical in an organic acid would, in the former case, be equivalent to an oxidation requiring $\frac{5}{16}$ths of an atom of oxygen, and in the latter case to one requiring $\frac{5}{6}$ths of an atom of oxygen. As there are two of these radicals in, and 5 atoms of oxygen are required for, each molecule of tartaric acid, the former case would represent an oxidation equivalent to $\frac{5}{16} \times \frac{2}{5} = 12{\cdot}5$ per cent., the latter one of $\frac{5}{6} \times \frac{2}{5} = 33{\cdot}3$ per cent. of the total oxidation possible. If we assume that the whole body is being equally oxidised, then the oxidation will be $\frac{12{\cdot}5 + 33{\cdot}3 \times 4}{5} = 29{\cdot}2$ per cent. of the total. But we have seen that only 69 per cent. of the total oxidation is effected in the presence of a large excess of acid in direct titration. If we include the oxidation of the oxatyl radicals in the 69 per cent., as we have reason for doing, the oxidation becomes $\frac{12{\cdot}5 \times 20 + 33{\cdot}3 \times 49}{63} = 27{\cdot}3$ per cent. The amount oxidised in a direct titration was found to be 29·7 per cent. of the total. If we allow for the small amount of acid in the sample of $KMnO_4$ employed, and the 1 per cent. capable of being oxidised in a neutral solution, the result is almost identical with the last-mentioned oxidation.

In working out these quantities for citric acid, we obtain $\frac{5}{18} \times \frac{3}{8} = 10{\cdot}4$ per cent. for the oxidation of the COOH radicals alone, $\frac{5}{6} \times \frac{3}{9} = 27{\cdot}8$ per cent. for the oxidation of the other portions of the body, and $\frac{10{\cdot}4 \times 16{\cdot}66 + 27{\cdot}8 \times 56{\cdot}34}{73} = 23{\cdot}8$ per cent. for the oxidation simultaneously of those radicals which are capable of oxidation by direct titration. In point of fact, 14·5 per cent. was oxidised before manganese was precipitated, showing that the oxatyl radicals in this case are oxidised much quicker than the rest of the body. Indeed, if we allow for the acidity of the $KMnO_4$, and deduct the 2 per cent. capable of being titrated in a neutral solution, it becomes doubtful if anything more than the oxatyl radicals are oxidised. Thus, to numbers apparently arbitrary, important meanings may be attached.

In the direct titration of oxalic, tartaric, and citric acids, I constantly observed that the speed of oxidation rapidly increased as the action proceeded; the first few drops of permanganate being exceedingly tardy in their reduction, even in warm solutions. The cause of the increased speed I traced to the presence of the manganous salt formed during the action, which salt, as we shall see later on, has the power of reducing the permanganate, thus accelerating the oxidation. It may be looked upon as a carrier of oxygen in the same light as ferric, aluminic, and other chlorides have been shown to act as carriers of chlorine to organic bodies by Page;* these salts themselves remaining unaltered. By taking advantage of this action, and adding a little manganous sulphate to the acidified solution, I found it possible to titrate fairly rapidly from the commencement, in comparatively cold solutions.

I was disappointed in the application of this result to the titration of those organic bodies which had proved so obstinate of reduction. On the addition of $MnSO_4$ to their solutions, they did not prove more amicable to titration, although the brown manganese precipitate was formed much sooner than in the absence of the manganese salt.

The direct titration experiments having failed to yield a reliable method of analysis, I was led next to investigate the action of excess of permanganate upon organic solutions. Before proceeding with this subject, it will be advisable to refer somewhat fully to the brown manganese precipitate, which is always formed in presence of excess of $KMnO_4$, and which we also found to be a final product in the direct titration of organic bodies.

ON THE NATURE OF THE MANGANESE PRECIPITATE.

With the ultimate composition of the precipitate I was not immediately concerned, but rather with the state of oxidation of the manganese it contained. Lunge and the author,† in examining the action of potassium permanganate on sodium thiosulphate in neutral and alkaline solutions, assumed that the precipitated manganese existed in the state of dioxide; and their assumption was borne out by the fact that the theoretical amount of permanganate was not absorbed until excess had been added to satisfy the following equation:—$3Na_2S_2O_3 + 4K_2Mn_2O_8 + H_2O = 3Na_2SO_4 + 3K_2SO_4 + 2KHO + 8MnO_2$—*i.e.*, five-thirds the amount which would be required if the $KMnO_4$ were completely reduced to the form of MnO.

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* Ann. 225, 196.

† This Journal, 1883, 163.

Morawski and Stingl* have attached the general formula $KH_3Mn_4O_{10}$ to the precipitate. Hönig and Zatzek† give $KH_3Mn_3O_8$ as its composition, in the case of the oxidation of $Na_2S_2O_3$ in alkaline solution. M. Gläser‡ states that K_2CO_3 enters into its composition under the conditions named, and confirms Morawski's formula in the case of the oxidation of $Na_2S_2O_3$ in neutral solutions. Hönig and Zatzek,§ replying to Gläser, question whether the precipitate can be represented by a constant formula, and state that they as well as other authors have been unsuccessful in analysing it, as it becomes altered in the process of washing, retaining foreign matter. Although such diverse opinions are held concerning the nature of the precipitate, it will be observed that in both the above formulæ the manganese exists as MnO_2. In all my experiments this result has been confirmed, and that whether the precipitation occurs in neutral, alkaline, or acid solutions.

F. Jones,‖ however, in treating of the action of hydrogen, ammonia, phosphine, arsine, stibine, manganese chloride, and manganese sulphate on potassium permanganate, finds the precipitated manganese, in each case, in the state of Mn_2O_3, never as MnO_2. Now Jones effects all his analyses by weighing the precipitate, dried either on the water-bath or over sulphuric acid ; then reducing it with hydrogen, or igniting in air, and again weighing. He has evidently assumed the precipitate to be a pure hydrated oxide of manganese, and does not seem to have examined it carefully for foreign constituents. The percentage of manganese which he finds in the precipitate dried on the water-bath is generally less than, but approximates 62·5, which corresponds to the formula $Mn_2O_3 + H_2O$. But in MnO_2 the percentage of manganese is 63·2 ; is it not probable, therefore, he has been dealing with an impure peroxide? It is true he estimates the water in the dried precipitate in two cases, and finds it to agree with the above hydrate ; but, again, the loss in weight would have been the same had the precipitate been MnO_2, and the heat employed barely sufficient to reduce it wholly to Mn_3O_4.

Christensen¶ has shown that pure Mn_2O_3 is so attacked by dilute nitric or sulphuric acid that *precisely* one-half of the manganese passes into solution, the other half remaining as insoluble MnO_2. This evidence disproves Jones' conclusions, therefore, with regard to the nature of the precipitate in acid solutions. Although it has not come within my province to examine the precipitate carefully for foreign matter, my experience corroborates that of previous authors in ascribing to it the property of retaining, at least under certain conditions, constituents of the solution in which it is formed, and this not only in neutral and alkaline solutions, but also in acid ones. With the state of oxidation of the precipitated manganese, however, I was most intimately concerned, and I shall now quote a few experiments which directly refute the conclusions of Jones, although abundant indirect evidence in confirmation of the manganese existing in the state of MnO_2 will be found throughout this investigation.

Five separate solutions, each containing 50cc. of pure oxalic acid solution, to which equal amounts of dilute sulphuric had been added, were exactly titrated with permanganate in the usual manner. To the 1st, additional $KMnO_4$ was added, in amount equal to exactly two-thirds of the quantity required for exact titration. The 2nd solution was exactly neutralised with NaHO, and the same amount of additional $KMnO_4$ added. The 3rd, 4th, and 5th solutions were made decidedly and equally alkaline with NaHO, K_2CO_3, and $KHCO_3$ respectively, and additional $KMnO_4$ immediately added as before. All 5 solutions, made up to 250cc., were heated on the water-bath for about 2 hours, and the precipitate allowed to settle. It will be seen that the $KMnO_4$ added was just sufficient in each case to satisfy the equation—$3MnO + K_2Mn_2O_8 = 5MnO_2 + K_2O$; the amount of $KMnO_4$ reduced being a measure of the MnO oxidised. Now the neutral solution had become quite colourless, showing that the manganese had been quantitatively oxidised and reduced respectively to the state of peroxide. The other four solutions were still coloured. After the precipitates had thoroughly subsided, the solutions were carefully decanted, acidified with H_2SO_4 where alkaline, and titrated back with standard $FeSO_4$ solution. The following results were obtained :—

No. of Experiment—	1	2	3	4	5
State of solution	H_2SO_4	neutral	NaHO	K_2CO_3	$KHCO_3$
% $KMnO_4$ reduced	99·85	100	96·0	96·8	97·0

If Mn_2O_3 had been precipitated, only 37·5 per cent. of the $KMnO_4$ would have been reduced, as shown by a comparison of the two following equations :—

$$3 \text{ times } K_2Mn_2O_8 + 8MnO = 5Mn_2O_3 + K_2O.$$

$$8 \text{ ,, } \quad K_2Mn_2O_8 + 3MnO = 5MnO_2 + K_2O.$$

That the reduction was not so complete in the alkaline solutions as in the acid solution may be partly accounted for by the slight oxidation of the manganese precipitates by the atmosphere, before the addition of the $KMnO_4$.

Now Jones considers that even if MnO_2 be precipitated, it is at once reduced to Mn_2O_3, oxygen being liberated. I shall treat of the evolution of oxygen in another part of this paper ; it will be sufficient to state that in the case of the neutral and alkaline solutions above referred to no oxygen is generated, while in the acid solution, under the conditions given, the loss is so slight that it need not be taken into consideration. In another experiment in acid solution, but merely warmed on the bath for five minutes, (Experiment 6), 98·5 per cent. of the $KMnO_4$ was found to have been reduced. We thus see that $KMnO_4$ is capable of oxidising $MnSO_4$ practically completely to MnO_2, even when the two bodies are present in only the theoretical proportions, and that whether the solution be acid, alkaline, or neutral. I shall refer later on to the application of these results to the estimation of manganese in manganous salts.

It is worthy of remark, that although all the precipitates contained Mn in the form of MnO_2, they were different in appearance, from which we might conclude that their absolute composition varied. That formed in the neutral solution was very bulky, and brown in colour ; those in the K_2CO_3 and H_2SO_4 solutions were very small in bulk ; while the others were of medium bulk. The precipitate in the acid solution was almost black ; the others were more or less brown.

It still remained to be proved that the precipitates formed with insufficient $KMnO_4$ are in the form of MnO_2. In order to confirm Christensen's experiments,** 50cc. of pure acidified oxalic acid solution were exactly titrated with $KMnO_4$, and additional permanganate added equivalent to 83·3 per cent. of

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* Berichte d. d. Chem. Gesell. xi. 1933.

† Ber. xvi. 2660. ‡ Monatsch. f. Chem. 6, 329. § *Ibid.* 7, 48.

‖ Chem. Soc. Journal, 1878, p. 95.

¶ Journ. fur. Prakt. Chem. [2], Bd. 28.

** *Loc. cit.*

the total quantity required to convert the whole of the manganese salt into MnO_2—*i.e.*, as we have seen, 45·8 per cent. in excess of the quantity required to convert it into Mn_2O_3, according to Jones's statement. After heating a few minutes the solution became quite colourless; it was then filtered, and K_2CO_3 added to the filtrate, when a considerable precipitate of $MnCO_3$ occurred. From this we learn conclusively that MnO is not oxidised to Mn_2O_3, but to MnO_2 in acid solutions.

The same experiment was performed in a solution nearly neutralised before the addition of the excess of $KMnO_4$, but sufficiently acid, I thought, to prevent the precipitation of MnH_2O_2, or the solution of the MnO_2 formed. The filtrate gave a slight precipitate with NaHO, which turned brown, but it was evident that some manganous hydrate had been precipitated with the MnO_2. Now if it existed in combination with MnO_2 as Mn_2O_3 we would not expect it to be oxidised by atmospheric oxygen. To prove whether this was the case I allowed the precipitate to remain on the filter for two hours, but otherwise no means were adopted to admit excess of air. At the end of that time the precipitate was dissolved in 50cc. of standard $FeSO_4$ solution, and titrated back with $KMnO_4$. I found that additional 2·1 per cent. (Experiment 7) of the original $MnSO_4$ had been oxidised to MnO_2. If, therefore, Mn_2O_3 were a stable body in neutral solutions, how could it be oxidised by the air, and more especially in the presence of a large excess of MnO_2?

It is generally accepted* that MnH_2O_2 is oxidised in moist air to $Mn_2O_2(OH)_2$, but my experiments prove that manganous hydrate is oxidised continuously in the moist state by atmospheric oxygen to dioxide both in neutral and alkaline solutions, and I am inclined to the opinion expressed by Hermann† and Rose‡ that the so-called sesquioxide, at least in the moist state, is not of similar constitution to Fe_2O_3, but a mere mixture of $MnO.MnO_2$.

In similar experiments to those just recorded, but in solutions made alkaline with NaHO, the following results were obtained; in each case the precipitate having been exposed two hours on the filter before being dissolved :—

No. of Experiment—	8	9	10	11
% $KMnO_4$ added of amount required for complete oxidation to MnO_2................	33·3	50·0	66·6	83·3
% oxidised by atmosphere ..	3·9	6·9	4·2	3·3

As we have already seen, 37·5 per cent. excess $KMnO_4$ would have been sufficient to convert all the MnO into Mn_2O_3. As a matter of fact there is no greater tendency to oxidation shown when less $KMnO_4$ has been added than when this amount has been far exceeded. Although the addition of $KMnO_4$ was performed as expeditiously as possible, it might be objected that the oxidation recorded had been effected between the addition of the alkali and the $KMnO_4$. To make quite certain upon this point the following alterations in the manipulation were made. Instead of the titrated oxalic acid, 25cc. of a solution of pure $MnSO_4$, whose strength had been accurately determined, were employed, and run in by means of a pipette at the bottom of the warm caustic soda solution, to which the requisite amount of $KMnO_4$ had previously been added. Under these conditions the action of the $KMnO_4$ must precede that of the atmosphere. These conditions might even be taken as equivalent to those of Jones, where he passed the respective gases into permanganate solutions until the latter were discoloured. As in the previous experiments, the solutions became colourless after a few minutes' heating. The precipitates were allowed to remain on their filters unwashed for seven hours :—

No. of Experiment—	12	13	14	15	16	Neut Sol. 17
% $KMnO_4$ added of total required	0	25	50	75	87·5	50
% original MnO oxidised by atmosphere	11·8	5·1	3·3	1·8	1·3	0

If we bear in mind that the amount of atmospheric oxidation decreases in two ratios—one due to the decrease of MnO present, the other due to the covering-up property of the MnO_2—then the above numbers are just such as we would expect from mere mechanical mixtures of the two oxides MnO and MnO_2. There is no violent oxidation until 37·5 per cent. of the hydrate has been oxidised, and a sudden disappearance, or at least decrease, of the same after this stage has been reached, as we would be justified in expecting, were $Mn_2O_2(HO)_2$ a definite chemical compound, and a final stage of oxidation under these conditions. Experiment 17 was performed under these improved conditions in a neutral solution. The MnO_2 precipitated corresponded exactly to the $KMnO_4$ added, no oxidation having taken place. The filtrate was only slightly acid, owing to the liberation of sulphuric acid, thus : — $3MnSO_4 + K_2Mn_2O_8 + H_2O = 5MnO_2 + K_2SO_4 + 2H_2SO_4$. It gave a considerable precipitate of MnH_2O_2 with NaHO.

These experiments, therefore, not only refute the results obtained by Jones, but they demonstrate that the brown manganese precipitate, including that formed as a final product in the direct titration of organic bodies, contains the manganese in the state of the dioxide. This precipitate, in the case of direct titration, might either be produced from the action of the manganous salt formed in the solution upon the final $KMnO_4$ added; or it might be formed from the reduction of $KMnO_4$ to MnO_2 by the organic body itself. The probability existed that some organic bodies or their constituent radicals can reduce $KMnO_4$ to the form of MnO_2 *only*, even in acid solutions, as is the case with sodium thiosulphate in neutral and alkaline ones; and I was led back to work under similar conditions to those which Lunge and I § had recommended in the case of the latter salt—*i.e.*, of adding a large excess of $KMnO_4$, more than sufficient for reduction to MnO_2 only, then adding excess of standard $FeSO_4$ solution after the completion of the oxidation, and finally titrating back with $KMnO_4$ in the usual manner.

As is well known, potassium permanganate is constantly being employed in organic research as an oxidising agent, and numerous are the bodies which have been discovered by its aid. Impure products are, however, obtained, and in varying proportions, depending upon the amount of the reagent employed, temperature, and many other conditions. It has, therefore, only been generally employed as a qualitative reagent. It occurred to me, that by employing an excess of the reagent, and working under varying standard conditions, definite and simple compounds would be obtained, whose composition in each case might be determined qualitatively by ordinary analysis, and quantitatively by an estimation of the oxygen absorbed in the reaction. I hoped that by this means we might be enabled not only to possess

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* Roscoe and Schorlemmer, vol. ii. 2, p. 11.

† Journal für Prakt. Chem. 43, 50.

‡ Pogg. Ann. 121, 318.

§ *Loc. cit.*

reliable processes for the valuation of commercial organic products, but that we might thereby be led to obtain a better insight into the nature of some of those complex organic principles, of whose constitution we are at present in almost absolute ignorance; as well as, perhaps, to increase our knowledge of the wonderful cycle of reducing and oxidising processes which attend the phenomena of life.

I was led to form these opinions from a study of the behaviour of solutions of various organic bodies in presence of a large excess of $KMnO_4$ under varying standard conditions. The determinations which I had in view were the following:—Oxygen yielded by excess of MnO_2 in acid, alkaline and neutral solutions respectively; oxygen yielded by excess of $KMnO_4$ in acid, alkaline and neutral solutions respectively. The latter would include the former: the difference would represent oxygen yielded by $KMnO_4$ in reduction to MnO_2 only, and would necessarily correspond to more stable bodies or radicals than those represented by the reduction of MnO_2. I further anticipated successive oxidations, more especially of a neutral one succeeded by an alkaline and acid one respectively, and an alkaline oxidation followed by one in acid solution. I found, however, that serious errors entered into my experiments, the elimination of which demanded the first attention.

I shall treat the subject in three divisions—namely, oxidation in acid, alkaline, and neutral solutions, respectively.

OXIDATION BY LARGE EXCESS OF $KMnO_4$ IN ACID SOLUTIONS.

Sulphuric acid is usually considered the only one generally applicable for titrations with permanganate, and as the objections to HCl and HNO_3 in working with excess of $KMnO_4$ and in hot solutions would be much more serious, H_2SO_4 quite free from these impurities was employed. The temperature at which oxidation proceeds is, as might be expected, an important factor—*i.e.*, as regards the speed, but not as regards the product of oxidation. Some bodies naturally require a higher temperature than others to obtain the final product of oxidation in a reasonable time; but I have reason to believe that all bodies—at least at ordinary temperatures—would reach that stage sooner or later. I think that valuable information might be derived from a study of the rate of oxidation of complex organic bodies under standard conditions, such as those I am about to describe, and at a temperature sufficiently low to allow of a number of accurate determinations of the progress of the oxidation at different stages. A graphic representation of the results obtained would indicate, by any abrupt change in the curve of oxidation, the completion of one, and the commencement of formation of another product of oxidation. Such manipulation, however, would be more especially interesting to the research chemist; for analytical purposes, a method by which the final product of oxidation is reached in a reasonable time is the only one which could be contemplated. The temperature of the hot-water bath was naturally that resorted to as being most convenient.

The permanganate solution which I employed, and which I shall designate as *normal*, was of such a strength that 1cc. was equivalent to 0·01grm. of pure metallic iron, or 0·00143grm. of oxygen. An organic, or other oxidisable solution, I also designate as *normal*, which requires the whole of the oxygen liberated by an *equal bulk* of normal $KMnO_4$, in its reduction to the state of MnO, for the complete oxidation of the body to CO_2 and H_2O.

To 50cc. of the normal solution of the organic body under investigation I added 100cc. normal $KMnO_4$ solution. It is important to observe that this quantity represents an excess of 20 per cent. $KMnO_4$, over the quantity necessary for complete oxidation, accompanied by a reduction of the $KMnO_4$ to MnO_2, only. 50cc. normal H_2SO_4 (1cc. = 0·049grm.) were then added. I generally made up the total bulk to the neck of a 750cc. flask with distilled water, and heated on the water-bath for a couple of hours, but now employ 250cc. flasks, when I find half-an-hour's heating sufficient. To avoid repetition, unless otherwise stated, it will be understood that the solutions employed were made up according to the *normal formula*—100cc. $n.KMnO_4$ + 50cc. *n*.organic solution + 50cc. nH_2SO_4 + 550cc. distilled water.

The results generally came out much too high, even for perfect oxidation, which indicated a loss of oxygen. The table below shows the representative numbers obtained.

These experiments show that the great loss of oxygen is not altered by varying the concentration of the solution, nor by decreasing the amount of free acid (21). They also indicate that the excessive loss is not due to the action of the acid upon the $KMnO_4$ alone (27), and also that it is not experienced by substituting ferrous sulphate for the organic body (26). I too hastily concluded from Experiment 26, that the loss was not due to the presence of MnO_2, and sought for the cause rather in some exciting action to the evolution of oxygen produced by the CO_2 generated in the case of organic bodies. I was, however, disappointed at the result of my endeavours to produce an equivalent effect in the experiment with ferrous sulphate, by introducing gradually into the solution—which had previously received a proportionate excess of sulphuric acid—35cc. of a 10 per cent. solution of potassium carbonate. The loss was even less than before—only 1·2 per cent. (28).

No. of Experiment—	18	19	20	21	22	23	24	25	26	27
Total bulk	200	200	200	750	750	750	750	750	750	750
Time of heating ....hours	2	2	2	1	2	2	2	1	1½	2
Organic body present	Oxalic Acid	Tartaric Acid	Citric Acid	Oxalic Acid	Oxalic Acid	Tartaric Acid	Citric Acid	Tannin	$FeSO_4$	0
Per cent. indicated of total oxidation possible	122	116	111	121 (10cc. H_2SO_4)	119	118	117·5	111	101·8	2 (equivalent).

In parallel experiments, with and without the addition of oxalic acid, and varying the times of heating, the results in Table A were obtained.

These experiments prove conclusively that in each case the loss increases with the length of heating, but is much more considerable in the solution which has been reduced by the organic body: although the actual permanganate in such a solution, where complete oxidation occurs, is only *one-sixth* of that to which no reducing agent has been added.

In experiments with glycerine and formic acid, confining the time of heating to half-an-hour, as seemed desirable from the above results, much more concordant indications were obtained—namely, 97 per cent. (35) and 103 per cent. (36) respectively. Encouraging as these results were, it seemed desirable to concentrate the attention upon the elimination of the error caused by the evolution of oxygen, as it would probably vary very much with the nature of the body under investigation.

TABLE A.

No. of Experiment—	29	30	31
Reducing body added......	Oxalic A.	nil	Oxalic A.
Time of heating...........	½ hour	½ hour	1 hour
Loss = cc. $nKMnO_4$	1·85	0·45	3·85

No. of Experiment—	32	33	34
Reducing body added......	nil	Oxalic A.	nil
Time of heating...........	1 hour	3 hours	3 hours
Loss = cc. $nKMnO_4$	0·95	7·95	1·95

In recalling to mind the experiment in which ferrous sulphate was substituted for the organic body (26), it occurred to me that the excessive loss of oxygen might still be due to the presence of MnO_2, but that the ferric salt had the power to prevent, or diminish, the action. The next experiments confirm this view.

Manganous sulphate was formed by titrating 50cc. normal oxalic acid in the ordinary manner. 50cc. of normal $KMnO_4$ were added, the bulk made up to 750cc., and the solution heated on the water-bath three and a-half hours. The loss of oxygen was equal to 9·0cc. of the $KMnO_4$. Another experiment, in which the $MnSO_4$ formed above was substituted by an equivalent of crystallised $MnSO_4$, showed a loss equivalent to 9·5cc. of the normal permanganate. 50cc. $nFeSO_4$ solution, titrated and treated as above, gave a loss = 1·8cc. $KMnO_4$ only. A blank experiment with 100cc. $KMnO_4$, and no reducing body, indicated a loss of 2·4cc. The only difference in the experiment with the titrated $FeSO_4$ and those with $MnSO_4$ is that, in addition to $MnSO_4$, ferric sulphate is also present. To confirm the retarding action of the ferric salt still further, a solution of pure ferric sulphate was made with free H_2SO_4, the amount of which latter was of course allowed for in regulating the total acidity of the solution. I shall denominate such a solution *normal* which contains the same quantity of metallic iron in a given bulk, that a normal solution of ferrous sulphate does. The above solution was only 80 per cent. normal, but I shall always quote the quantity employed in terms of the normal solution. In an experiment with oxalic acid, under normal conditions, but with the addition of 40cc. normal ferric sulphate solution, a loss equivalent to 1·85cc. of normal permanganate was recorded. The foregoing experiments are compared in the following table :—

No. of Expt.—	37	38	39	40	41
Addition......	Titrated Oxalic A.	$MnSO_4$	Titrated $FeSO_4$	none	Oxalic A. + Fe_23SO_4
cc. $nKMnO_4$ lost..........	9·0	9·5	1·8	2·4	1·85

To find the action of the ferric salt upon MnO_2 alone, 50cc. normal $FeSO_4$ solution, exactly titrated, were added, in an experiment with oxalic acid under normal conditions. The $MnSO_4$ reduced the remaining $KMnO_4$, rendering the solution colourless in a few minutes. Absolutely no loss of oxygen was recorded in this experiment (42). This indicated that the small loss of oxygen experienced in the presence of the ferric salt was not due to the MnO_2 formed, and differed in this respect from the excessive loss in the absence of iron.

From the experiments in Table B we learn the influence of the ferric salt under varying conditions.

By normal $MnSO_4$ solution, I mean one which is able to reduce a solution of normal permanganate in equal measures. From the experiments I have already recorded, it will readily be seen that such a normal solution contains $\frac{3}{2}$-times the amount of actual Mn that an equal measure of normal $KMnO_4$ does. Experiments 44 and 45 confirm 42, demonstrating that no loss occurs, when all the $KMnO_4$ is wholly reduced to the form of MnO_2. The presence of the ferric salt, however, does not prevent the loss of oxygen from the $KMnO_4$, as such (43), in fact, it seems to increase the action considerably (48 and 49). From Experiments 46 and 47 we learn that the loss is less when a reducing body is present, this being no doubt due to the much smaller quantity of permanganate present (only ⅛th of the total) after reduction by the organic body. The action of the ferric salt is thus

TABLE B.

No. of Experiment—	43	44	45	46	47	48	49	50	51
Reducing body added	none	Oxalic A. + 33 $nMnSO_4$	Oxalic A. + 50 $nFeSO_4$ Titrated.	Oxalic A.	none	none	none	Oxalic A.	Oxalic A.
cc. nFe_23SO_4 ,,	40	40	40	40	40	none	20	none	40
Time of heating	2hrs.	2 hours	2 hours	½ hour	½ hour	3 hours	3 hours	3 hours	3 hours
Loss = cc. $nKMnO_4$	2·1	0·1	0·1	0·25	1·0	0·7	2·3	8·65	1·85

TABLE C.

No. of Exp.—	56	57	58	59	60	61	62
Organic Body.	Glycerine.	Tannin.	Sugar.	Citric A.	Tartaric A.	Alcohol.	Acetic A.
% indicated ...	97	91·8	83·2	99·6	99·8	34	0·5

seen to be of a two fold character; it acts as an accelerator in the presence of much $KMnO_4$ and little MnO_2 (49), but a retarder in the presence of much MnO_2 and little $KMnO_4$ (51). The loss which we wish particularly to avoid is that which occurs after the oxidation of the organic body is complete—*i.e.*, when a considerable quantity of MnO_2 has been formed, and only a small excess of $KMnO_4$ remains: hence the beneficial action of the ferric salt.

Under these improved conditions various organic bodies were subjected to oxidation, with much more satisfactory results, as indicated below. The time of heating was 2½ hours in each case, and 20cc. normal $Fe_2\,3SO_4$ were added, other conditions being normal:—

No. of Exp.—	52	53	54	55
Body added	Formic A.	Glycerine.	Tannin.	Cane Sugar.
% indicated..	106·2	99	93·2	85·8

With a total bulk of 200cc., the solution being heated for half-an-hour only, the numbers given in Table C (page 103) were obtained.

A parallel experiment with cane sugar, in which the 100cc. $KMnO_4$ were added in five equal portions at equal intervals, thereby avoiding excess of $KMnO_4$, indicated only 80 per cent. (63). Probably the difference in the two experiments was due to loss of oxygen, from the action of the acid on the free $KMnO_4$. The alcohol was most distinctly oxidised to acetic acid, as evinced by the smell. The percentage indicated also agrees closely with the formation of that body. Acetic acid itself is unoxidised (62), the small amount (0·5 per cent.) of oxidation recorded, after deducting the calculated loss, being probably due to impurity in the acid.

Such results as these recorded, although bearing the impress of approximations to certain absolute quantities I was endeavouring to estimate, were not so perfect as those to which I had aspired. The errors due to loss of oxygen have not been allowed for in the above experiments, except in the case of acetic acid; indeed, it would be difficult to do so. Although we know the quantity of free $KMnO_4$ existing both before and after reduction, we do not know when the oxidation is completed; and even did we know this, we could not be certain whether any oxygen at all would be lost until, the completion of the oxidation. Simultaneous experiments, without addition of any reducing body, and with 100 and 20cc. $nKMnO_4$, indicated a loss of oxygen equivalent to 4·8 per cent. (63) and 0·9 per cent. (64) respectively, in terms quoted above. Now, if we assume that no loss occurs until the body reaches its final stage of oxidation; and, further, that this latter occurs after ¼ hour's heating, both assumptions being within the region of probability; then the loss could scarcely have exceeded 0·5 per cent., except in the case of alcohol, where the oxidation is so incomplete.

Another possible source of error was impurity in the bodies under investigation. Although they were obtained in the usual course as pure chemicals (excepting the loaf sugar, which was of ordinary commercial quality), their absolute purity was doubtful in some cases. Beyond drying in the hot water oven, or estimating the acidity or specific gravity, they were not subjected to any systematic analysis. Through the kindness of Messrs. Mawson & Swan, I have been supplied with some specially pure chemicals, which will assist in the elimination of this source of error. Before making use of them, however, I was anxious to still further improve the process if possible; and, accordingly, more systematic experiments were instituted, which I shall now record. At this stage I determined, in order to utilise the time as much as possible, to reduce the total bulk of solution to 250cc., and the time of heating to half-an-hour, except in cases where a longer period was necessary, to ensure greater accuracy in the estimation of small differences in the errors derived from working under varying conditions under comparison.

Throughout this investigation, I have been frequently impressed with the excessive caution which must be exercised in drawing conclusions from experiments, however carefully made. We have seen that there is a slight action of sulphuric acid upon potassium permanganate in the absence of iron salts, causing a small loss of oxygen. When $MnSO_4$, or an organic body which is capable of reducing the $KMnO_4$ *incompletely* to the form of MnO_2, is added, we find a very great increase in the amount of oxygen evolved, although the loss due to the action of the acid on the $KMnO_4$ as such, must necessarily be considerably decreased. It seemed very natural to conclude that the increase was due to the action of the H_2SO_4 upon the MnO_2 as such. In the experiments already recorded I was labouring under this impression. As the experiments were strictly comparative in each case, their value was not diminished by the subsequent revelation that this hypothesis was a false one. As a matter of fact, I found that the loss of oxygen due to the action of the acid upon MnO_2 is absolutely nil under the conditions which prevailed. With a view to determine the amount of loss due to the action considered, to 50cc. $nC_2H_2O_4$ just sufficient $KMnO_4$ was added to reduce all the manganese to the form of MnO_2, 50cc. nH_2SO_4 were then added, *but no iron salt*. The bulk was made up to 250cc., and the solution heated one hour. The solution was only very faintly coloured after heating. A loss of *only* 1·35cc. $KMnO_4$ (65) was shown. Surprising as this result was, I was still more astonished at the result of a corresponding experiment, in which the heating was prolonged to 4½ hours. No more oxygen was evolved than in the preceding case—*i.e.*, only the equivalent of 1·5cc. $nKMnO_4$ (66). As a repetition of the old experiments, with the proportions of 100 $KMnO_4$ to 50cc. oxalic acid, proved that the laws of nature had in no degree been enjoying a temporary relaxation, the only conclusion which could be formed was, that the presence of *both* $KMnO_4$ and MnO_2 is required for the excessive evolution of oxygen, which had been so frequently observed. Final test experiments completely confirmed this conclusion. To 50cc. $nC_2H_2O_4$, already titrated, only one-half the quantity of $KMnO_4$ was added necessary to oxidise the Mn to MnO_2. Absolutely no loss of oxygen was recorded after half-an-hour's heating (67). A parallel experiment, with the usual proportions of $KMnO_4$ and oxalic acid, indicated a loss of 4·4cc. $nKMnO_4$ (68). This result was most important, and suggested a method of analysis to which I shall refer later on. It also furnishes the proof that in the experiments (Nos. 1 and 6) in which the $KMnO_4$ and $MnSO_4$ were added in the theoretical quantities to convert the whole of the manganese into MnO_2, similar to the conditions of 62 and 63, the quantity of oxygen lost is not sufficient to be taken into consideration, more especially in No. 6, which received only half-an-hour's heating. Jones* makes a great point of the liberation of oxygen in oxidations by permanganate. He states that it occurs under all the conditions it is possible to imagine, and he attributes the cause of its generation to the tendency to the formation of Mn_2O_3,

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* *Loc. cit.*

which he considers to be the stable oxide of manganese, and the final product of oxidation by $KMnO_4$ in all cases. MnO_2 he finds to act in the same manner as $KMnO_4$, and would lead one to question the accuracy of Fresenius and Will's method for the valuation of that ore, on account of the oxygen evolved in the reaction. Now, my experiments throw light upon many of the results obtained by Jones with regard to the evolution of oxygen, but they show at the same time that the above-mentioned method is free from reproach in this respect. They further show that MnO_2 is really the stable compound of manganese in acid as well as other solutions; and, indeed, this very fact accounts for the liberation of oxygen from $KMnO_4$, the evolution of that gas not being completed until the whole of the Mn has been reduced to the state of MnO_2, as is still more strikingly illustrated by the following experiments, with varying amounts of permanganate solution. Total bulk = 250cc.; free acid = 50cc. nH_2SO_4; organic body = 50cc. $nC_2H_2O_4$:—

No. of Experiment—	69	70	71
cc. Free $KMnO_4$ after reduction by oxalic acid ..	15·65	32·3	82·3
Time of heating	½hr.	½hr.	½hr.
cc. $nKMnO_4$ lost	4·1	6·15	10·55

No. of Experiment—	72	73	74
cc. Free $KMnO_4$ after reduction by oxalic acid ..	15·65	49	99
Time of heating	3hrs.	3hrs.	3hrs.
cc. $nKMnO_4$ lost	9·4	25·65	46·5

Of course no iron salt was present in these experiments. It is very interesting to observe that the loss increases very nearly in the ratio of the square root of the amount of $KMnO_4$ present, in the first three experiments with the shorter heating, from which we can form an idea of the speed of reduction. In the last three, the reduction of the $KMnO_4$ was more or less complete, as represented by the following equation:— $K_2Mn_2O_8,nMnO_2 + H_2SO_4 = n + 2MnO_2 + K_2SO_4 + H_2O + O_3$. This shows that to effect complete reduction of $KMnO_4$ to MnO_2 under the influence of pre-existing MnO_2, a loss of oxygen occurs = $\frac{3}{5}$ of the total oxygen available from the $KMnO_4$. Keeping this in view, we learn that the reduction in Experiment 72 was theoretically complete, and this was borne out by the solution being almost colourless at the termination of the heating. In Experiments 73 and 74, 87·2 and 78·3 per cent. respectively of the reduction represented by the above equation had been completed.

Comparative experiments, with no reducing body present, gave the following results :—

No. of Experiment—	75	76	77	78
cc. $nKMnO_4$ added	25	100	25	100
Time of heating	½hr.	½hr.	2hrs.	2hrs.
cc. $nKMnO_4$ lost	0·2	0·5	0·4	1·05

Here we can form no very reliable conclusion with regard to the speed of reduction of the $KMnO_4$, although it seems to increase in the ratio of the square root of the quantity of $KMnO_4$ present as we found before. Not only is the loss too small to found any weighty conclusions upon it, but if I am right in my opinions we should have no reduction at all if no impurity were present in the $KMnO_4$, and no trace of a reducing agent were otherwise introduced. But if we presume the presence of a reducing agent in the solution, should it even be an impurity of a manganous salt in the $KMnO_4$, equivalent to 0·1 per cent. in the above experiments, then it is easily seen we have the conditions existing for the initiation of the reaction expressed by the equation given above. Corresponding experiments were instituted in presence of ferric sulphate. 20cc. nFe_23SO_4 were added to the usual proportions. With 50cc. n oxalic acid added, the following results were obtained :—

No. of Experiment—	79	80	81	82	83
Time of heating	½hr.	½hr.	½hr.	2hrs.	2hrs.
cc. Free $KMnO_4$ present after reduction	25	50	75	25	75
cc. $nKMnO_4$ lost	0·8	1·0	1·3	3·45	8·95

From these experiments we learn that the loss of oxygen is only about 15 per cent. what it is without the addition of the ferric salt, and it increases more in proportion to the free $KMnO_4$ present than in the ratio of the square root of that quantity; at least in the case of the longer heating, which gives naturally more accurate results.

With the iron salt, but in absence of any reducing body, the following results were obtained :—

No. of Experiment—	84	85	86	87	88
cc. $nKMnO_4$ added ..	25	50	75	25	75
Length of heating	½hr.	½hr.	½hr.	2hrs.	2hrs.
Oxygen = cc. $nKMnO_4$ lost..................	0·15	0·6	1·6	1·9	8·2

The ferric salt, as we had previously seen, increases the loss considerably when no MnO_2 is present, and the loss in this case increases in a *greater ratio* than the amount of $KMnO_4$ present: in fact, in the experiments above, with half-an-hour's heating, it closely corresponds to the *square* of the amount of permanganate.

The influence of the ferric salt is quite a paradox, being in one case an accelerator and in another a retarder of the action of the acid on the $KMnO_4$. Without iron, the loss increases with the increase of MnO_2, while under its influence the loss increases with the amount of $KMnO_4$, and decreases with the increase of MnO_2. Hence two problems are presented for solution—viz., the cause of the retarding action with excess of MnO_2, and the cause of the accelerating action with excess of $KMnO_4$. The most likely explanation I can offer is that the iron salt is really an accelerator, but that it has the power of neutralising the action of the MnO_2 after a certain excess has been formed, and this opinion has been borne out by subsequent experiments. The Fe_23SO_4 does not, however, perfectly neutralise the action of the MnO_2, for by comparing the above experiments (79 with 84, etc.) we find that for the same quantity of free $KMnO_4$ a greater loss is experienced in the presence of MnO_2, at least up to a certain point.

In order to find if iron were precipitated with the MnO_2, $KMnO_4$ was completely reduced by $MnSO_4$ solution in presence of ferric sulphate, the solution was filtered, and the precipitate was well washed and dissolved in oxalic acid. To one portion ammonium hydrate was added in excess when a considerable precipitate of $Fe_2H_6O_6$ was formed. The other portion was acidified with HCl, and $BaCl_2$ added, but no precipitate occurred. We learn then that iron is precipitated with the MnO_2, and in the form of oxide, not as sulphate.

It seemed important to ascertain if other salts had the same power of neutralising the MnO_2. The following were tried, added in proportion equivalent to 25cc. $n Fe_2 3SO_4$ The $KMnO_4$ added was increased to 108·3cc., leaving 25cc. free $KMnO_4$ after reduction by the 50cc. n.oxalic acid, added in each case. The heating lasted two hours.

No. of Experiment—	89	90	91	92	93
Salt added	none	$Fe_2 3SO_4$	$MgSO_4$	$ZnSO_4$	$Al_2 3SO_4$
cc. $n KMnO_4$ lost	13·0	2·55	12·3	11·9	9·25

No. of Experiment—	94	95	96	97
Salt added	$Cr_2 3SO_4$	$K_2Cr_2O_7$	$NiSO_4$	$CoSO_4$
cc. $n KMnO_4$ lost	0	8·3	9·1	5·55

The peculiar action of the chromic sulphate is easily explained. The chromium is itself oxidised to the state of the trioxide by $KMnO_4$, under the conditions of experiment. The solution was rendered colourless, showing that the $KMnO_4$ had been completely reduced; and, as we have already learned, under such conditions no loss of oxygen is experienced. In titrating back the solution to which $K_2Cr_2O_7$ had been added, allowance was of course made for the $FeSO_4$ it was capable of oxidising. As an indirect result of experiment No. 94, we find that $KMnO_4$ is a much more active oxidising agent than chromic acid in solution. This was confirmed by experiments in which an equivalent amount of $K_2Cr_2O_7$ was used instead of $KMnO_4$. The results are strictly comparable with Experiments 52 to 55, but no ferric salt was added. The loss of oxygen from $H_2Cr_2O_7$ is nil (102).

No. of Exp.—	98	99	100	101	102
Body added ..	Formic A.	Glycerin	Tannin	Cane Sugar	None
% oxidised	7·0	14·0	51·8	12·1	0
% with $KMnO_4$	106·2	99	93·2	85·8	—

Returning to the experiments with various salts, we see that Mg and Zn are without influence, while the others are all inferior to iron. An additional objection to Cr, Co, and Ni, lies in the insensitiveness of the end reaction, on account of the colour imparted by the salts themselves to the solution. Cobalt sulphate, which proved the next best to iron, was tried in double quantity, with no better result, 5·3cc. $KMnO_4$ being lost (Experiment 103). In conjunction with iron, it proved also of no advantage. With equal quantities of the two salts, a loss of 3·05cc. was recorded (104).

It was next necessary to determine the best amount of ferric sulphate to add to the solution. I had reduced the amount in the foregoing experiments to 20cc. normal, on account of the action on the $KMnO_4$; more especially as I had found this amount to be nearly as efficient as 40cc., as first used to check the action of the MnO_2. More accurate experiments proved that an advantage existed in increasing this amount considerably. The general average of these results is given below. To 50cc. n.oxalic acid, sufficient $KMnO_4$ was added to leave 25cc. free permanganate after reduction to MnO_2. The free acid present was always equal to 50cc. $n H_2SO_4$, in addition to that of the acid itself. The heating was prolonged for two hours.

No. of Experiment—	105	106	107	108	109	110	111	112
cc. $n Fe_2 3SO_4$ added	8	12	16	20	24	28	32	36
cc. $n KMnO_4$ lost	5·1	4·2	3·95	3·65	3·1	3·1	3·1	2·85

No. of Experiment—	113	114	115	116	117	118	119
cc. $n Fe_2 3SO_4$	40	48	60	80	100	120	160
cc. $n KMnO_4$ lost ..	2·6	2·55	2·3	1·5	1·2	1·2	1·1

We gather from these experiments, that there is a continual decrease in the loss until about 100cc. $Fe_2 3SO_4$ are added, but no advantage in the further addition of the salt. A confirmation, and, at the same time, an explanation, of this result was obtained from an analysis of the precipitates formed by the addition of 50cc. $n C_2H_2O_4$, or its equivalent, in the presence of 25, 50, 81 and 130cc. respectively of normal $Fe_2 3SO_4$. In order to avoid the trouble of separating the Mn and Fe in the precipitates, the iron was estimated in the filtrate directly, and the amount in the precipitate determined by difference. To reduce the amount of manganese in the solution to a minimum, only sufficient $KMnO_4$ was added to oxidise the body, and the manganous salt formed, completely to MnO_2 as already explained. After heating, the small quantity of $KMnO_4$ still remaining was reduced with $FeSO_4$, whose amount was carefully noted. The iron was always determined gravimetrically.

No. of Experiment—	120	121	122	123
cc. $n Fe_2 3SO_4$ present	25	50	81·3	130·1
cc. $n FeSO_4$ required to decolourise	0·5	1·1	0·15	0·25
Equiv. cc. $n Fe_2 3SO_4$ in ppt. ..	3·55	6·6	10·05	12·9
% Fe in ppt. on total present..	13·9	12·9	12·3	9·9

From the above, we learn that the quantity of iron precipitated bears a certain ratio to the total iron, until a particular stage is reached (between the addition of 81·3 and 130·1cc. $Fe_2 3SO_4$), when it appears that little further precipitation occurs. Now, if we estimate the amount of $Fe_2 3SO_4$, which would be required to give a precipitate equivalent to, say, 12·5cc. $Fe_2 3SO_4$, as 12 per cent. of the total, we find 104cc. would be required. This, as we have seen, is about the stage after which no material advantage is derived from the further addition of the ferric salt. But the ratio of the Fe_2O_3 derived from 12·5cc. $n Fe_2 3SO_4$, to the MnO_2 derived from 83·3cc. $n KMnO_4$, is exactly expressed by the formula, $3Fe_2O_3.8MnO_2$. It seems, therefore, to be a warantable conclusion, that the advantage gained by the addition of the ferric salt, is due to the formation of this compound, or its hydrate.

The following results were obtained from experiments with varying quantities of $Fe_2 3SO_4$, but in absence of a reducing body, 40cc. $n KMnO_4$ were added, and the heating lasted two hours:—

No. of Experiment—	124	125	126	127	128
cc. $n Fe_2 3SO_4$ added ..	0	20	40	80	100
Loss = cc. $n KMnO_4$ ..	1·0	4·6	6·0	6·5	6·8

We observe that the loss rapidly increases until between the addition of 20 to 40cc. $Fe_2 3SO_4$, beyond which the increase is very small. Now we know the great similarity which exists between the elements, manganese and iron, and their oxides. Is it not possible, then, that an unstable oxide of iron exists corresponding to the dioxide of manganese; that this compound is formed by the reduction of the $KMnO_4$; and that it is immediately split up again into Fe_2O_3 and O by the action of the acid? This seems to me a very plausible explanation of the accelerating action of the iron salt, and it receives some support from the fact, that the maximum acceleration occurs when the $KMnO_4$ and $Fe_2 3SO_4$ are present in the proportions necessary to satisfy the following equation—
$K_2Mn_2O_8 + 3Fe_2 3SO_4 + 8H_2O = K_2SO_4 + 8H_2SO_4 + 2MnO_2 + 6FeO_2$.

We have already been impressed with the magnitude of the loss experienced from the action of $Fe_2 3SO_4$ in the presence of much $KMnO_4$. The following experiments with 100cc. $nKMnO_4$, and heated for three hours, show this still more strongly:

No. of Experiment—	129	130	131
cc. $Fe_2 3SO_4$ added	0	20	20
Loss = cc. $nKMnO_4$	2·3	18·6	15·6

In Exp. 131, 18 per cent. of the $KMnO_4$ had been previously reduced by the addition of $MnSO_4$.

The following experiments are instructive as showing the amount of oxygen lost, with varying proportions of MnO_2 and $KMnO_4$ present, both with and without the iron salt. The MnO_2 present was regulated by the amount of oxalic acid added:—

WITHOUT IRON SULPHATE. HEATED 2¼ HOURS.

No. of Experiment—	132	133	134	135	136
cc. $nKMnO_4$ reduced to MnO_2	0	0	0	40·7	40·7
cc. free $nKMnO_4$ in solution	18·6	59·3	100	18·6	59·3
cc. $nKMnO_4$ lost	0·6	1·0	5·6	8·7	22·0
% free $KMnO_4$ reduced to MnO_2....	5·5	2·8	9·3	21·5	37

No. of Experiment—	137	138	139	140
cc. $nKMnO_4$ reduced to MnO_2	40·7	81·4	81·4	81·4
cc. free $nKMnO_4$ in solution	100	18·6	59·3	100
cc. $nKMnO_4$ lost	33	11·0	30·4	19·6
% free $KMnO_4$ reduced to MnO_2....	39	18·3	36	15·5

WITH 100cc. $nFe_2 3SO_4$ ADDED. LENGTH OF HEATING, 2 HOURS

No. of Experiment—	141	142	143	144	145	146
cc. $nKMnO_4$ reduced to MnO_2	0	0	0	40·7	81·4	81·4
cc. free $KMnO_4$ in solution....	18·6	59·3	100	59·3	18·6	59·3
cc. $nKMnO_4$ lost	2·6	11·3	18·5	7·9	2·6	8·0
%free $KMnO_4$ reduced to MnO_2	23·3	31·7	30·8	13·2	1·3	9·5

In summing up the evidence derived from the foregoing experiments, I came to the conclusion that the beneficial action of the ferric salt could be considerably enhanced, if it could be rendered so difficultly soluble as to be at once precipitated by the MnO_2 formed; thereby rendering the theoretical quantity necessary to form $3Fe_2O_3 8MnO_2$ sufficient to be added, instead of eight times that quantity, which we had found otherwise to be necessary. Of the salts whose services could be enlisted, I concluded that ferric phosphate would be the most likely to succeed, and in this choice I was most fortunate. In two parallel experiments with 50cc. $nC_2H_2O_4$, and under the usual conditions, I obtained quite as good a result with 20cc. $nFe_2 3SO_4$, to which I had added 2grms. of crystallised sodium phosphate, as with 160cc. $Fe_2 3SO_4$ alone, with which I had previously obtained the best result. The losses were 1·0cc. $nKMnO_4$ with (147), and 1cc. without, the addition of phosphate (148). The heating lasted two hours. In repeating these experiments, they were most satisfactorily confirmed, with the same time of heating, as follows:—

No. of Experiment—	149	150	151	152	153	154
cc. $nFe_2 3SO_4$ added ..	100	0	8	16	100	3grm. $CaSO_4$
Grms. cryst. Na_2HPO_4 added	0	2	2	2	2	—
Loss = cc. $nKMnO_4$	1·3	1·3	0·7	0·7	1·5	8·0

Although we find here a considerable advantage in the presence of the phosphate alone (150), it is the combination of the phosphate and the iron which is the most beneficial. We learn also that there is an actual disadvantage in adding a large quantity of ferric sulphate with the phosphate (153), which indeed we might have expected. The experiment with calcium sulphate was made with a view to find if the mere presence of a precipitate would have any beneficial result. Such a view is not confirmed.

The following series shows that between 4 and 12cc. is the best amount of ferric sulphate to be added. 140cc. $nKMnO_4$ were employed in order to leave a large excess of free permanganate after reduction by the 50cc. $nC_2H_2O_4$, that the differences might be the more accurately estimated. The heating lasted 1½ hours:—

No. of Experiment—	155	156	157	158	159	160	161	162
cc. $nFe_2 3SO_4$ added..	0	0	2	4	8	12	16	20
Grms. Na_2HPO_4 do.	0	2	2	2	2	2	2	2
Loss = cc. $nKMnO_4$ ..	25	8	2·2	1·6	1·4	1·6	1·9	2·0

Here again the great advantage of the phosphate alone should be noted, as also the great influence of such a small quantity of the sulphate as is represented by 2cc.—*i.e.*, 0·07grm. $Fe_2 3SO_4$, sufficient only to yield a precipitate with the MnO_2, represented by the formula $Fe_2O_3.16MnO_2$.

A corresponding series, to find the best amount of phosphate, yielded the following results. 140cc. $nKMnO_4$ and 8cc. $nFe_2 3SO_4$ were employed, and the heating lasted 1½ hours:—

No. of Experiment—	163	164	165	166
Grms. crystallised Na_2HPO_4 added	¼	¾	2	3
Loss = cc. $nKMnO_4$	2·0	1·1	1·2	1·0

No. of Experiment—	167	168	169	170
Grms. crystallised Na_2HPO_4 added	5	5	10	10 (no Fe)
Loss = cc. $nKMnO_4$	0·7	0·8	0·8	2·1

5grms. are seen to be sufficient to add under the conditions existing. The increased phosphate has a marked benefit even in absence of iron (170), although it is evident that the iron salt cannot be dispensed with.

The influence of various amounts of acid is shown by the following series. 5grms. phosphate, and 10cc. iron solution were employed, other conditions being as before:

No. of Experiment—	171	172	173	174
cc. total Normal Free Acid ..	25·0	50·0	100·0	200·0
Loss = cc. nKMnO$_4$	0·8	0·7	1·3	5·0

No advantage is derived, therefore, from decreasing the amount of acid; but probably there would be an advantage gained in point of speed of oxidation by increasing it to, say, 75cc., which would more than compensate for the increased loss with the same time of heating, more especially as the large quantity of phosphoric acid liberated might not be so energetic in inducing the decomposition of the organic bodies whose investigation was contemplated as sulphuric acid.

The following series, under the improved conditions to which we have attained, shows most strikingly the advantage of the addition of phosphate. 140cc. n KMnO$_4$ were employed, and the heating lasted two hours:—

No. of Experiment—	175	176	177	178
cc. nFree Acid present	50·0	50·0	75·0	50·0
cc. nFe$_2$3SO$_4$ added	8·0	4·0	6·5	80·0
Grms. Na$_2$HPO$_4$ added	5·0	5·0	4·0	0·0
Loss = cc. nKMnO$_4$	1·0	1·1	1·2	5·3

We note, also, that with 4grms. Na$_2$HPO$_4$ and 75cc. acid, we get nearly as good a result as with 5 and 50 respectively.

The influence of the phosphate in presence of varying proportions of MnO$_2$ and free KMnO$_4$., obtained from a total of 100cc. added, is here exhibited. The time of heating was two hours:—

No. of Experiment—	179	180	181	182	183	184	185	186	187	188	189
cc. nAcid present	50	50	50	75	75	75	75	75	75	75	75
cc. nC$_2$H$_2$O$_4$ added	25	50	75	0	25	50	75	0	25	50	75
cc. free KMnO$_4$ left	58·3	16·6	0	100	58·3	16·6	0	100	58·3	16·6	0
cc. nFe$_2$3SO$_4$ added	8	8	8	6·5	6·5	6·5	6·5	6·5	6·5	6·5	6·5
Grms. Na$_2$HPO$_4$ added	5	5	5	4	4	4	4	2	2	2	2
cc. nKMnO$_4$ lost	1·1	0·7	0·4	1·2	0·9	0·4	0·2	7·0	2·3	0·7	0·2

The special function of the phosphate, when added in large quantity, is, as we here see, in checking the accelerating action of the ferric salt in presence of much KMnO$_4$, which had caused so much anxiety before. When 4 or 5grms. of phosphate are added, we see it is reduced to a minimum. I have ascertained that the iron is almost completely precipitated under such conditions. 50cc. n oxalic acid were exactly titrated with KMnO$_4$. 16·25cc. nFe$_2$3SO$_4$, and 5grms. crystallised Na$_2$HPO$_4$ were added together with two-thirds extra KMnO$_4$ of the quantity required for titration. After heating, 0·8cc. nFeSO$_4$, were required to decolourise the solution. Ferric phosphate was found in the filtrate equivalent to only 2cc. nFe$_2$3SO$_4$; or, if we deduct the ferrous sulphate introduced, only 1·2cc.—*i.e.*, only 7·4 per cent. of the iron salt added remained in solution, the remainder having been precipitated. Although we found the error due to the accelerating effect of the ferric sulphate to be much less serious in actual work than the error which resulted in its absence, still, in the case of bodies which are not oxidised at all, or only partially, or even wholly but very slowly, this error might be very considerable. Now, however, we are rendered, in a sense, independent of the different behaviours of the organic bodies under investigation. Here we have a regular scale of errors, of only small dimensions, which we can allow for, after obtaining the indicated oxygen absorbed. In the *very worst* case, that of a body unoxidisable, as in Experiment 182, we see that the error in the case of half-an-hour's heating represents an oxidation of 0·6 per cent. of the body under investigation. But as this error can be accurately allowed for, the errors which may creep in are only such as might be attributed to manipulation.

In order to make quite certain that the phosphate introduced does not interfere in any way with the oxidation, three of the organic solutions already employed were subjected to oxidation with addition of 6·5cc. nFe$_2$3SO$_4$, and 4grms. Na$_2$HPO$_4$; 75cc. n free acid being present. The heating lasted for thirty minutes. The following are the results:—

No. of Experiment—	190	191	192
Body oxidised	Glycerin	Alcohol	Cane Sugar
Per cent. indicated after deducting for loss..................	97·6	32·2	82·2

These numbers agree within a per cent. with the numbers we already obtained with Fe$_2$3SO$_4$ (Experiments 56, etc.); except in the case of alcohol, where the oxidation is only one-third of that possible, and we know that the iron alone in this case gives too high a result, on account of the large quantity of free KMnO$_4$ remaining after oxidation has been effected. In such a case, where great accuracy is required, it is preferable to employ a larger quantity of the body, such as would absorb about the same quantity of oxygen as is yielded by 50cc. nKMnO$_4$ when completely reduced. With this view it is expedient to concentrate the solutions as much as possible. Instead of 100 nKMnO$_4$, I now add 50cc. double normal solution; and the phosphate, iron, and free acid I make up in one solution, of which only 20cc. are required. This allows for the introduction of 175cc. of the organic solution, should such an amount be necessary. Bodies which are generally considered insoluble, or nearly so, may frequently be rendered available by this means. If this bulk were too small, they might still be made up to say 750cc., and a longer heating given. Indeed, potable waters would require to be treated in this way, unless evaporation were resorted to. It is quite probable that certain insoluble bodies may be oxidised, if means be taken to allow of their free circulation in the solution.

With regard to the height of the oxidation, this is indicated by the change of colour the solution undergoes, owing to the precipitation of MnO_2. In the above experiments, it occurred after from five to ten minutes with glycerine and alcohol; in the case of sugar not until fifteen or twenty minutes. The progress of the oxidation can also be observed from the transparency of the solution, as seen through the neck of the flask: and might be roughly estimated by a comparison with similar flasks containing known amounts of $KMnO_4$. If any doubt existed as to the oxidation being complete, it would be advisable to repeat the experiment, giving one or two hours' heating, and deducting the small error which occurs.

Probably in no analytical work is greater care and more scrupulous cleanliness required than with such experiments as those described. Traces of bodies which are otherwise innocuous or even beneficial may be productive of the greatest harm. Precautions must be taken against the introduction of dust or organic matter from the air, into the flasks or solutions employed. The use of antiseptics must be particularly avoided. Before using any flask for this description of work, it must be first thoroughly "sterilised" by boiling in it an acidified solution of $KMnO_4$. I have known $KMnO_4$ to be reduced in a flask which had contained alcohol, although it had, previous to employment in a blank experiment, been well washed and rinsed with distilled water. It is of course much preferable to keep certain vessels and measures exclusively for this work. All the chemicals employed must also be tested in blank experiments, and any oxidisable impurity they may contain allowed for.

I have decided to employ 8cc. $n Fe_2 3SO_4$ to 4grms. Na_2HPO_4, with free acid equivalent to 75cc. normal. This corresponds very closely to the formula $Fe_2 3SO_4 . 15Na_2HPO_4 . 50H_2SO_4$ to every four molecules of MnO_2 precipitated. My solution is made up as follows:—15grms. of pure ferric sulphate (calculated anhydrous) are dissolved in about 300cc. of distilled water acidified with about 50cc. of pure sulphuric acid (sp. gr. = 1·84). In another beaker 200grms. of pure crystallised sodium phosphate are dissolved in 300 or 400cc. of distilled water acidified with the remainder of 100cc. of the sulphuric acid. When solution is complete the liquids are mixed, the bulk made up to one litre, and the solution filtered. 20cc. of this solution are added to 50cc. (2n)$KMnO_4$, in a flask containing 250cc. when filled to the neck. 50cc. of the normal organic solution are added, and the bulk made up to 250cc. The solution is heated for thirty-five minutes on the water-bath, which allows five minutes for the temperature to rise. In dissolving the precipitate after oxidation, it is well to have the ferrous sulphate solution strongly acid, in order that no phosphate may remain undissolved. I employ a normal solution of ferrous sulphate containing free acid equivalent to a double normal solution. This is made by dissolving 50grms. crystallised $FeSO_4$ in water acidified with 108cc. sulphuric acid (sp. gr. = 1·84), and making up the bulk to one litre. The strength of this solution must be tested daily when in use. The flask must be carefully rinsed with the ferrous sulphate solution run in from a pipette, to dissolve any adhering MnO_2; this is very easily effected. After the solution is thoroughly clear, I make up the bulk to about 800cc. in a beaker with cold distilled water, when it will be found sufficiently cool to titrate at once. It is possible to complete six experiments in the course of an hour by this method of working.

In order to estimate quite accurately the error introduced by the loss of oxygen in employing the solution I have described, experiments were made without addition of a reducing body, and with 50cc. n.oxalic acid added, the heating being extended to *five hours*. Parallel experiments were also made with the iron increased to 12·5cc. normal, but, as will be seen, the results are almost identical:—

No. of Experiment—	193	194	195	196
cc. $n Fe_2 3SO_4$ present	8	8	12½	12½
Reducing body added	none.	Oxalic acid.	none.	Oxalic acid.
Loss = cc. $n KMnO_4$	2·8	0·6	2·8	0·5
Error = per cent. of body per half-hour	0·56	0·12	0·56	0·10

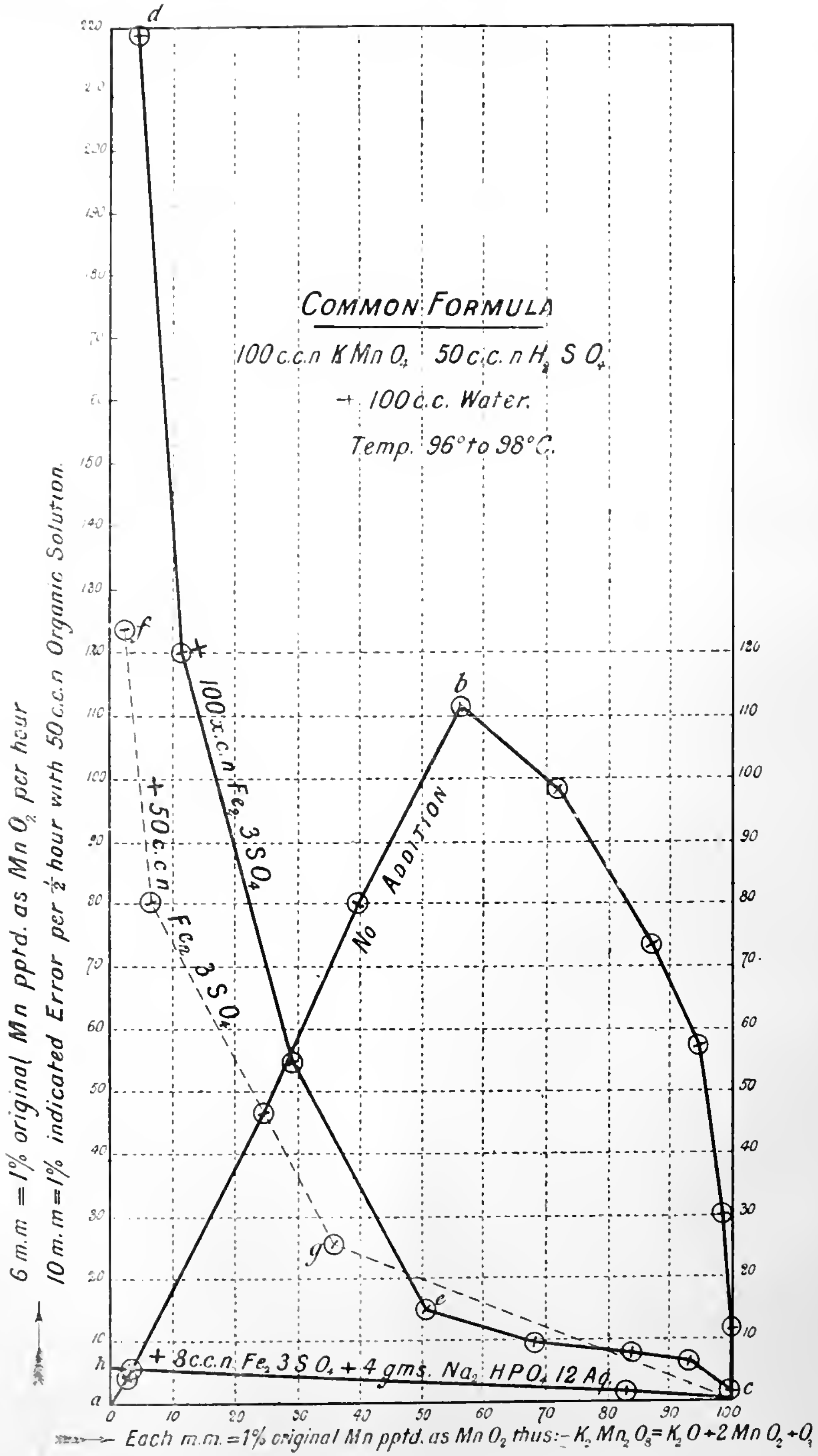
We see here that the error introduced is very constant compared with former results. For a body which is found to be wholly or nearly completely oxidised, if we make a deduction of 0·15 or 0·2 per cent. we may be sure that the result obtained is within 0·1 per cent. of the truth, at least as far as the error introduced by the loss of oxygen is concerned.

Acetic acid, as we have seen, is not oxidised by the permanganate. In order to determine if this was absolutely the case, and whether it could be substituted for sulphuric acid in case of necessity, the following experiments were tried:—A neutral solution of sodium acetate, containing 8grms. of the crystallised salt (*i.e.*, more than sufficient to combine all the free H_2SO_4), was introduced in place of the organic body in both experiments.

No. of Experiment—	197	198
Length of heating	½hr	2hrs.
Loss = cc. $n KMnO_4$ after deducting for error	2·1	3·4

From the loss in 197 we can draw no conclusion, as it includes any impurity in the acetate: but from the difference in the two experiments (= 1·3) we obtain the loss due to oxidation of the acetic acid itself in 1½hrs. We learn, then, that there is a slight oxidation of the acetic acid when present in very large quantity, which would not exclude its use, however, where sulphuric acid could not be employed. An additional error would be introduced which would not be greater than 0·8 per cent. (*i.e.*, in the worst case, where no oxidation occurs), provided the acid were perfectly pure.

The accompanying diagram illustrates the most important results obtained from this investigation, and will serve the purpose of a summary of the same. It is sufficiently clear to render detailed explanation unnecessary. The curves are drawn from an independent series of experiments. The height of any point in the curve indicates the speed of the reduction of $KMnO_4$, after the percentage indicated on the base line has been reduced. The points were found by adding varying quantities of normal oxalic acid, heating for a convenient time, and estimating the oxygen lost during the interval. The speed of reduction calculated therefrom was ascribed to the middle point between the reduction artificially initiated, and that finally indicated after heating. The diagram is drawn to a scale of millimetres, from which the percentage of the complete reduction, or


COMMON FORMULA
100 c.c.n KMnO4 50 c.c. n H2SO4
+ 100 c.c. Water.
Temp. 96° to 98° C.
+ 100 x c.c.n Fe2 3SO4
No ADDITION
+ 50 c.c.n Fe2 3SO4
+ 8 c.c.n Fe2 3SO4 + 4 gms. Na2HPO4 12 Aq.
a
b
c
d
e
f
g
h
6 m.m. = 1% original Mn pptd. as MnO2 per hour
10 m.m. = 1% indicated Error per ½ hour with 50 c.c.n Organic Solution.
Each m.m. = 1% original Mn pptd. as MnO2 thus:- K2Mn2O8 = K2O + 2MnO2 + O3
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220

the indicated percentage error per given time corresponding to any given initial reduction of the $KMnO_4$, or *vice versâ*, may be accurately measured. It should be noted that the maximum speed of reduction with no addition, and the minimum speed of reduction with $Fe_2 3SO_4$ added, very nearly correspond to an initial reduction of 60 per cent. With the smaller amount of $Fe_2 3SO_4$, the indication is similar, showing that these maxima and minima depend on the ratio of MnO_2 to $KMnO_4$. The enormous initial speed of reduction with $Fe_2 3SO_4$, as well as the nearly complete annihilation of the reduction with Na_2HPO_4, should be noted.

Practical Applications.

The chief recommendation of such a method as I have described to a Society like ours lies in the advantages which it offers for the rapid and accurate estimation of commercial organic products, and these occupy a position of the highest importance in English chemical industry. For the determination of the organic matter in potable waters, and in the waste liquors of the numerous manufactories which largely employ organic materials, the method will doubtless prove of the greatest practical importance.* For the estimation of alcoholic, and possibly ethereal, solutions when largely diluted, it presents a more rapid solution than the specific gravity method. For the examination of milk and other animal secretions its application will be obvious.

But to the research chemist the field laid open is much wider. The want of a method for estimating the oxygen in organic bodies directly, has long been felt. Now, although this method does not supply that want in every case, probably in the vast majority of organic bodies it does so, and will at least prove a valuable aid to ordinary elementary analysis. The probability is that the number of organic bodies which the permanganate will not oxidise, under the conditions obtaining, is very small; very possibly acetic acid is the only body. Sugar we found to be oxidised to the extent of 82·2 per cent. This corresponds to the absorption of 20 atoms of oxygen per molecule. Now, if one molecule of acetic acid were a product of the oxidation, we can account for the additional four atoms of oxygen required for complete oxidation not being absorbed.

The time is immature to speak definitely in the matter, but I foresee the application of this method possibly for the ultimate analysis of organic bodies; in which case carbon, oxygen, and nitrogen would be determined directly in one experiment, and the hydrogen by difference. In the case of nitrogenous bodies, I have reason to believe the nitrogen is evolved as gas. Both it and CO_2 might be collected over mercury and measured, and the nitrogen subsequently measured after absorption of the CO_2 by potash.

I hope to treat of the oxidation of organic bodies by means of MnO_2 in acid solutions, as well as of oxidations by permanganate in neutral and alkaline solutions, and of analytical methods derived therefrom, in my next paper.

Although I wish to reserve to myself the right of pursuing these investigations in a systematic manner, I trust others will take up the matter from their own particular standpoints, and report upon the method I have here propounded.

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* The presence of ammonium salts, and of nitrates, I have found to be absolutely without influence; and this is also the case with chlorides when present only in small quantities; the other halogens are, however, detrimental. In my next paper I shall quote experiments in proof of the above statements, and show how the error arising from even large quantities of chlorides may be altogether prevented.

INFLUENCE OF MINUTE QUANTITIES OF SULPHURIC ACID ON THE ACTION OF WATER ON LEAD.

BY W. CARLETON-WILLIAMS, B.SC.,

Firth College, Sheffield

The action of dilute saline solutions on lead has been the subject of repeated investigations, but until recently the influence exerted by the presence of minute quantities of free acids on the solvent action of water on lead has been entirely neglected. The attention of Jarmain, A. H. Allen (*Chem. News*, 46, 145), and others, was first called to this subject by the numerous cases of lead poisoning which occurred in certain towns where the water supplied for household purposes is slightly acid.

Last year Mr. A. H. Allen and Dr. Sinclair White presented an interesting report on the prevalence of lead poisoning in Sheffield. The town is supplied with water collected on moorland, and is preserved in and distributed from two distinct set of reservoirs, A and B. The water from the two sources is almost identical in composition, as the quantity of chlorine, sulphuric acid, lime and magnesia is the same in each. The sole points of difference are that A contains 5·53grns. per gallon total solids (of which 0·47 is silica and 0·40 Al_2O_3), and has an acid reaction to litmus; whereas B contains 5·84grns. per gallon total solids (of which 0·65 is silica and 0·58 Al_2O_3), and is neutral to litmus. The water from the B reservoirs has no action on lead, but the feebly acid water drawn from the houses supplied from reservoirs A contains from 0·07 to 0·7grns. of lead per gallon.

The quantity of the free acid contained in the water from the A reservoirs is so minute that the authors were unable to ascertain its nature. They are of

Solutions.	Strength in Grains per Gallon.	H_2SO_4 Grains per Gallon.	Lead dissolved—Grains per Gallon.				
			2	4	6	24	48hrs
Distilled water	—	0	0·07	0·14	0·21	0·21	0·14
" " ..	—	+ 1	0·49	0·56	0 7	0·84	0·56
" " ..	—	+ 5	0·70	0·91	1·36	2·10	3·50
Ammonium nitrate	1	0	0·21	0 07	0 07	—	—
" "	1	+ 1	0·42	0·81	0·84	0·93	0·21
" "	1	+ 5	0·84	1·54	1·19	3·01	4·2
" "	5	+ 0	0·35	0·14	0 21	—	0·14
" "	5	+ 1	0·84	1·4	1·48	1·05	1·05
" "	5	+ 5	1·05	2·10	2·10	2·80	3·64
Sodium phosphate Na_2HPO_4	1	+ 0	0	—	—	0	0
	1	+ 1	—	0	0	—	0
" "	1	+ 5	0·91	1·36	1·33	1·47	1·10
" "	5	+ 0	0	0	0	—	0
" "	5	+ 1	0	0	0	—	0
" "	5	+ 5	0·49	0·77	0·7	0·63	0·56
Ammonium chloride	1	+ 0	0	0·28	0·28	0·28	0·28
" "	1	+ 1	0·46	0·84	0·77	0·70	0·21
" "	1	+ 5	0·98	1·26	2·24	1·96	2·80
" "	5	+ 0	0	0	0	0	0·28
" "	5	+ 1	0·7	0·63	0 56	0·7	0·63
" "	5	+ 5	1·26	1·68	1·54	1·82	2·8

Salt.	Grains per Gallon	H_2SO_4. Grains per Gallon.	Lead dissolved Grains per Gallon.				
			2	4	6	24	48hrs
Potassium nitrate..	1	0	—	0·21	0·21	0·14	0·11
„ „ ..	1	+ 1	0	0·84	0·91	0·91	0·14
„ „ ..	1	+ 5	1·82	1·68	2·52	3·01	2·8
„ „ ..	5	+ 0	—	0·14	0·14	0·11	0·14
„ „ ..	5	1	—	0·84	1·05	0·56	0·28
„ „ ..	5	5	—	1·82	3·08	3·36	4·48
Calcium sulphate..	1	—	0·11	0·084	0·11	0·21	0·07
„ „ ..	1	+ 1	0·7	0·84	0·91	1·33	0·84
„ „ ..	1	+ 5	0·7	0·91	1·20	2·1	4·2
„ „ ..	5	—	—	0·07	—	—	—
„ „ ..	5	+ 1	0·77	0·84	1·26	1·68	1·68
„ „ ..	5	+ 5	0·56	0·63	0·77	1·82	2·91
Magn'sium sulphate	1	—	0·14	0·14	0·11	0·07	0
„ „	1	+ 1	0·63	0·49	0·49	0·14	0·14
„ „	1	+ 5	0·91	1·88	0·987	2·24	2·45
„ „	5	—	0·07	0·07	0·07	0·07	—
„	5	+ 1	0·63	0·84	0·98	0·35	0·28
„ „	5	5	0·42	0·91	1·26	0·61	2·87
Sodium sulphate ..	1	—	0·14	0·07	0·07	0·14	0·14
„ „ ..	1	1	0·7	0·7	0·63	0·63	0·11
„ „ ..	1	5	1·14	1·26	1·54	2·66	1·26
„ „ ..	5	—	0·14	0·11	0·07	0·07	0·07
„ „ ..	5	1	0·56	0·77	0·77	0·91	0·42
„ „ ..	5	5	0·84	1·33	1·61	1·61	1·41
Sodium chloride....	1	—	0·14	0·14	0·14	0·14	—
„ „	1	1	0·56	0·7	1·26	1·68	1·89
„	1	5	0·84	1·05	1·26	2·80	3·36
„ „	5	0	0·14	0·11	0·11	0·14	0·11
„ „	5	1	0·77	1·33	1·05	1·40	2·21
„ „	5	5	1·4	1·82	1·75	2·21	3·22

opinion that it may be either sulphuric acid derived from the oxidation of the iron pyrites contained in the shale underlying the peat of the collecting ground, or organic acids derived from the peat.

The following experiments were made with the object of ascertaining the influence of minute quantities of free sulphuric acid on the action of dilute saline solutions on lead :—

Chemically pure lead foil was cleansed from grease by washing with alcohol and water, and was afterwards rubbed bright on a soft towel. It was cut up into pieces of 12·5 square centimetres area; each piece was rolled into a hollow cylinder, placed in a flask of about 150cc. capacity, and covered with 100cc. of the solution to be examined. A sheet of unglazed paper was placed over the flasks, in order to protect them from dust, and at the same time to allow free access to the air.

The distilled water used in preparing the solutions was aërated by shaking up with air, and also by repeatedly causing the water to trickle slowly from one vessel to another.

In order to estimate the amount of lead, 50cc. of the clear solution were taken, and the lead determined colourimetrically by means of sulphuretted hydrogen or ammonium sulphide. If the liquid was turbid it was necessary to filter it through asbestos, or, as this did not always prove effective, a stoppered bottle was filled quite full of the turbid liquid, and left at rest for 24 or 48 hours until the finely-divided suspended matter deposited. The numbers arranged in the table above represent the mean results of two or three determinations.

It appears from these results that the addition of 1 grain per gallon of sulphuric acid increases the solvent action of the dilute saline solutions on lead to a marked extent. The amount of lead in solution, as a rule, steadily increases until a point is reached where the solution begins to show signs of turbidity; this is alwaye accompanied by a decrease in the amount of lead in solution. The time which elapses before the solution becomes turbid depends not only on the nature of solution, but also on the physical condition of the lead, and on the temperature. It sometimes happens that the results obtained at different times, with the same solution and with lead from the same origin, give results which show a difference of from 0·3 to 0·45 grains per gallon, more especially in the case of the solution of sodium chloride and sulphate with free sulphuric acid. The lowest numbers obtained when sulphuric acid was present were always much higher than the highest readings obtained for the neutral solutions, so that there is no doubt that the presence of free acid increases the amount of lead in solution.

The total action of the solution on lead as distinguished from the amount of lead in solution, was estimated by exposing coils of lead to the action of 100cc. of the solution for 4 hours. The lead is brushed free from any deposit, and removed from the flask. A few drops of acetic acid were added to the turbid liquid to dissolve the basic salts of lead, and the amount of lead in solution was then estimated. The solutions containing free sulphuric acid remained clear for at least 24 hours. The results are, therefore, identical with those in the previons table.

Total Action in 4 Hours.

	Grains per Gallon.		+ 1 Grain per Gallon H_2SO_4.	+ 5 Grains per Gallon H_2SO_4.
Water................................	—	1·75	0·56	0·91
Ammonium Nitrate	1	2·45	0·84	1·51
„ „	5	2·91	1·4	2·1
Ammonium Chloride............	1	1·4	0·84	1·26
„ „	5	0·56	0·63	1·68
Potassium Nitrate	1	1·75	0·81	1·68
„ „	5	2·10	0·84	1·82
Calcium Sulphate	1	1·12	0·81	0·91
„ „	5	0·07	0·81	0·63
Magnesium Sulphate............	1	1·12	0·49	1·68
„ „	5	0·91	0·84	0·84
Sodium Chloride	1	1·47	0·7	1·05
„ „	5	0·56	1·33	1·82

These numbers show that the presence of 1 grain per gallon of free acid decreases the action of the dilute saline solutions on the lead, although it increases the quantity of lead dissolved.

Dr. Tidy brought before the British Association, at Birmingham, some interesting observations on the effect of silica in diminishing the action of water on lead. In the case of the Sheffield water supply, the water which attacks the lead contains 0·47grns. per gallon of silica, and the water containing 0·65grns. per gallon of silica has little or no action. Experiments were made to ascertain whether the presence of small quantities of silica diminishes the action of water on lead even when the water contains free acid. The results show that in certain conditions it is efficacious. A common lead pipe was filled with 100 cubic centimetres of solutions of calcium sulphate and free sulphuric acid (1 grain per gallon each) and left for 24 hours. The water contained 4mgs. of lead per litre. On repeating the experiment, with a similar solution, to which 2grns. per gallon of dialysed silica were added, no lead was found in solution. When ammonium nitrate was substituted for the calcium sulphate, the addition of dialysed silica diminished the action of the water on the lead. The results are quite different when strips of pure lead, which have been cleaned by immersion in dilute nitric acid, and thoroughly washed and rubbed bright, are exposed for 24 or 48 hours to the action of 100cc. of the solutions of the different salts (+ 1 or 5 grains per gallon H_2SO_4) used in the previous experiments. The addition of 2 or 4 grains per gallon of dialysed silica had no effect on the quantity of lead dissolved by the solutions containing free acids.

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THE PURE CULTIVATION OF MICRO-ORGANISMS, WITH SPECIAL REFERENCE TO YEAST.

BY G. HARRIS MORRIS, PH.D., F.C.S.

THERE is no subject perhaps which has received greater attention during the last few years than the study of micro-organisms, and the various changes and actions which are produced by their agency. I propose to give you this evening some account of the methods which are employed for cultivating the various organisms in a state of purity—that is, in a state of freedom from all other organisms than the one we wish to study; and then to draw your attention to what has been done and is being done in connection with the pure cultivation of yeast, and its employment upon a practical scale. Klein,* in a lecture delivered before the Chemical Society, lays great stress upon the absolute necessity of working with pure cultivations. He says:—"Not till chemists come to look upon the matter in the same light in which we look upon it—namely, to obtain the organism pure, to render nutritive material sterile, to be able to produce with this pure organism the specific chemical activity you wish to obtain; not till you have fulfilled all these conditions, can you claim to have established the fact that a definite organism is the cause of a definite chemical change."

I do not intend this evening to say anything regarding the pathological micro-organisms, which are admirably treated of in Klein's "Micro-organisms and Disease;" although the methods employed for the cultivation of these are practically the same as those used for organisms which produce purely chemical changes, the only difference lying in the different nutritive medium employed for their cultivation.

Before all things it is necessary, in working with micro-organisms, to have a good microscope, capable of giving a magnification of from 300—400 linear diameters. This magnification is sufficient for all ordinary work; but in some cases it is, of course, an advantage to be able to examine growths under a higher power than the above. There are now so many makers of good, cheap instruments, that it is almost impossible to quote any special maker, but taking everything into consideration, the German makers, Zeiss and Seibert, supply as good an instrument at a lower price than English makers. I myself use one of Seibert's microscopes with No. IV. objective, and No. 3 eyepiece (this combination giving a magnification of 350 diameters), and fitted with an Abbé's substage condenser. For higher magnifications, Seibert's No. VI. objective, with the above-mentioned eyepiece, answers all purposes, a magnification of 950 diameters being given by this combination.

The media used for pure cultivations consist of both liquid and solid material. The former, in the case of pathological organisms, consists of different preparations of meat-broth, peptone, blood-serum, etc.; but for the organisms we shall consider to-night Pasteur's or Cohn's solutions or diluted beer-wort are more generally used.

Pasteur's solution consists of 10 parts pure cane-sugar, 1 part ammonium tartrate, and the ash of 1 part of yeast dissolved in 100 parts of water.

Cohn's solution is composed of 1grm. of ammonium tartrate, 0·5grm. potassium phosphate, 0·5grm. crystalline magnesium sulphate, 0·5grm. tribasic calcium phosphate in 100cc. distilled water.

The solid material used is a mixture of gelatine with broth, peptone, etc., or beer-wort. Koch, who introduced this solid mixture, used only 2—3 per cent. gelatine. But this mixture, although solid at ordinary temperatures, becomes liquid when the temperature is raised, and as in most cases it is necessary to carry on the growth at 25—30° C., or even higher, a larger percentage of gelatine must be added, varying from 6 to 10 per cent.

The vessels employed for pure cultivations consist of test tubes, Pasteur's flasks, Chamberland flasks, moist chambers, etc. One of the most important considerations in working with pure cultivations is, as Klein has pointed out, to obtain the apparatus and the solutions used in a perfectly sterile state. I propose, therefore, to briefly describe the precautions which it is necessary to take in order to ensure complete sterility of apparatus and culture material.

In the first place it is absolutely necessary that all vessels and apparatus, flasks, test tubes, beakers, filter papers, cotton wool, glass rods, etc., to be used, must be thoroughly sterilised by heating to 120—150° C., that is, at a temperature which is sufficient to kill all micro-organisms and their spores, which may have settled from the air upon and within the vessels. In the case of large vessels, such as flasks, this is best done by passing the flame of a Bunsen burner over the surface of the vessel until it is hot, and then immediately closing the mouth and side tube with sterilised cotton-wool and indiarubber tubing and glass rod. For small vessels, test tubes,

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* Jour. Chem. Soc. 1886, 205.

beakers, cultivation chambers, etc., an air-bath heated to the required temperature is most convenient. This should be maintained at 120—150° C., and the vessels allowed to remain in it for 2—3 hours, at that temperature. The cotton-wool for plugging the mouths of flasks and test-tubes must also be well sterilised by being loosely pulled out and then heated in the air-bath to the above temperature for some hours, on several successive days. Filter-papers used for covering the cotton-wool plugs should also be heated in the air-bath. Forceps, pipettes, and all other odds and ends of apparatus must be sterilised by being passed through a Bunsen burner at the moment of use.

I have mentioned above the solutions most commonly employed for cultivations. These are rendered sterile and ready for inoculation in the test-tubes, and small flasks, in the following way:—The solid material, as broth gelatine, beer-wort gelatine, etc., must be poured into the previously sterilised flasks and test-tubes, whilst still in a fluid state, and then sterilised by being boiled twice or three times on successive days. Tyndall has pointed out that the spores of certain bacteria are not killed by boiling, therefore it is necessary to boil on successive days, in order to give the unkilled spores an opportunity of developing between each successive boiling, when, of course, the next boiling kills the developed organism.

No test-tube or flask, containing nutritive material, can be considered sterile until it has been kept at a temperature of 32—38° C., for at least seven days, without any sign of growth appearing.

This is of necessity a very brief sketch of the precautions which have to be observed, both in the preparation and sterilisation of culture solutions. A very complete and detailed description will be found in the little book by Klein, previously mentioned.

We will now pass on to the methods employed for obtaining pure cultivations of definite micro-organisms by inoculating the test-tubes and small flasks containing sterile material. We may roughly divide the inoculations into four classes.

1. Inoculations, by which it is required either to obtain an organism in a state of purity, which has previously been growing in a culture tube or other vessel, or to separate two or more organisms which were previously growing in the same vessel, and each of which we wish to obtain in a pure state. As an instance of this, I may take a hay infusion, which has been exposed to the air and then allowed to remain in a warm place. We should then have a mixed growth of two or more micro-organisms, each of which we may wish to isolate and study in a pure state.
2. Inoculations from animal fluids and tissues. This, however, relates solely to pathological organisms, and does not come within the scope of this paper.
3. Examination of water for micro-organisms.
4. Examination of the floating matter of the air.

In the first case we will suppose that we have an artificial cultivation in a test-tube, and that we desire to inoculate one or more sterile tubes with the micro-organisms contained in this cultivation. We then take a freshly drawn-out capillary pipette, slightly raise the plug of cotton-wool in the tube containing the cultivation with sterilised forceps, and carefully push the pointed end of the pipette through the loosened plug, until it reaches the growth in the tube; a small quantity of the latter then ascends the pipette, which is quickly withdrawn, the plug of cotton-wool again pressed down, and the minute drop of inoculating solution at once conveyed to a new culture-tube by exactly the same procedure as before—that is, the partial withdrawal of the cotton-wool plug, the insertion of the pipette with the solution into the sterile culture material, whether solid or liquid. A small quantity of the inoculating solution flows out of itself, or, if it does not, it may be forced out by a gentle pressure applied to the other end of the pipette. The pipette is then withdrawn, and the cotton-wool plug replaced as before. If more than one tube is to be inoculated, this operation is repeated, using, however, a fresh pipette for each inoculation. The freshly-inoculated tubes are then placed in a suitable support, preferably in a beaker on a cushion of cotton-wool, and placed in the incubator at the required temperature. If, however, we have a fluid—hay infusion, for instance—which a microscopical examination shows us to contain more than one organism, and we wish to obtain these in a state of purity, it is necessary to adopt either Kleb's method of "fractional cultivation," or the method of "dilution" employed by V. Nägeli and Lister.

The former consists in endeavouring to fractionate by successive cultivations the different organisms growing together in the same culture. It is effected by inoculating by means of a capillary pipette traces of the culture fluid into a series of new tubes, containing different nutritive materials; these tubes are then placed in the incubator at 35° C. for a short time, say 24 hours, at the end of that time it is probable that in some of the tubes the organism, which thrives best on the particular nutritive material contained in the tube, will have grown almost exclusively. The treatment is then repeated, and a series of fresh inoculations made from each of the first tubes. This is continued until the physical appearance, microscopic examination, etc., show us that we have a pure organism in our culture tubes.

The latter method, that of "dilution," consists in diluting the culture fluid containing the various species to a very large extent—varying from 1 in 1000 to 1 in 1,000,000—with a sterile saline solution, and then inoculating fresh culture-tubes with this diluted fluid. In this case it is possible that, owing to large dilution, only one species of organisms may be sown in some of the tubes, and a pure culture is at once obtained.

The two methods may often be advantageously combined by first making one or two cultures by the "fractional" method and then using this cultivation for "dilution" with sterile saline solution. If necessary this may be repeated until the desired pure culture is obtained.

In the examination of waters for micro-organisms, the plate method, originally introduced by Brefeld,[*] and later adopted by Koch for this purpose, is the one used. It has been so fully described recently in this Journal by Dr. Percy Frankland,[†] and also by Bischof,[‡] that it is unnecessary to refer to it at greater length.

With regard to the examination of the micro-organism in air, many methods have been suggested for collecting and cultivating these prior to their cultivation in a state of purity. The simplest method is to expose open flasks containing sterile nutritive material to the air in the desired locality for a certain time, and then to close them again. You have then in the flasks the organisms which were deposited from the atmosphere during the given time, and these can then be separated and examined. Using this method, Hansen examined[§] the atmosphere of various places within and around the brewery of Old Carlsberg at Copenhagen, and isolated a large number of organisms — yeast, bacteria, moulds, etc.

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[*] Method. z. Unters. d. Pilze. Med. Phys. Ges. zu. Würzburg, 1874.

[†] This Journal, 1885, 608.

[‡] This Journal, 1886, 114.

[§] Compt. rendu du Laboratoire de Carlsberg, 1879.

Another method, proposed by Cohn and Mitlet,* consists in aspirating a given volume of air through a series of flasks containing sterile nutritive material, taking every care that no contamination can take place except from the aspirated air. The flasks are then placed in the incubator and the growths examined. A third method is that devised by Hesse,† in which a given volume of air is slowly drawn through a tube coated with nutritive gelatine, the micro-organisms are deposited on the gelatine and grow where they fall.

Such is a brief outline of the methods employed for obtaining pure cultivation of the Schitzomycetes or bacteria, as distinguished from the Saccharomycetes or yeasts. Apart from certain pathological micro-organisms, which have been thoroughly worked at in pure cultivation, we are almost entirely without sufficient evidence of the nature of the changes brought about by micro-organisms. Thus nothing definite is known of the organisms which produce lactic fermentation or the viscous fermentation of wine and beer; the butyric fermentation is also in a state of uncertainty. It is true that these, amongst others, have been worked at by Pasteur and other observers, but in all cases the results are vitiated by the fact that pure cultivations of the organisms were not employed. Another source of the frequent discrepancies between the descriptions of different observers is, I think, the failure to recognise the pleomorphism of micro-organisms which is well illustrated in the case of the acetic ferment. There are a great many statements which require investigation; for instance, *mucor racemosus* is said to be capable of producing alcoholic fermentation, but this statement is based upon very insufficient evidence, and requires confirmation by experiments carried on with pure cultivations of the ferment before it can be accepted. And this is only one of many statements of the same nature.

Hansen and other investigators have during the past few years examined morphologically and physiologically a considerable number of ferments in a state of purity, but it is only within the last few months that any advance has been made in the examination of the chemical action of these ferments, and the advance in the latter direction will be very slow until vegetable physiologists are also sufficiently chemists to be able to study the chemical changes taking place, or until chemists, working with organised ferments, adopt the method of pure cultivation which I have briefly described above.

I think we may consider that the researches of Adrian Brown,‡ alluded to above, on *Bacterium aceti* and *Bacterium xylinum* constitute quite a fresh departure in the investigation of the organised ferments. We have here not only pure cultivations carried out with every possible precaution, but also a quantitative examination of the fermentative action of the pure organism on certain definite sterile solutions. A brief outline of the researches will not be out of place here, since no better example can possibly be found of the treatment which must in future be applied to the chemical actions produced by micro-organisms.

Both *Bacterium aceti* and *Bacterium xylinum* were found growing on the surface of a beer which had been exposed to air. They were separated and purified by a combination of Kleb's "Fractional" and V. Nägeli's "Dilution" methods as described above. Both micro-organisms being strictly aërobic, and consequently requiring a free supply of air, flasks and test-tubes plugged with sterilised cotton-wool were employed for the cultivations. For the former the cultivating fluid was a 2 per cent. solution of alcohol in yeast water; for the latter claret diluted with half its volume of water and rendered acid with 1 per cent. acetic acid. When repeated cultivations showed that the organisms were pure, the action of the pure ferments on various *sterile* solutions was examined. *B. aceti* oxidises ethylic alcohol to acetic acid, together with a mere trace of a non-volatile acid, probably succinic: the acetic acid is further oxidised into carbonic anhydride and water by prolonged action; propylic alcohol is converted into propionic acid; methyl alcohol is unacted upon, although the ferment grows freely in a 1 per cent. solution in yeast water. Grown in Pasteur's solution with 2 per cent. dextrose and calcium carbonate, the ferment converts the carbohydrate in gluconic acid, which forms calcium gluconate with the calcium carbonate present; cane-sugar is unacted upon, but mannitol is converted into *levulose*, which, however, is itself entirely unacted upon by the ferment. This reaction is most important in helping to throw light upon the constitution of the carbohydrates. It also enables us to convert *dextrose* into *levulose*, since dextrose is converted into mannitol by the action of sodium amalgam, and mannitol into levulose by the action of pure *B. aceti*. *B. xylinum* is characterised by the remarkable fact that it converts dextrose, mannitol and levulose, more particularly the last, into *cellulose*. In its action on other substances it resembles *B. aceti*. It grows in the form of a tough gelatinous membrane, and is commonly known as the "vinegar plant;" this latter, however, is always mixed with yeast, which in the manufacture of vinegar from sugar solutions, first inverts and ferments the sugar, so forming alcohol for conversion into acetic acid by the ferment, since the pure ferment is without action upon sugar solutions.

I have ventured to quote thus fully from the two papers of Mr. Adrian Brown, as they are, so far as I know, the only instances of a quantitative chemical examination of the action of a pure organised ferment, and because the examination has brought to light some interesting facts connected with the action of such an every-day micro-organism as the acetic ferment.

I must now pass on to the more special part of my paper—viz., the pure cultivation of yeast, and its application upon an industrial scale. I suppose that we are all more or less familiar with the effect which Pasteur's celebrated work, "Etudes sur la Bière," produced upon the practice of brewing. It awoke brewers to the fact that upon their yeast depended the success or failure of their operations. But Pasteur chiefly directed their attention to the presence of ferments capable of setting up acetic, lactic, butyric, and similar fermentations, although he also pointed out the necessity of working with a yeast which was not contaminated to any great extent with "wild" yeast forms. Having had this danger so forcibly pointed out to them, brewers became alive to the absolute necessity of cleanliness in every part of the brewing plant, and I suppose that now the contamination to any great extent of brewing yeast with "disease" ferments, as distinguished from foreign yeast forms, is a thing of the past in all well-conducted breweries. With regard, however, to wild yeast forms, it is not so easy to know when they are present in a yeast, or to get rid of them when they are there.

We owe what will in all probability turn out to be the solution of the "wild" yeast question in our English breweries, as it has already done in the Continental breweries, to Dr. E. C. Hansen, of the Carlsberg Institute, in Copenhagen. He has applied the methods of pure cultivation to yeast, and has further so extended them as to be able to prepare pure cul-

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* Zeitschrift f. Biol. de Pfl. iii. 7.

† Mittheilungen Kaiser Gesundheitsamte, Berlin, 1881.

‡ Jour. Chem. Soc., 1886, 172 and 432.

tures of yeast from a *single selected yeast cell.* When Hansen published in 1878 his investigations on the micro-organisms in air, referred to above, he remarked on the unsatisfactory state of the earlier work on the Saccharomycetes, and expressed his opinion that, in order to obtain a true knowledge of this class of organisms, it would be necessary to approach the subject from a different standpoint to that adopted by Reess* and Pasteur† in the work which they had already done. In 1881 he published the first of his researches in this direction—viz., that on "*Saccharomyces apiculatus*, and its circulation in nature," ‡ to which I shall again refer. In this he laid down the fundamental principle that investigations with the Saccharomycetes should be so carried on that each species could be cultivated from a *single* cell, in order to ensure the absolute purity of the cultivation, and ascertain the constant characteristics of the ferment. When this result could be obtained, we should have in our hands a method for the analysis of yeast, and not only would the results be of great scientific and theoretical interest, but they would also be of importance to the fermentation industries.

In his earlier work, above-mentioned, Hansen adopted a modification of v. Nägeli's "dilution" method, which was as follows :—A vigorous fermentation with the yeast from which it was desired to cultivate is promoted in a Pasteur flask ; the yeast formed is then largely diluted with a known volume of sterilised water, thoroughly mixed with the water by shaking, and the number of cells in a small drop of the water counted. The counting is effected by means of a hæmatimeter. This may consist either of a microscopic cover-glass on which a number of microscopic squares have been ruled, or of a microscopic glass slide, on which the squares are ruled in the centre of a very shallow cell. A good form of the latter is made by C. Zeiss, of Jena, in which the squares measure $\frac{1}{400}$th of a square mm., and the cell is 0·1 mm. deep, the cubical capacity, therefore, of each square, when the cover-glass is on, being 0·00025cmm. The drop is placed well upon the squares, which then assist the eye in counting the cells contained in the drop. Supposing 10 cells are found, then if a similar-sized drop is added from the fluid, which has again been thoroughly shaken, to a flask containing a known volume of sterilised water, say for instance 20cc., the probability now is that this 20cc. of water contains 10 cells. The flask is thoroughly shaken for some time, and then 1cc. of the liquid quickly introduced into each of 20 flasks containing nutritive solution ; there is now in all likelihood 1 cell in each of 10 of these 20 flasks. This is of course only a probability. In order to be sure that some of the flasks contain only one cell, it is necessary to allow them to remain until a growth appears. Directly after adding the 1cc. of the diluted yeast to the flasks, they are thoroughly shaken and placed in the incubator at the required temperature, the cell or cells present then sink to the bottom of the flask, remain and grow where they settle, which, in the latter case—*i.e.*, if more than 1 cell is present—is probably at different points on the bottom. After some days the flasks are carefully examined, and the points of growth noted. In those flasks in which there is only one speck of growing yeast visible, the inference is that it proceeds from one cell, and consequently the flask contains a pure cultivation ; in other cases it is possible that two or more specks are visible, then it is safe to conclude that more than one cell was sown in the flask, and its contents are consequently rejected.

This method has yielded good results in Hansen's hands, especially with ferments which have some distinguishing characters, such as *Sacch. apiculatus.* This method also gives much better results than the one about to be described when it is wished to separate weak and strong yeasts, which are growing together in a nutritive liquid. Another point in its favour is the complete absence of any possibility of outside contamination after the 1cc. of diluted yeast has been added to the flask.

Hansen, however, afterwards adopted a solid medium for his cultivations—viz., hopped wort and gelatine ; and he gives the preference to this material, except under the circumstances mentioned above, since it enables the experimenter to directly observe the individual cells under the microscope, and to follow the course of their development. He adopted a modification of Koch's gelatine plate method, taking, however, more elaborate precautions to prevent contamination after the inoculated gelatine is spread on the plate. Before proceeding to describe the method in detail, it will be as well to point out the necessity of having some place set apart entirely for pure cultivation work, as the success or failure of these operations depends greatly upon the freedom of the air from germs at the time the experiments are being carried out. For this reason, the room should be allowed to remain perfectly undisturbed for some hours before the cultivation is made, in order to allow the dust to settle.

In order to prepare a pure cultivation of yeast, we take a growth of young and vigorous cells, dilute this down very largely with sterile distilled water in a small Chamberland flask, until the proper dilution is reached (this is ascertained by a microscopic examination), and then again dilute a drop of this with sterile beer-wort gelatine (hopped wort of about 1058 sp. gr. with 5—10 per cent. gelatine), until we have an extreme dilution. A drop of this is then withdrawn with a sterilised glass rod, and spread upon the under side of a thin cover-glass, which is then quickly placed on the ring of a Böttcher's moist chamber. Fig. 1 represents one of the chambers in question ; *a* is the thin cover-glass, with a layer of gelatine on its under surface *b*, and placed on the glass circle *c*, which is 30mm. in diameter, and cemented to the glass slide ; *d* is a thin layer of sterile distilled water. Fig. 2 shows the Chamber-

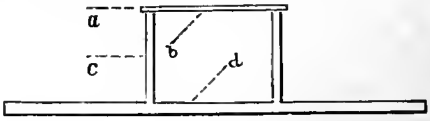

FIG. 1.

FIG. 2.

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* Botan. Untersuchungen über die Alkoholgärungspilze, 1870.

† Etudes sur la Bière, Paris, 1876.

‡ Meddelelser fra Carlsberg Laboratoriet, 1881.

land flask mentioned above: it consists of a flask on the neck of which a cap has been ground with emery; one end of the cap is drawn out, and this end is closed with a plug of sterilised cotton-wool.

The inoculated gelatine having been spread on the glass circle and allowed to set, the chamber is then placed on the stage of the microscope and examined. One or two well isolated yeast cells are picked out, and the position of these marked on the glass circle by a marker of some description. The whole is then placed in an incubator at about 25–30° C. and allowed to remain for a day or two. At the end of about two days the growths are generally visible to the naked eye, and appear as small whitish specks about the size of pins' heads. These specks should be well separated from each other on the glass circle

When the specks have attained a sufficient size they are transferred to sterile hopped-wort, of about 1·058 sp. gr., contained in Pasteur's flasks (Fig. 3).

FIG. 3.

These consist of flasks with the neck drawn out and bent over, as shown in the figure, and with short side-tubes, which are closed with a piece of indiarubber tubing, and a glass rod; the bent tube is closed with a plug of sterilised asbestos. The transference is effected by quickly lifting the cover-glass with the colonies, plunging a short piece of sterilised platinum wire into the colony, and then immediately dropping this into the side-tube of the flask, the glass-rod stopper being quickly withdrawn and replaced. Having got the colony *which we know is derived from one single cell* into the flask, we are then in a position to study its characters and properties. Fig. 4 shows another form of flask, which is often of great service, the mouth of which is closed by two layers of sterilised filter-paper.

FIG. 4.

The above is of necessity only a brief outline of the operations to be performed and the precautions to be observed, since it is impossible in the scope of this paper to enter fully into details.

[Dr. Morris, in the course of the paper, gave a practical illustration of the manipulations necessary, and showed moist chambers with colonies in various stages of growth.]

Such is the process which Hansen has employed to effect a revolution in the study of the Saccharomycetes. By its means he has succeeded in separating a number of apparently different species of yeasts, from which he has selected six for further study. In addition to these he has isolated two varieties of ordinary bottom-fermentation yeast, which are at present used in the brewery of Old Carlsberg, and also in a very great many other breweries on the Continent, and to which I shall again refer. He has also determined that the form, the limits of size, and the appearance of the cells do not remain constant for each variety or species, but are influenced by different conditions of growth. The form and phases of development of the cells, however, when viewed from another standpoint, give very important differences for each variety. This is the case when the cells of the different varieties are exposed to similar conditions, as in the ascospore and film formations; it is found then that the different yeasts behave in a very different manner, and each species gives well-defined characteristics. This can only be explained by the supposition that the different varieties or species have distinct innate properties.

We will now proceed to consider the differences which Hansen has found between the different varieties of yeast. He has, as stated above, differentiated six species of yeasts, which he calls—

Saccharomyces cerevisiæ, I.
Saccharomyces Pastorianus, I., II. and III.
Saccharomyces ellipsoideus, I. and II.

The ordinary sedimentary forms of these are shown in Figs. 5 to 10: Fig. 5 being *S. cerev.* I.; Fig. 6, *S. Past.* I.; Fig. 7, *S. Past.* II.; Fig. 8, *S. Past.* III.; Fig. 9, *S. ellip.* I.; and Fig. 10, *S. ellip.* II. It will be seen that although the varieties taken separately appear quite distinct, yet if they were mixed it would be extremely difficult to detect one from the other—for instance, the *S. Past.* when mixed with *S. cerev.*, or the *S. ellip.* when mixed with *S. Past.* or *S. cerev.* The size of the cells varies considerably with the species.

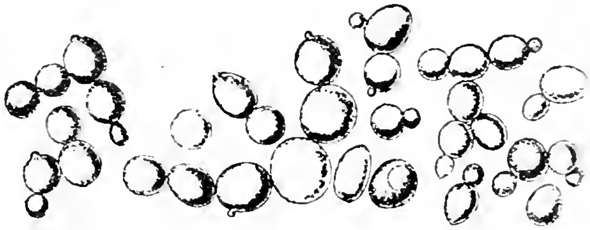

FIG. 5.

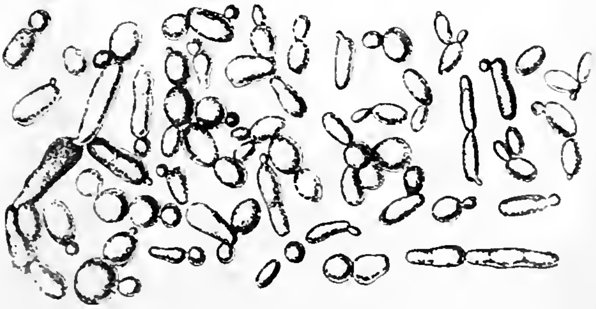

FIG. 6.

Fig. 7.

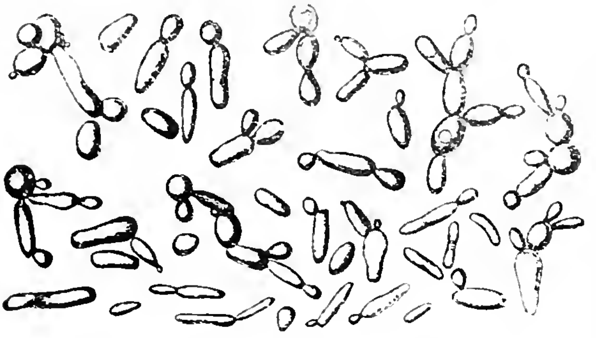

Fig. 8.

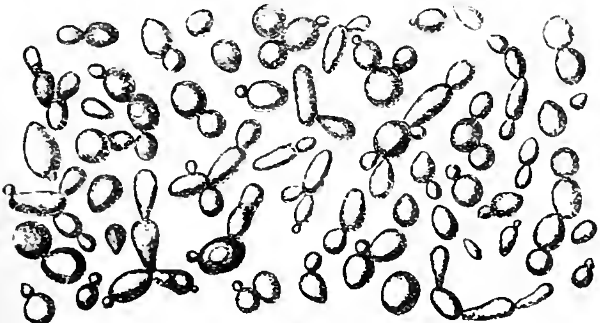

Fig. 9.

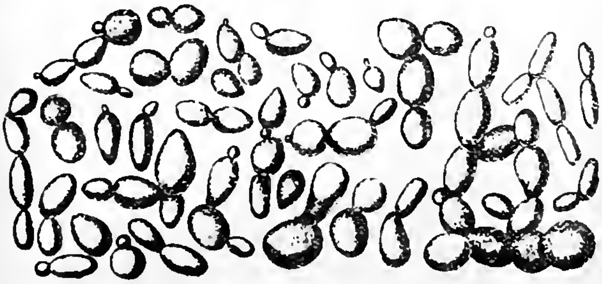

Fig. 10.

The characteristic which Hansen chiefly relies upon in differentiating these species is the ascospore formation. The formation of ascospores in yeast cells has long been noticed, Reess, Engel, and several other observers having described it, and attributed this formation to various causes. Reess built up a system of the Saccharomycetes based upon the form and size of the cells and spores. Brefeld concluded that only "wild" or "natural" yeast was capable of giving spores, whilst cultivated yeast had lost this property. Hansen[*] examined his six species for this formation as follows: A small quantity of the yeast was spread on a sterilised gypsum block, this block was then placed in a flat covered glass dish, and was kept moist by filling the latter half full of water. The formation was then generally seen when the dish had stood for a few days at the ordinary temperature. The spores generally form as round bodies within the cell, and are usually accompanied by the "sheath-wall" formation. Fig. 11, page 120, shows the formation for the six species. Hansen investigated the influence of different temperatures upon the rate of formation of the spores, in order to determine whether the different species could be distinguished from each other in this way. For this purpose it was necessary to know—

1. The limits of temperature—*i.e.*, the highest and lowest temperatures at which spores were formed.

2. The most favourable temperature at which the spores were formed.

3. The ratio of the intermediate temperatures.

The results obtained (which are given in Table I.) showed that the formation of spores proceeded very slowly at ordinary temperatures, but more rapidly as the temperature rose, until it reached a certain point. When this point was passed, then the formation again decreased, until it at last ceased entirely. The lowest temperature found for the six species was ½—3° C.; the highest 37·5° C. The highest and lowest temperatures for the different species were also different, and also the limits of temperature within which the ascospore formation takes place in the different species. We see from the table that the differences at the high temperatures, and down to 25° C., are almost inappreciable; but when we lower the temperature the differences become more marked. For instance, at about 11° C., *S. cerev.* first shows ascospores at the end of ten days, whilst *S. Past.* II. shows them at the end of seventy-seven hours, and so on with the other species. In making this comparison, it is necessary to make the experiments with each of the six species under exactly the same conditions, since the use of old or young cells, composition of the nutritive medium, etc., exercise a marked influence on the temperature and rate of formation of the ascospores.

Upon these results Holm and Poulsen[†] have based a method for the practical analysis of brewing yeast. Hansen found that the ordinary bottom-fermentation yeast only formed spores at 25° C. after some days, whilst, as we have seen, the "wild" forms, as exemplified by the six species we are considering, form ascospores at this temperature in a few hours. Working with pure cultivations of each species, Holm and Poulsen found that they were able to detect 0·5 per cent. of *S. Past.* I. and III., or *S. ellip.* II., in a mixed yeast; and, as Hansen has shown, that when these "wild" yeast forms, which are the cause of the diseases in bottom-fermentation beer, are present in a barm to the extent of not more than 2·5 per cent. of the total yeast, they do not develop their particular form of disease; it will be seen that, for bottom-yeast at least, the ascospore formation forms a valuable means of determining the purity of a barm.

The next and most recent of Hansen's observations are those on the "film" formation.[‡] The formation of films on the surface of the culture-liquid is peculiar to most micro-organisms when the greater portion of the food-stuff contained in the liquid is consumed. As the result of a series of exhaustive experiments with the six foregoing species, Hansen has established differences in their film formations, both as regards

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[*] Meddelelser fra Carlsberg Laboratoriet, 1883.

[†] Meddelelser fra Carlsberg Laboratoriet, 1886.

[‡] *Ibid.* 1886.

the limits of temperature within which it is possible for a growth to take place, and also in the appearance of the cells of the film; whilst, as a general rule, all the cells of old films show a remarkable change of form, large mycelium-like cells in ramified colonies being formed, yet the cells of *S. cerev.* I., *S. Past.* II., and *S. ellip.* II. in a young state show no mycelium-like colonies. *S. Past.* I. and III., and *S. ellip.* I., however, (13—15° C.) show very marked differences, and allow the various species to be easily distinguished. *S. Past.* II. and *S. Past.* III., which are both top fermentation forms, and the cells of which are very similar under ordinary conditions, show a marked difference at this temperature. Fig. 12 (p. 121) shows the various forms of the cells of the films of the six species at 13—15° C.

TABLE I.

ASCOSPORE FORMATION.

Temperature.	S. cerev. I. (Hansen.)	S. Past. I. (Hansen.)	S. Past. II. (Hansen.)	S. Past. III. (Hansen.)	S. ellip. I. (Hansen.)	S. ellip. II. (Hansen.)
37·5° C.	none	—	—	—	—	—
36—37	29 hours	—	—	—	—	—
35	25 ,,	—	—	—	—	none
33·5	23 ,,	—	—	—	none	31 hours
31·5	—	none	—	—	36 hours	23 ,,
30	20 ,,	30 hours	—	—	—	—
29	—	27 ,,	none	none	23 ,,	22 ,,
27·5	—	21 ,,	31 hours	35 hours	—	—
26·5	—	—	—	30 ,,	—	—
25	23 ,,	—	25 ,,	28 ,,	21 ,,	27 ,,
23	27 ,,	26 ,,	27 ,,	—	—	—
22	—	—	—	29 ,,	—	—
18	50 ,,	35 ,,	36 ,,	41 ,,	33 ,,	12 ,,
16·5	65 ,,	—	—	53 ,,	—	—
15	—	50 ,,	18 ,,	—	15 ,,	—
11—12	10 days	—	77 ,,	—	—	5·5 days
10	—	89 ,,	—	7 days	4·5 days	—
8·5	none	5 days	—	9 ,,	—	9 ,,
7	—	7 ,,	7 days	—	11 ,,	—
3—4	—	11 ,,	17 ,,	none	none	none
0·5	—	none	none	—	—	—

TABLE II.

FILM FORMATION.

Temperature.	S. cerv. I. (Hansen).	S. Past. I. (Hansen).	S. Past. II. (Hansen).	S. Past. III. (Hansen).	S. ellip. I. (Hansen).	S. ellip. II. (Hansen).
40° C...	—	—	—	—	—	none
36—38 ..	none	—	—	—	none	8—12 days
33—31 ..	9—18 days	none	none	none	8—12 days	3—4 ,,
26—28 ..	7—11 ,,	7—10 days	7—10 days	7—10 days	9—16 ,,	4—5 ,,
20—22 ..	7—10 ,,	8—15 ,,	8—15 ,,	9—12 ,,	10—17 ,,	4—6 ,,
13—15 ..	15—30 ,,	15—30 ,,	10—25 ,,	10—20 ,,	15—30 ,,	8—10 ,,
6—7 ..	2—3 months	1—2 months	1—2 months	1—2 months	2—3 months	1—2 months
3—5 ..	none	5—6 ,,	5—6 ,,	5—6 ,,	none	5—6 ,,
2—3 ..	—	none	none	none	—	none

show them very early. Table II. shows the temperatures and the length of time necessary for the formation of the films of each of the six species. At the high temperatures there is very little difference in the forms, excepting in the case of *S. cerev.* I. and *S. ellip.* II.; but the young films at lower temperatures

These are the principal scientific results obtained by Hansen in his researches on the morphology and physiology of pure cultivation yeasts. It is an open question how far these different yeasts can be considered to represent distinct species, since it is at present a moot point where the bounds can be drawn between species and varieties in the Saccharomycetes. On this account Hansen has preferred to give his yeasts the above distinguishing numerals instead of re-naming them, leaving this latter until more is known on the subject.

Jörgensen has recently published a book on "Die Micro-organismen der Garungsindustrie," in which he attempts a classification of the Saccharomyces. In this he sums up Hansen's six species as follows :—

Saccharomyces Cerevisiæ I.—A top-fermentation yeast, giving excellent results in practice ; used in the breweries of London and Edinburgh in an impure state ; develops ascospores at temperatures between 11—37° C. ; film formation at 13—15° C.—the predominant number of the cells resemble the original yeast (Fig. 12, *a*).

Fig. 11.—Ascospore Formation (after Hansen) × 1000.

1. *S. cerev.* I. 2. *S. Past.* I. 3. *S. Past.* II. 4. *S. Past.* III. 5. *S. ellip.* I. 6. *S. ellip.* II.

Saccharomyces Pastorianus I.—Gives a bitter flavour to beer ; develops ascospores at temperatures between 3° and 30·5° C. ; film formation at 13—15° C.—fairly numerous, strongly-developed mycelium-like colonies of very elongated sausage-shaped cells (Fig. 12 *b*).

Saccharomyces Pastorianus II.—Causes no disease in beer ; develops ascospores at temperatures between 3° and 28° C. ; film formation at 13—15° C.—oval and round cells predominant (Fig. 12, *c*).

Saccharomyces Pastorianus III.—Cause of yeast-turbidity in beer ; develops ascospores at temperatures between 8½° and 28° C. ; film formation at 13—15° C.—strongly-developed colonies of sausage or thread-shaped, mycelium-like cells (Fig. 12, *d*).

Saccharomyces Ellipsoideus I.—Yeast of grapes ; develops ascospores at temperatures between 7·5° and 31·5° C. ; film formation at 13—15° C.—greatly ramified and strongly-developed colonies of short and long cells ; ramifications often forked (Fig. 12, *e*).

Saccharomyces Ellipsoideus II.—Cause of yeast-turbidity in beer ; develops ascospores at temperatures between 8° and 34° C. ; film formation at 13—15° C.—resembles the ordinary form in a marked degree (Fig. 12, *f*).

In addition to these, various other yeast forms have been described by various observers—viz., *S. exiguus* (Reess), *S. minor* (Engel), *S. conglomeratus* (Reess), and so on, but they have not yet been put to the test of pure cultivation.

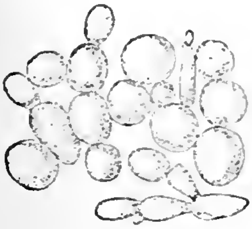

Fig. 12*a*.

Fig. 12*b*.

Fig. 12*c*.

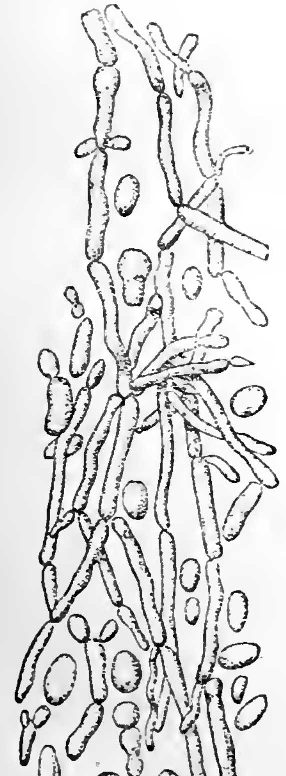

Fig. 12*d*.

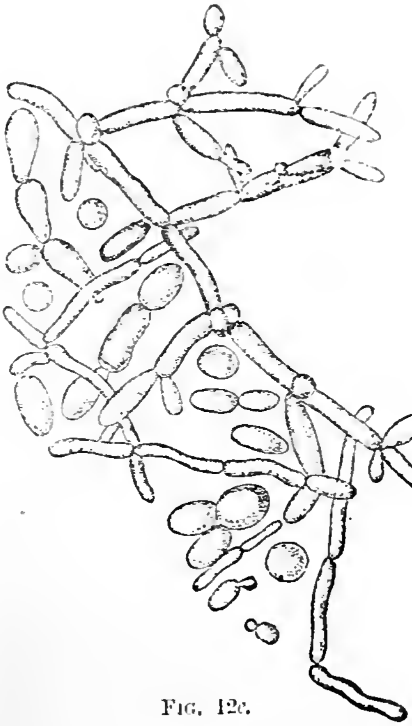

Fig. 12*e*.

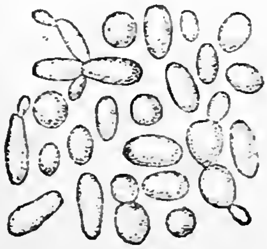

Fig. 12*f*.

There is another yeast form, to which I have alluded — viz., *Saccharomyces apiculatus*, which possesses great interest on account of its being the only alcoholic ferment whose cycle in nature has been exactly determined, and since it formed, as already stated, the starting-point in Hansen's researches on the yeasts. It lends itself especially to this purpose, since it has a peculiar shape which is possessed by no other yeast. It forms typical citron-shaped cells (shown in Fig. 13), which do not yield endogenous spores, and, therefore, correctly speaking, it does not belong to the genus Saccharomyces. The ferment is found upon all ripe succulent fruit, in the yeast of wine, and also in the spontaneously fermented Belgian beer. *S. apiculatus* is a bottom-ferment which is capable of setting up alcoholic fermentation in beer. The fermentation is, however, slight, only 1 per cent. alcohol being formed instead of 6 per cent.

formed by *S. cerevisæ* under similar conditions. The explanation of this is, that it does not ferment maltose, and does not secrete any invertase. In dextrose solutions it sets up a vigorous alcoholic fermentation. Microscopical examinations of ripe, succulent fruit in summer show that this ferment is present in considerable quantity in a healthy budding condition; on the unripe fruit, leaves, etc., it is not found, and no trace of the ferment can be found upon the plants in the winter. Hansen has, however, shown that the ferment hibernates in the earth under the trees, and in early summer is carried again into the air and on to the ripe fruit by the action of the wind and insects.

FIG. 13.

S. apiculatus compared with *S. cerev.* (after Hansen) × 950.

Now, what have been the practical results of this work of Hansen? I have already mentioned that pure cultivation yeast is in use at the Carlsberg breweries. In 1883 Hansen, having had occasion to study the causes of some cases of yeast-turbidity, came to the conclusion that the only real remedy for diseases of beer caused by "wild" yeast was to work in all cases with yeast which could be guaranteed free from these wild forms. This can only be done by Hansen's method of pure cultivation or some modification of this method.

Hansen* succeeded in isolating from the beer which was submitted to him, by the method I have described, three varieties of yeast—*Sacch. cerevisæ* (ordinary bottom-yeast, which constituted the greater portion), *Sacch. Pastorianus* III. (a form of bottom-yeast), and the *Sacch. ellipsoidens* II. (a form of top-yeast). Experiments carried out with the pure yeasts showed that fermentations with the *S. cerev.* gave a beer which was quite free from any form of disease, but that when either one or both of the other forms were also used in the proper proportions, the disease was set up. Further experiments showed that the yeast-turbidity was not caused if the two "wild" yeasts were not added until the end of the primary fermentation, and also that the disease did not show itself if *S. Past.* III., or *S. ellip.* II., formed 2·5 per cent. only of the yeast used for pitching, and when the fermentation was carried on in the fermenting cellar until the beer showed an attenuation of 6·7° Balling, and when the resulting beer was stored for at least three months. If, however, the attenuation was not run down so low as this, and the storage not continued so long, the disease showed itself with the above proportion of "wild" yeast.

The result of these experiments was that Hansen cultivated two varieties of bottom *S. cerev.*, for use in the Old Carlsberg Brewery, which are known as Nos. 1 and **2**. These yeasts, which, under the microscope, appear to the uninitiated to be identical, give very different results in practice.

No. 1 gives a beer well adapted for bottling, and containing less CO_2 than No. 2. The beer should remain bright in bottle for at least three weeks; it has also a lower attenuation than No. 2. This yeast is chiefly employed for home use.

No. 2 gives a good draught beer, containing more CO_2 than No. 1; it is not adapted for bottling, and is much preferred by German brewers to No. 1, and is, therefore, chiefly cultivated for export.

Now, a word as to the cultivation of pure yeast upon a sufficient scale to barm brewery vessels. I have shown you that it is comparatively easy with experience and a rigid adherence to the small precautionary details, to obtain a small quantity of pure yeast, but then the question arises—How are we to carry on the cultivation under conditions of purity until we have sufficient pure yeast for our fermenting-square? Well, at Carlsberg it is done by transferring the yeast from a small flask to a number of larger flasks, and when the growth of yeast is over, dividing the yeast in these between a still greater number of larger flasks, taking care, of course, to use all due precautions, as many as 50 1½ litre Pasteur's flasks being used for the last laboratory cultivation. This, however, only gives about 2 pounds of fairly thick yeast. It is then necessary to work with still larger vessels; this is done in the brewery, and as, fortunately for the Danish brewers, they are not hampered by any excise regulations in the breweries, they are able to arrange small fermenting rounds in such a way that they can collect in them sterilised wort, and after adding the yeast, lock the vessels up and adopt means to prevent air contamination.

The employment of these pure yeasts is coming very largely into use in the beer-drinking countries of the Continent, and some of the most noted brewing technologists have given it their support, notably Jacobsen, Aubry, Marz, Lintner, etc. The latter sums up the question in the following statements:—

1. By contamination with so-called "wild" yeasts, an otherwise normal brewery yeast can be rendered incapable of producing a beer of good flavour and with good keeping properties.
2. A contamination with "wild" yeasts may be produced by the dust of the air during summer and autumn, by the malt, or other sources.
3. By employing Hansen's method of pure cultivation and analysis, it is possible to obtain from a contaminated yeast a good brewery yeast in a state of purity.
4. Yeast cultivated in a state of purity possesses in a marked degree the properties of the original yeast before contamination, as far as concerns the degree of attenuation, the flavour, and keeping properties of the beer.
5. There exist different varieties of normal bottom yeasts *(S. cerevisæ)*, each with special properties, which like the peculiarities of species are maintained constant.

It must, however, be added that the method is not without its opponents, Delbrück and Hayduck, of Berlin, being the chief. These consider that yeast can be purified by cultivation in a saccharine solution of hops, and that all bottom yeast *(S. cerev.)* belongs to one species, the differences in behaviour which are noticed being merely transitory.

So far, all that has been done with pure yeast relates entirely to bottom yeast, with the exception of a few top-fermentation breweries on the Continent, particularly in Denmark, for which Jörgensen has cultivated a pure top yeast. Nothing has yet been done in England in this direction, although experiments upon an industrial scale are now being carried on at Burton-on-Trent with different species of pure yeast. We, however, in England labour under a variety of difficulties from which the Continental

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* Zeitschrift f. das gesammte Brauwesen, 1883, 177.

brewers are exempt, such as temperature of fermentation, conditions of storage and of consumption of the beer.

Sufficient has, however, already been done to prove that in ordinary brewery yeast we also possess a mixture from which, by Hansen's method, several varieties of *S. cerev.* can be separated, which cannot microscopically be distinguished from each other, but which, when used upon a practical scale, give entirely different results, both as to flavour, brightening, attenuation, and mode of separation of the yeast. Experiments have also shown that these characteristics can be maintained unimpaired throughout a very great many successive fermentations in the brewery.

With regard to the scientific aspect of the question, the pure cultivation of yeast opens up an immense field of work. Attention has already been drawn by Mr. Horace Brown and myself to the different behaviour of what are usually called "secondary" forms, to the various constituents of malt-wort; this is a question which can only be studied by means of pure cultivations of the various yeast forms, and I trust that before long we shall have something more to say on this subject. Then there is the question of the products of alcoholic fermentation; all the work which has been done on this subject by Pasteur and others requires to be repeated with pure yeast, for we cannot too strongly insist upon the fact that, although Pasteur's celebrated work paved the way for all that has been since done, and his methods of working for the prevention of outside contamination are still used, yet he had not the initial purity of his yeasts which we can now get. Any general condemnation of the value of Pasteur's work, such as has been recently passed upon it by certain German investigators, cannot be too strongly protested against, since his almost unrivalled accuracy of experiment and scientific method of work formed the basis on which all subsequent experiments have been based.

As instances of the value of investigations with pure yeast, I may quote the following recent researches:—

Borgmann* has lately shown how largely the use of pure yeast modifies the products of fermentation in one important particular. He has made analyses of a large number of ordinary lager beers, and finds that the proportion of alcohol to glycerin in these varies between a maximum of 100:5·497, and a minimum of 100:4·140; whilst analyses of pure Carlsberg beer, fermented with Nos. 1 and 2 yeasts, gave the proportion 100:2·63 for the former, and 100:3·24 for the latter.

Ordonneau † has shown also that a potato-spirit mash, when fermented with beer yeast, gives amongst the products isobutyl alcohol, whilst when fermented with *S. ellip.*, the natural ferment of wine and eau-de-vin, normal butyl alcohol is formed, and that the unpleasant flavour of artificial spirit is due to the former alcohol, fermentations of *S. ellip.* giving spirit with the pleasant aroma and flavour of natural cognac.

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The Fourth Meeting of the Fourth Session of this Section was held in the Rooms of the Chemical Laboratories of the University of Edinburgh, on Tuesday, February 1, 1887.

PROFESSOR CRUM BROWN, M.D., D.SC., F.R.S., IN THE CHAIR.

CHAIRMAN'S OPENING REMARKS.

Professor Crum Brown said he had much pleasure, on behalf of the Chemists of Edinburgh, in welcoming the Section there. He was sure that many of them knew the fact—and he thought it right to say it now—that they owed this meeting greatly to Mr. Irvine, whose zeal for the progress of the Society—not only in this part of Scotland, but for the Society generally—had induced him to move in this direction. When the proposition was at first mooted, a feeling seemed to exist that attempts of this kind were hazardous, but now that it had taken place he thought it would be admitted by all that the step was a right one. He hoped that the Society would find that they were able to have a good meeting in Edinburgh, and that by-and-bye they might see their way to have more regular and stated meetings in that city, as well as perhaps in other parts of Scotland.

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ON PARAFFIN SCALE TESTING.

BY D. A. SUTHERLAND, F.C.S.

The estimation of the percentage of impurities in paraffin scale of commerce is one of great monetary importance, and being to a certain extent merely an arbitrary or comparative test, is the cause of frequent disputes. At all times should the particular test be one agreed to by the parties concerned, and specified in the contract.

Somewhat recently I have had occasion to test a large number of samples. Despite every care in testing, in a room where the temperature can be maintained for a considerable time at 60° F., my results seldom agreed with those of the buyer—a contingency, however, not always inseparable from a falling market. That my results were accurate according to the method I used, was proved on repeated arbitration by the public analyst, whose method it was. But the buyers were still unsatisfied, and adhered to their own results.

The differences were not of 0·02 or 0·04 per cent., which would be of serious importance in the assay of pig iron for sulphur or phosphorus; but differences ranging from one to three per cent., which, on a valuable product like scale at £25 to £30 per ton, is of no little importance.

Acting on advice, I inquired into the methods of testing. No two appeared to me to use exactly the same test, but I proceeded to try them *seriatim* to ascertain the difference by the same operator. While doing this, it occurred to me, that as they are not all mentioned in any publication, it might be better if they saw the light, and that a timely discussion on their merits might result in the survival

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* Zeits. Anal. Chem., 25, 532; this Journal, 1887, 47.
† Compt. Rendu., 1886, 217.

of the fittest, or the evolution of a better. To make the point interesting to those who may not be familiar with the subject, I would briefly explain that the scale (hard scale) referred to, is obtained by cooling the heavy oils from petroleum or shale oil, filtration to separate the oil, and subsequent hydraulic pressure.

I have on the table a sample of paraffin scale as it comes from the press.

Scale is of value to the refiner and candlemaker, only for the wax it contains of a melting point higher than that of the ordinary temperature. Consequently he makes a claim upon each delivery for water and dirt contained, and for what he terms oil, which, however, consists mostly of soft paraffin held in solution.

The claim is generally allowed up to 6 per cent., being less in summer, or when weather is warm; and greater in winter time and cold weather, when the cooling power is greater, and a corresponding increase of soft paraffin is extracted.

The oil (so-called) is universally extracted by pressure, at 60° F., in a press provided with a plunger and cup, 5⅞in. diameter.

The powdered scale is placed between two circles of cloth, so many circles of filtering or blotting paper placed on each side, and the pressure applied.

Here, however, the analogy terminates, for different weights of substance are used, and different amounts and duration of pressure applied; in the case of the plunger and cup on the table by means of a screw with a cross-head lever, four feet long, in other cases by a spiral spring or by a long lever with a weight on the end. Of the melting point I do not propose to speak, though the results vary also according to the method used. Mr. A. H. Allen* has, in his very valuable book, given a description as complete as possible of the various methods.

Sampling.—I would like to say in passing that this, as in all tests, is most important. Scale is usually conveyed in tierces such as are used for sugar, and samples drawn two weeks or so after casks have been exposed to wet weather show at least a gain of one per cent of water.

Mr. Boverton Redwood has given the most valuable communication on the subject in his paper, read before this Society, "On the Determination of Oil in Scale,"† and I cannot do more than refer to his conclusive experiments given there, which prove that the amount of pressure is not of so much importance as the length of time it is applied, and that the temperature of the press and sample must be exactly 60° F.

He again refers to this point in his very comprehensive Cantor Lectures (1886) on "Petroleum and its Products," and gives some further experimental results.

Mr. A. H. Allen's work, already referred to, quotes Mr. Redwood, and gives two methods for water estimation.

The following processes are in use at present:—

METHODS BY DIRECT PRESSING OF SCALE.

I.—(*a*) 16grms. (250grs.) pressed (pressure of two men, one at each end of lever), at temperature of 60° Fah., with five circles each side for two minutes; removed, replaced with two circles each side, pressed for ten minutes. Loss = oil and portion of water (*a*).

(*b*) The pressed cake is dissolved in gasolene in a tared beaker, settled, decanted, washed with gasolene, the gasolene is almost entirely decanted after the last washing, and the remainder is evaporated at the ordinary temperature till the weight remains constant. Weight = water and dirt in pressed cake. Dried in water-bath, re-weighed. Loss = water, weight = dirt.

(*c*) Water and dirt in similar manner in 10grms. of original sample. Results expressed in percentage and calculated (*a*) + (*b*) − (*c*) = oil.

II.—*Oil:* (*a*) 32grms. (500grs.) pressed at 60° Fah. (nine tons pressure) between sufficiency of circles for five minutes. Loss = oil.‡

(*b*) *Water.*—25grms.§ maintained at 230° Fah. and stirred with a thermometer till weight constant, or done similar to III.

(*c*) *Dirt.*—Scale dissolved in petroleum spirit, filtered through tared filter, washed well with spirit.

METHODS WHERE WATER IS FIRST SEPARATED.

III.—Scale is melted in a 1000 grain graduated cylinder, and allowed to settle in warm water, scale decanted, residue shaken up with shale naphtha, settled, and percentage of water read off at 60° F.

IV.—1000grs. (64grms.) taken, melted and settled in beaker flask, decanted, residue washed with shale naphtha, and finally treated with gasolene as in I. (*b*). This method is used to check I. and III.

IV.—1 or 2lb. are heated in a copper still, vapours led through condenser, water collected in graduated cylinder. Dirt as in II. (*c*).

In III. and IV., oil is determined in scale poured off, and in V. in scale left in the still.

A sufficiency is poured into a tin dish, cooled directly by some operators, by others slowly in a water-bath overnight.

32grms. (500grs.) are taken and pressed as in II.

The latter methods are most frequently used, but the time of pressing is by no means the same, varying from 5 to 20 minutes.

It is claimed for them that some scales are "doughy" and will not bleed out the oil they contain, unless re-melted and allowed to cool slowly to ensure perfect crystallisation.

Differences of no less than 4 per cent. in oil alone between a sample done this way and one done by direct pressure have been quoted to me, though personally I have not had opportunity to prove this highly probable theory. In all cases I found little or no difference.

Method III. is very open to criticism; it is impossible to read in so wide a tube as is generally used nearer than 0·5 per cent. Moreover, it is held by Dr. Wallace, city analyst, Glasgow, that the insoluble may be bulky, and so be a source of error. He says, in a letter received by me this morning, "We have found the method of testing water by melting and settling very unreliable, when the percentage of water is small, and the insoluble bulky." Dr. Wallace had only received the abstract of my paper yesterday, and consequently had not time to say more.

Some experiments done with the same sample of scale by the different methods for water and dirt, showed rather lower results by method I. than by the others, due, no doubt, to partial evaporation in so small a quantity, a loss of 0·09grm. being equal to 0·9 per cent., while IV. and V. compared favourably with the tube method (in a narrow tube); the percentage of dirt in 20 samples only averaging 0·15 per cent.

The experiments done for per cent. of oil by the methods varied according to time of pressing, etc. 8000grs. also of a sample were melted, allowed to settle, and clear scale poured off to cool. The scale was used at leisure moments for various experiments. Portions of the sample were pressed for various lengths of time; the results were constant when the conditions were the same, three tests, at 5 minutes pressure, not differing by more than 0·2 per cent.; longer pressing or less scale used for test gave results which were analogous to those of Mr. Redwood,‖ and tended to show that the time, *five minutes*, laid down

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* Allen's "Coml. Organic Analysis," vol. ii.

† This Journal, 1884, p. 430 *et seq.*

‡ This Journ. 1884, p. 430.

§ Soc. Arts. Cantor Lectures, p. 57.

‖ This Journ. 1884, p. 431.

by him, after careful experiments and consideration, is the most just and fair.

Other experiments with samples maintained, previous to weighing, at 45°, 65°, and 70° F., showed similar results, showing attention must also be paid to the temperature of the sample.

Since receipt of Mr. Redwood's letters, I have added that experiments were also done with various qualities and quantities of absorbent paper; grey filter, botanical bibulous, and white blotting paper, all of which are in use. The results showed slight but distinct differences.

Experiments were made with circles of coarse and fine linen and cotton with like results.

What has to be settled then is—Which is the most accurate method of estimating the water and dirt? For the oil—Temperature of press and sample, length and approximate amount of pressure, amount of sample to be used, the number of circles of paper, the character of the cloths and paper.

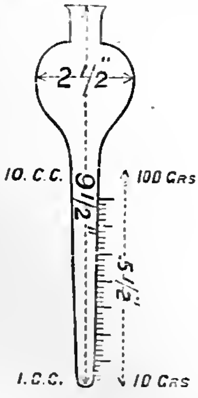
Until a universal method be adopted this test must remain unsatisfactory, and be the source of much friction between buyer and seller, who at present talk quite freely of the test of some one analyst being always 2 per cent. higher than that of another, or *vice versâ*.

It is my object *merely* to draw attention to this anomaly, and to the necessity for union and compromise on this point, so that a fixed process may be laid down for general adoption, which I trust will be done by those more qualified from knowledge and experience than myself.

At the same time I may be permitted to mention the process I have adapted from the foregoing till the uniform test be agreed on.

Water and Dirt.—Finding a very long 1000-grain tube troublesome to fill, I have had a tube made with a two-fold object—to save time in filling and melting, and to minimise error in reading of meniscus.

A tube with a top like that of a separator, wide mouth $\frac{3}{4}$in. diameter, neck 1in. long, bulb pear-shaped, terminating in small tube $\frac{3}{8}$in. diameter and 5 to 6in. long, graduated in $\frac{1}{10}$cc., or grains 1 to 100; the whole tube holding about 1500grs.*



64grms. (1000grs.) is weighed out, introduced into tube; tube being held by neck with burette clamp and immersed in water at 150° F. till scale melts and dirt is settled (it requires a little tapping). The bottom portion is solidified by immersion in cold water, and as much as possible of scale is poured off to cool; the residue shaken up with shale naphtha and allowed to settle, water read off at 60° F.

Oil.—Scale which is poured off into a vessel immersed in a larger basin with water at 130° F. is allowed to cool slowly; maintained at 60° some time before weighing.

32grms. (500grs.) pressed five minutes at 60° F. between two discs of fine linen, with five circles of grey filtering paper on each side.

In conclusion, I have to render my thanks to those from whom I obtained note of various processes. To Dr. Wallace for liberty to mention the first; and last, but not least, to Mr. Boverton Redwood, by whose courtesy and letters I have been much encouraged in the hope that the object of my paper may be achieved.

As the opinions and suggestions contained in Mr. Redwood's letters are of importance, I beg permission to read them in full:—

85, GRACECHURCH STREET,
LONDON, E.C.,
26th January, 1887.

D. A. SUTHERLAND, ESQ.,
THE BURNTISLAND OIL CO., LIMITED,
BURNTISLAND

DEAR SIR,—I have carefully read the notes for your proposed paper, and am of opinion that the information you are in a position to convey will be of practical value, if only as showing the necessity for the adoption of some generally accepted method of operating.

(1.) As regards the *Determination of Water.*—The paraffin scale submitted to me is principally American. This scale usually contains less than 1 per cent. water, and I find that the method of assay which gives me the best results is to melt 25grms. in a tared hemispherical glass dish, and maintain it at a temperature of 230° F., with constant stirring (with the thermometer) until the weight is constant—the cessation of the crackling sound is a guide. When the quantity of water is considerable this method is tedious, and loss of scale by spurting *may* occur unless great care is exercised. In such cases I treat the scale with petroleum spirit and determine the water by measurement (in the way you describe), converting volume into weight in working out the percentage. It is important that the petroleum spirit used should previously have been caused to take up as much water as it will at the temperature of the experiment, otherwise there will be loss of water by solution in the spirit.

(2.) *Determination of Dirt.*—I prefer to get the dirt on a tared filter, where it can be washed with petroleum spirit (after the bulk of the scale has been removed by solution in the spirit).

Occasionally, however, it is more convenient to weigh the dirt in a tared dish or beaker.

(3.) *Determination of Oils.*—This stands upon a somewhat different footing, for it is necessarily a *purely arbitrary test*, the results depending entirely upon the manner in which the operation of testing is carried out—there being, of course, no natural or defined line of demarcation between the liquid and the semi-solid hydrocarbons present. I see you are acquainted with my method as described by me in the *Journal of Soc. Chem. Industry*. I do not know whether you have seen the further reference I made in my Cantor Lectures. I therefore send you a copy for perusal, in which, at pp. 56 and 57, you will find the remarks in question. These are chiefly interesting from what I previously stated in the Journal, that amount of pressure is of small importance compared with temperature.

I see you consider that the number of discs of absorbent paper should be specified, but would it not be equally necessary to specify the character (thickness, etc.) of the paper? It is my practice to employ so many papers that the outer ones are scarcely stained with oil, and I think you will find the results strictly comparative if this principle is carried out.

I note you have experienced difficulty in maintaining a temperature of 60° F. in pressing. You will find it a great advantage to adopt my present plan of having the plunger and cup of massive construction and detached from the bed-plate, etc., so that they can be cooled in water at 60°. They are provided with mercury cups and delicate thermometers.

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* Messrs. Baird & Tatlock, 100 Sauchiehall Street, Glasgow, will supply these tubes.

There is no doubt that scale of a "doughy" character does not part with its oil with facility, but the process of slow cooling is now so generally adopted in refineries that it is comparatively rare to find scale marketed that is not fairly crystalline. I have had to write this letter very hurriedly, but I hope I have dealt with the points on which you wished for my views. I trust that your laudable efforts to place the subject upon a more satisfactory footing may be crowned with success.—Yours truly,
BOVERTON REDWOOD.

30th January, 1887.

DEAR SIR,—I am in receipt of your letter of yesterday's date, and enclose samples of the cloth and paper I use. These we cut with a steel die in the press, substituting the die and a hard wood block for the press-cup and plunger. Thus a considerable number can be cut of uniform size at one operation. You will find this method (perhaps you already adopt it) a great convenience. I do not think I have ever referred to it in print.

I forgot to say that the edge of the cup in which the scale is pressed is separate from the bottom, so that it can be lifted off. The "cake" is thus readily removed whole.

You are at liberty to make any use you like of the very hurried remarks contained in this and my previous letter.—Yours truly,
BOVERTON REDWOOD.

ADDENDUM.

Since reading the foregoing paper I have, by the kindness of Mr. Beilby, received a copy of an extract from the minutes of the Scottish Mineral Oil Association, dated August 13, 1884.

It consists of the report of an influential committee of oilworks managers who had been appointed to fully consider and discuss the subject. After unanimously recommending Mr. McCutchon's press, they gave the following recommendations :—

"1. That the quantity to be tested be 250 grains.

2. That the scale be freed from dirt and water by melting and settling, and the above-named quantity (250 grains) of the melted paraffin weighed and run into a mould, and thereafter cooled in water to 60° Fahr.

3. That the paraffin which is being tested remain under pressure for a period of 15 minutes.

4. That linen pressing cloths and a number of filter papers sufficient to absorb the oil (not less than six) be used.

5. That the maximum pressure be 10cwts. per square inch, and the working pressure 9cwts. per square inch."

Water and dirt estimation is not referred to. I am glad to be able to include these recommendations before the discussion, as they are a most valuable addition, being the result of no little investigation and discussion ; they are on the same lines as those laid down in the paper.

It is a matter of regret that the labours of the Association should not have resulted in the adoption of one standard commercial method.

It remains for all members of this widely representative Society interested in the subject to see that a final settlement is now arrived at.

DISCUSSION.

It was agreed to postpone the discussion on this paper.

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ON THE EMPLOYMENT OF "AGALITE" IN THE MANUFACTURE OF PAPER.

BY W. IVISON MACADAM, F.I.C., F.C.S.,
Professor of Chemistry, New Veterinary College, Edinburgh.

IT is well known that in the manufacture of paper there is frequently employed, besides the actual fibre, a quantity of material intended to weight the finished product, and, at the same time, enable the manufacturer to sell the article at a lower rate than would be otherwise possible were it necessary to send out only vegetable fibre.

For this "filling" or "weighting" many substances have been suggested and tried with more or less success. We may mention barytes or heavy spar or barium sulphate, stucco, kaolin or China clay, waste bleach (practically stucco), etc. Barytes being very heavy gives weight, but the great difference in specific gravity between the paper pulp and the barytes renders it very difficult to keep the bodies sufficiently mixed when the stuff is passing to the machine. Stucco and waste bleach are too coherent, and do not sufficiently intermingle with the pulp. With kaolin, which is the usually-employed substance, the difficulty arises that whilst the pulp and China clay are readily mixed, yet the substance is not retained sufficiently by the pulp, and passes into the effluent water, not only causing a loss of the China clay, but seriously aiding in the pollution of the waste waters, and therefore requiring to be removed from the liquids before these are allowed to pass into water courses. The above remarks would also apply to the effluent waters from works where cheap linen and cotton goods are finished and weighted.

The American printing and other papers are known for their beautiful surface and gloss, and many attempts have been made in this country to obtain a similar surface. The usual method of hot-pressing has not been found equal to the task, although much has been done in that way.

On examination of the ashes left on incinerating various portions of American paper, it is found that the loading material is of a fibrous character, and altogether different from the ashes obtained from the home-manufactured articles. The chemical analysis of the American paper ashes show them to consist of a silicate of magnesia, and the material used for loading is not, therefore, China clay, which is practically a silicate of alumina.

The material is a fibrous steatite found in large quantities in America. It is of a white colour, with a very slight tinge of green. It is somewhat readily reduced to a powder, the particles composing which are fibres. The specific gravity of the mineral is from 2·5 to 2·2, while the gravity of kaolin runs from 2·4 to 2·6.

The fibrous character of the agalite renders it possible to employ a larger gravity of the material with paper pulp than in the case of China clay, which, having no fibrous character, tends to weaken the manufactured article more than the agalite does.

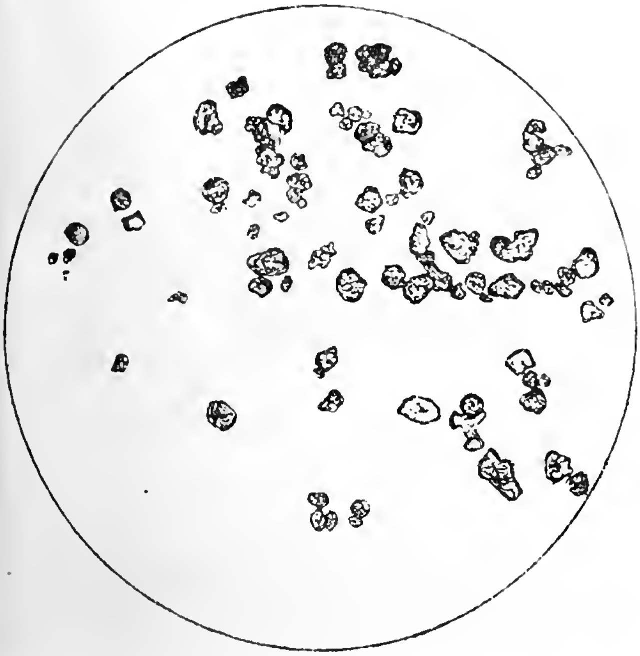
A series of experiments were made with linen rag pulp and the agalite, and with the same pulp mixed with China clay. The results are given below :—

Specific gravity of paper pulp (water 1000)	1012·94
Specific gravity of agalite	2·220 to 2·562
,, ,, of China clay	2·4 to 2·6

ANALYSIS OF PAPER PULP.

Water	96·58
Fibre	3·35
Ash	0·07
	100·00

A given quantity of pulp was placed upon metallic gauze of the size employed in the paper machine ; a second piece of gauze was then put over the pulp, the wires were surrounded by sheets of filter paper, and the whole transferred to the press. After fifteen minutes the materials were removed from the press, fresh blotting paper substituted in place of the now wet pieces, and the substance was again placed in the press. After ten minutes the material was removed,



CHINA CLAY.

Magnified 150 Diameters.

PRECIPITATED CARBONATE OF LIME.

Magnified 150 Diameters.

AGALITE "A."

Magnified 150 Diameters.

AGALITE "B."

Magnified 150 Diameters.

the paper formed taken from between the wires and dried in the water oven till it ceased to lose weight. This process was repeated with the addition of 25 per cent. of China clay, with 25 per cent. of agalite, finer quality, and with 25 per cent. of coarser quality of agalite. The results obtained were :—

1. 1000 of paper pulp containing 33·5 grains of dry fibre yielded of dry paper 28·615 grains. In this experiment, made without the addition of any loading material, the actual loss of fibre was 4·885 grains per 1000, or 0·4885 per cent.

2. 1000 of paper pulp mixed with 25 per cent. (calculated on the dry fibre) of China clay yielded 38·170 grains of dry material, of which 32·9 was fibre and 5·27 clay. The theoretical quantities present in the materials experimented with were : Of dry fibre 33·5

grains, and of clay 13·2 grains. The loss sustained in converting the mixture into paper was equal to 0·51 grains of fibre and 7·93 grains of China clay, or to 0·051 per cent. of fibre and 63·6 per cent. of the clay used.

3. With 1000 of pulp and 25 per cent. of the finer ground agalite the results obtained were: Of dry material 45·63 grains, composed of 33·31 grains of fibre and 12·32 grains of the agalite, or an actual loss of fibre equal to 0·19 grains and of agalite 0·88 grains. These figures are equal to 0·019 per cent. of the pulp and 6·04 per cent. of the mineral used.

4. A test similar to No. 3, but made with a less finely ground sample of agalite, gave a total of 45·96 grains of dry substance, composed of 33·42 grains of paper fibre and 12·54 grains of mineral. The loss in this experiment was equal to 0·080 grains of fibre and 0·66 grains of agalite, or 0·008 per cent. of fibre and 5·28 per cent. of agalite.

These results therefore show that there is a decided advantage in substituting agalite for China clay, because not only is there an increase of dry paper, but such is obtained by a saving of fibre, as well as a decrease of the waste in the actual loading material, and a lessened amount of polluting matter to be dealt with. Moreover, the fibrous character of the agalite causes it to yield a paper of higher class quality than is the case with China clay. The extra gloss which it is possible to obtain with papers containing agalite is shown in various American journals and books.

The substance has been stated to be a silicate of magnesia, and to resemble asbestos in character. The actual results of the analysis of the mineral are given below:—

CHEMICAL COMPOSITION OF AGALITE AND KAOLIN.

	Agalite.
Silica	62·077
Magnesia	33·126
Water	4·286
Ferrous oxide	0·101
Aluminic	0·313
Undetermined and loss	0·094
	100·000

	Kaolin.	
Silica	61·02	49·65
Aluminic oxide	28·61	45·24
Ferric	1·96	0·31
Calcic	2·36	1·53
Magnesic	0·45	0·52
Potassic Sodic	1·76	0·78
Water and loss	3·81	1·91
	100·00	100·00

The samples which I have the honour of submitting to the Section have been kindly supplied by Messrs. A. B. Fleming & Co., Granton.

DISCUSSION.

Mr. Todd said that American paper had certainly a superior gloss, but that was the case, in his opinion, long before agalite was used, although Mr. Macadam was perfectly right in saying that agalite produced a fine skin. He pointed out, also, that in using vegetable fibre it was absolutely necessary to add China clay, as the paper would not print without it, and there were certain classes of paper, such as those used for printing with many colours, in which as high as 30 per cent. was used, as it was necessary to give it a genuine good dose, and while admitting that agalite was a very good thing, he knew the Americans produced the fine gloss on their paper from a different cause to that indicated by Mr. Macadam.

Mr. Macadam, in reply, said that it would be generally admitted that the Americans produced superior paper to ours, and in American Government contracts it was specially specified that azalite was to be employed because it gave a better gloss to the paper. He pointed out also, that if it was desirous to fill up the pores of the paper, he would do so by taking a fibrous rather than a non-fibrous material. Replying to a further question of Mr. Todd's as to what the loss would be on 100 grains of azalite if burned in a crucible, Mr. Macadam stated that the loss (which was practically water) would be 3·42 per cent.

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ON THE OCCURRENCE OF PETROLEUM IN A SHALE MINE AT BROXBURN.

BY D. R. STEUART, F.C.S., F.I.C.

Although the existence of petroleum in this country is by no means rare, with the exception of the so-called oil spring at Alfreton, in Derbyshire, utilised by the late Mr. Young and his partner, Mr. Meldrum, its occurrence has been considered more as a natural curiosity than of any practical importance or commercial value.

Sample Broxburn Petroleum.—In 1884 indications of the existence of petroleum were discovered at Broxburn (one of the centres of the shale oil trade of Scotland) when boring for shale to the north-east of that village. At about 100 fathoms the rods came up coated with petroleum of a semi-solid consistency. The sp. gr. of this oil was 0·842 and it assumed the consistency of butter (or it "set") at 75° F.

In the Sandhole pit, about 950 yards westward from the above-mentioned bore, petroleum was found in some quantity. This pit was sunk through the Broxburn and Dunnet shales to a depth of 10 fathoms below the latter; total depth, 155 fathoms—where a level mine was cut through strata which gave a constant ooze of oil and brine, while there was a strong odour of gas.

The sp. gr. of the petroleum obtained in this level is 0·830; the setting, or solidifying point, 61° F., and the colour is brown by transmitted, and green by reflected light.

Refined in the usual manner, it gave:—

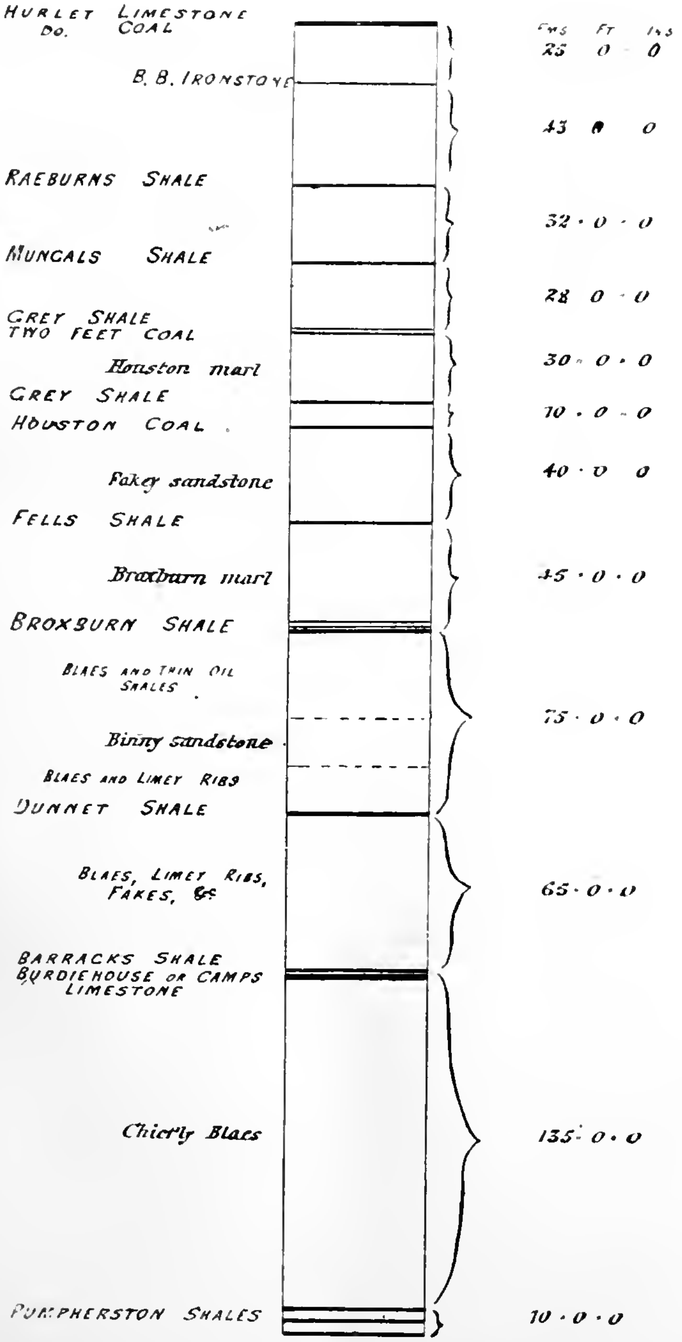
	Sp. Gr.	Per Cent.
Light naphtha	0·700	5·0
,,	0·730	5·2
Burning Oil	0·802	34·1
Intermediate Oil	0·840	10·5
Lubricating Oil	0·865	16·7
Paraffin Scale (melting pt. 103° F.)	—	12·5
Loss in refining	—	16·0
		100·0

The bromine-absorption, which indicates the proportion of olefines present, is much less than usual, as the following figures will show. Comparing refined burning oils, the bromine absorbed is: Baku, 0 per cent.; Broxburn petroleum, 6·5 per cent.; American petroleum, 11 per cent.; Broxburn shale oil, 40 per cent.

The brine which accompanies the petroleum has a sp. gr. of 1·095 (that of sea-water being 1·025) and gives 11,000 grains or 25oz. of solid matter in one imperial gallon, or 14·4 per cent. The salts present are chlorides of sodium, potassium, calcium, and magnesium, with traces of ferric chloride. Chloride of ammonium is present in amount equal to 0·01lb. per gallon.

In the Broxburn district combustible gas is given off from bore holes in considerable quantity. One at "Sandhole" blew about every minute. A bore hole at Middleton Gate (about a mile south-west), put down sixteen years ago, regularly, once a month, blew off gas for a day or two at a time. This intermittent discharge continued for many years. When lighted, the gas burned with a brilliant flame, about 20ft. in height, which was seen from a great distance. The discharge is now less frequent; occurring only at intervals of several months, and when the barometer is very low.

GENERAL SECTION OF THE BROXBURN DISTRICT



Of course the discharge of gas is a common enough thing from bore holes; but the association of brine, gas, and petroleum at Broxburn is of interest, as these are associated in other parts of the world.

The portion of the mineral field at Broxburn containing this natural petroleum is of considerable extent, and doubtless would yield sufficient oil to make it profitable to pump, if it would only flow. It, however, contains too much paraffin, and is semi-solid at a temperature below 61° F.; a simple, but fatal objection to this oil supply ever becoming of practical value or importance.

DISCUSSION.

The discussion on this paper was postponed owing to the absence of the author.

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EGYPTIAN PETROLEUM.

BY ROBERT IRVINE, F.C.S., F.R.S.E.

This oil, which is obtained both from superficial wells and deep bores, is found in the neighbourhood of Gemsah and Gebel el Zeit, a district in which crude oil has for some time been known to exist. The crude oil is of a dark brown colour, and has a disagreeable odour, owing to the presence of sulphur compounds, in this respect resembling the inferior qualities of Canadian and Italian petroleum. Its specific gravity is 0·934 at 60° F., and it is of a thick viscous nature, retaining its fluidity at low temperatures, owing to the almost entire absence of solid paraffin. Purified in the same manner as other natural oils, and those obtained by the distillation of coal and shale, it yields a product ranging in gravity from 0·850 to 0·950 (burning oil, such as is used for household purposes, being absent). On washing with sulphuric acid previous to distillation, the loss sustained exceeds 50 per cent., which is more than double the amount as compared with ordinary petroleum and shale oils. This loss, coupled with the expense of chemicals required for its purification, and the absence of burning oil (ordinarily so-called), puts it beyond the chance of being profitably purified; whilst, on the other hand, its heavy, viscous character, or body, and its non-liability to "set," give it a high place as a lubricant, as also make it suitable as a substitute for coal in steam-raising, in locomotive and other boilers. Gemsah, or Gebel el Zeit, is about 400 miles from Suez, on the western side of the Straits of Jubal, at the entrance to the Gulf of Suez; and this oil is said to be found in calcareous strata, in structure resembling coral. The amount of basic impurities present suggest that it is the product of decomposed animal matter.

Captain Roberts, from whom I obtained the oil, writes under date 24th January:—"The latest information I have is that one boring has reached 400ft., and at that depth coral, and, lastly, stiff clay, have been reached, and that they hope to find petroleum below this clay. About 50 casks of a very dark substance, called petroleum, were recently sent to Cairo. The crude oil is used successfully in lubricating the machinery of and in raising steam in a repairing establishment the Egyptian Government have at Suez. Two local steamers also use the crude petroleum for their engine bearings."

DISCUSSION.

Mr. Hamilton said he had also obtained a sample of Egyptian petroleum, but his results were somewhat different. The oil, of course, was very heavy, and totally unsuitable for use as a burning oil; on the other hand, the lubricating oil was the most magnificent he had ever seen for what was known as viscosity and lubricating purposes, while the loss in treatment was very little.

Mr. Harris: What was the proportion of the 0·930 lubricating oil in the Egyptian oil?

Mr. Hamilton: 45 to 50 per cent.

Mr. Laing said that he had received from the Egyptian Government two gallons of petroleum, both of which he distilled with steam and without steam. He got a considerable percentage of lubricating oil—about 70 per cent. in both cases—although the sample distilled with steam purified more readily than that distilled without it.

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ADJUSTABLE THERMOMETERS.

BY ANDREW HADDOW.

All users of thermometers may not be aware that these instruments undergo a gradual change for some time after their manufacture, and that although possibly quite correct when they left the makers' hands, they may indicate a much higher temperature than what is correct in a year or two, the increment of change being less as the thermometer becomes older.

This change of zero was first noted by M. Flaugergues in 1822.*

Dr. Joule found the change going on during twenty-six years.†

Despretz tested the rise during five years, the curve formed being sensibly a parabola.‡

The writer has found the rise of zero in thermometers from two to five years old to be from 2 to 2½ degrees.

The rise of zero appears to be due entirely to molecular changes in the glass, because it goes on even when the tube is not sealed, and, consequently, when there is no greater pressure outside than inside.

A method for hastening the change of zero, by keeping the thermometer tubes at a high temperature for some time before graduating, is described in the *American Chem. Jour.* for 1884.§ Besides this permanent rise of zero, there are temporary rises and falls due to immersing the thermometer in very cold or very hot liquids.‖ These temporary errors disappear in from ten to fourteen days.¶

In some operations—for instance, in the manufacture of ice—2½° would represent 50 per cent. of the whole power of the machine, while in brewing operations (where really good beers are brewed) every fraction of a degree has an important influence on the final product. Standard thermometers from Kew Observatory may be used, but these are very costly, easily broken and difficult to read, the figures being on a glass tube instead of on a separate scale.

In practice it is usual to make allowance for the error of the thermometer, but this is a very dangerous practice from the liability to make the allowance on the wrong side, thus doubling the error. For instance, a workman is told to cool down a liquid to 60°, and he learns that his thermometer reads a degree too high; he then makes up his mind that he will read the thermometer a degree lower than 60°, the result being that he cools the liquid 2° too low—namely, to 58°.

The only way that can be depended on for accurate work is to use practically correct thermometers, or in some operations, thermometers which at least all agree with one another. A thermometer which can be adjusted for error fulfils all that is required in practice, and the writer has patented the construction of thermometers in which the tube is fastened at one end to a separate piece, sliding in the

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* Ann. de Chimie et de Physique, xxi, p. 333 (1822).

† Phil. Soc. of Manchester, Feb. 22, 1870.

‡ "Watt's Dict. of Chem." p. 767.

§ This Journal, March, 1885.

‖ "Watts' Dict. of Chem." p. 767.

¶ Balfour Stewart's "Treatise on Heat," p. 15 (1866).

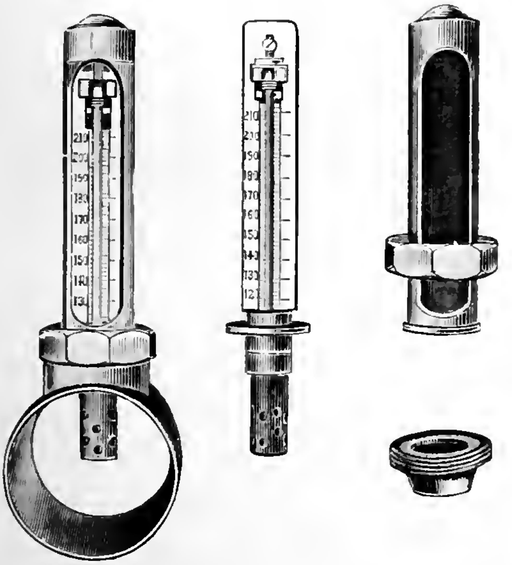
scale, by means of which any user of thermometers can at once adjust them to agree with a standard, or with one another.

In the manufacture of these thermometers, tubes must be rejected when the difference in length between 10° at one part of the scale and 10° at another part of the scale, is more than half a degree. With this amount of difference, and a rise of zero equal to 2°, the adjustment allows of the greatest error at the extreme ends of the scale being reduced to one twentieth of a degree, which error gradually diminishes until it vanishes at the centre of the scale. This amount of error is of course quite inappreciable in manufacturers' thermometers.

For scientific work the tubes must be more carefully selected, and as old as possible.

The patent pipe thermometers remove several inconveniences felt by users of this class of thermometers.

In the prevailing design there is an internally screwed socket soldered into the pipe, the contents of which it is desired to test, and the thermometer has a screw formed on it which should fit the socket, but it often happens, when a new thermometer has to be screwed into an old socket, that the two do not fit, also when one of these thermometers is screwed in tight it may be facing in the opposite direction to what is desired, if slackened back leakage occurs, and if tightened up further the case is liable to be broken, or the screw overhauled.



In my patent thermometer these two difficulties are overcome by attaching the thermometer to the socket by means of a flange instead of a screw. The screwed socket and the nut form a part of the case, and remain together when the thermometer is removed. The flange allows the thermometer to be set facing in any desired direction, and tightened in that position to any desired degree. The other improvements refer to strengthening the case, and lessening the chance of leakage past the glass tube.

Professor Crum Brown, in moving a vote of thanks to the authors of the papers, hoped that the success which had attended the first meeting of the Section in Edinburgh would induce them to renew the experiment before long, and would increase the membership and the interest of members in the work of the Society.

On the motion of Mr. Stanford, a very hearty vote of thanks was awarded to the Chairman for his kindness in placing the rooms of the new Chemical Laboratories of Edinburgh University at the disposal of the Section.

Nottingham Section.

Chairman : Prof. Clowes.
Vice-Chairman : Lewis T. Wright.
Treasurer : J. B. Coleman.

Committee :

L. Archbutt.
W. A. Curry.
H. Doidge.
R. Fitzhugh.
E. Francis.
T. W. Lovibond.
H. J. Staples.
E. B. Truman.
R. L. Whiteley.

Hon. Local Secretary :
J. R. Ashwell, Midanbury Lodge, Bentinck Road, Nottingham.

At an early date, "Water Softening," by J. B. Coleman.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

CHROMIUM MORDANTS.

BY R. LLOYD WHITELEY, F.C.S.,

Lecturer on Dyeing, etc., University College, Nottingham.

Chromium was first discovered by Vauquelin in the year 1797, but bichromate of potash does not appear to have been used as a mordant for cotton till 1820, by Koechlin, nor as a wool mordant till about 1840, whilst it was not introduced into this neighbourhood (at Loughborough) till 1850.

Bichromate of potash, or "bi-chrome," is not only used for its own sake as a mordant, but also as the starting point for many other chromium compounds. It is, perhaps, hardly necessary to mention the fact that chromium can play the part of an acidulous as well as a basilous radical. "Bi-chrome" is an example of the former, and in thinking about its use as a mordant, I was led to try to throw some light on its action, more particularly in wool dyeing; viz., to ascertain whether at the end of the mordanting operation it were still present as "bi-chrome," as chromic hydrate, or in some intermediate stage of oxidation. At the same time I wished to ascertain the influence of temperature, both on the mordanting and dyeing processes, as well as to notice the effect of different states of dilution.

A very general idea has been that when wool was boiled with "bi-chrome" only, a deposition of chromic hydrate took place upon the fibre; but the wool mordanted in this manner does not appear green, as it would do if there were green hydrated oxide deposited. That being so, the most natural explanation is that the chromate simply soaks into the body of the fibre. That this is so is shown by sulphurous acid giving to a mordanted pattern a *green* colour. The wool used had been mordanted in a strong "bi-chrome" bath, being put in cold and heated up to the boil, the total time of immersion being an hour-and-a-half. It was then carefully washed with distilled water till the wash-waters gave no trace of chromic acid, so that the greenish hue produced by the reduction could not be merely a surface colouration. A portion of this wool was also taken and immersed in a solution of silver nitrate, and after a little standing a reddish brown colouration of the wool took place, which was, no doubt, due to the formation of silver chromate. After this the remainder of the wool was allowed to stand in distilled water for a week, and at the end of that time the water showed distinctly the presence of a chromate, which had evidently diffused into it from the wool fibre. The wool itself could still be turned brown by silver nitrate, as well as give a decided yellow with a solution of lead acetate and acetic acid. It was, therefore, once again washed till the washwater showed no traces of chromate, and it was once more allowed to remain in water for a week. At the end of this time the liquor and wool were again examined, with the result that chromic acid was found in both; but, after rewashing at the end of another week, the wool retained its power of dyeing yellow in lead acetate, whilst the diffusion back of the chromate, with the liquor, seemed to have ended.

Besides these tests showing the presence of a chromate in the wool, the original liquor was carefully tested for chromium in the state of a chromic salt, but not the slightest trace could be detected. This experiment was performed with an exceptionally large amount of "bichrome" in the bath, so as to obtain, if possible, a clear result. These results seem to show, that when wool is mordanted with bichrome alone, *no reduction* takes place. In order to confirm this the experiment was repeated and another was carried out with acid in the bath. It was found that when acid was absent, both the liquor and mordanted pattern gave the same re-actions as in the previous trial; whilst in the other case, in which sulphuric acid was used in the bath in the proportion of 1 molecule of acid to 1 molecule of bichrome, a mordanted pattern was obtained, which bore a distinct green tinge, the liquor gave a precipitate with dilute ammonia, and also showed the presence of unchanged chromate. It is, therefore, evident that in this case we have both acid and hydroxide on the fibre. I noticed, too, that the pattern mordanted with bichrome only was much more easily washed free from reagent externally than the other, as if in the latter case the action had been such as to render it more sponge-like in texture, or else to thoroughly loosen the imbrications of the fibres by the oxidation of adhering fat. After this I planned a somewhat lengthy series of experiments, with the view of trying the influence of different temperatures on the mordanting operation, both when the bichrome was used alone, and also when assisted by sulphuric acid. I also intended to analyse the liquids, so as to ascertain the change which had taken place in their composition. The part relating to chrome alone I carried out as far as testing the influence of temperature, but I shall have to adopt different apparatus in which to mordant so as to obtain accurate comparative analytical results, though with the apparatus used the analytical results would seem to show that it is a question of absorption unchanged into the fibre.

To easily obtain accurate comparative results as to the amount of chromic acid remaining, it will be necessary to use a liquor of accurately known strength for mordanting, and perform the operation in a vessel provided with an inverted condenser. With regard to temperature you will see that the trials have yielded some interesting and instructive results.

I took six sets of six patterns each. In each set every pattern was numbered with the same number. These sets were mordanted in a liquid which contained bichrome in the relation of 3 per cent. of their weight; the sets were all entered cold and heated up to 50°, 60°, 70°, 80°, 90° and 100° C. respectively as quickly as possible, and mordanted for a total period of an hour-and-a-half. These sets, after being washed, were redistributed into six new sets, in such a fashion that each pattern in each set was mordanted at a different temperature, and these sets in their turn were dyed in a bath of logwood liquor, at the temperatures 50°, 60°, 70°, 80°, 90° and 100° C. respectively. The results, when arranged in order, show a distinct convergence of colour towards the pattern which was both mordanted and dyed at the boiling point. In every case the pattern mordanted at the highest temperature gives the best result.

This is an important result, since it shows that a dyer does not get his best result (in the case of logwood) unless he both mordants and dyes at the boil, and that in any case mordanting at the boil gives the best result with "bi-chrome." It was also noticed that no dyeing action took place till about 40—50° C. The corresponding trials with acid in the bath I have not yet been able to carry out.

Coming next to the question of dilution. Does a greater or less amount of dilution affect the final result, or is it merely a question of the actual amount of salt in the bath? Siebold (this Journal, 266, 1885) says that it practically does not matter about dilution, the ratio between wool and mordant being the main point. I have not carried out his experiments afresh, but those I have made go to prove that both the increase and decrease of strength have an effect similar to that of the use of larger or smaller quantities of the chromate; and if the wool possesses little or no preferential affinity for the bichromate this is what might be expected.

When we come to the use of bi-chrome and acid together, this fact is still more strikingly shown, and it is easy by mere concentration to overchrome the pattern. For instance, whilst 10grms. of wool mordanted with 3 per cent. of its weight of bichromate, and 1 per cent. of sulphuric acid in 1200cc. of water, gives a good colour, the same amount of mordant in 600cc. produces an overchromed pattern. These results were obtained under strictly comparable conditions.

The practical bearing of these experiments is therefore to emphasise the influence of temperature on dyeing results, and also to show that dilution *does* require to be taken into account in determining the percentage of mordant to be used.

What, then, is the best way of using "bi-chrome"? Experiment has shown that about 3 per cent. of the salt (compared with the weight of the wool) is sufficient, under ordinary circumstances, to give a good blue-black; but the addition of 1 per cent. of strong sulphuric acid improves the result; the reaction which occurs probably being represented by the following equation:—$K_2Cr_2O_7 + H_2SO_4 = K_2SO_4 + 2H_2CrO_4$, since the proportions used are such as to satisfy its requirements.

It must be noted that this proportion of acid does not always hold good; many circumstances will affect it—*e.g.*, very hard water; or, again, whilst it might be perfectly right for logwood, it very possibly might not be suitable to its extract. The presence of easily reducible substances in the extract may even do away with the necessity of adding sulphuric acid; in fact, may make its presence an evil. You will, therefore, see that the practice of every dyer should be governed by his special conditions, which may be carefully ascertained by experiment, and worked from accordingly. Besides sulphuric acid, tartar is employed so as to bring about similar results. Its action is questionable. It may act by neutralising the potash and liberating chromic acid; but, probably, whether it does so or not, it also acts the part of a reducing agent, and so helps the precipitation of the hydrate on the fibre. This idea is supported by the fact that it gives bluer shades than those produced by H_2SO_4, and also by the known fact that oxalic, tartaric and citric acids all convert soluble chromates into green solutions of chromium salts with evolution of CO_2, and that alcohol and sugar in presence of an acid will also do the same (Gmelin). It becomes then a question whether the expensive tartar may not be replaced by cheaper materials, such as treacle, glucose, etc., and so obtain like results at a much cheaper rate.

For certain classes of blacks the addition of a small amount of copperas to the bath gives a very good result; it has the effect of slightly reddening the black, and probably will counteract the tendency which chrome blacks have of turning green; but in the hosiery trade such a black is of no use. Copper sulphate, on the other hand, has almost the opposite effect; and it is possible that about a quarter per cent. of each would produce a black which would not show such greening tendencies.

Turning next to the use of chromium salts. These, more especially chrome alum, if used at all, do not find a very extended use in the wool-dyeing industry. Neither the alum nor the sulphate yield the hydrated oxide in sufficient quantity to produce deep shades. The ease with which the bichromate can be used, will stand in the way of any development of their use on wool, especially as, in the case of the chrome and acid, there is little doubt that the result is due to two actions—viz. (1) the hæmateïn forms a lake with the precipitated chromic hydrate; (2) the free or combined chromic acid oxidises the hæmatoxylin, and then combines, after its reduction, with the hæmateïn thus produced. When we turn to its use in cotton dyeing, we meet at once with a very different set of conditions. Cellulose, unlike wool, is a comparatively inert substance. Whilst in the case of wool the chromic acid is reduced, either at the expense of the fibre itself or of unremoved fats, in the case of cotton comparatively little action would take place, except such as led to the disintegration of the fibre; besides which, cotton does not possess so great an amount of elective affinity or absorbing power as wool does. The principal use of this salt is, therefore, rather to serve as an oxidising agent or for the formation of other chromium compounds, than as an actual mordant for cotton; *e.g.*, in cutch dyeing, the cotton, after steeping in the cutch, is passed into a hot bath of bichromate, to oxidise the cutch, and to produce the so-called japonic acid. A considerable quantity of chromic hydrate is deposited on the fibre at the same time, and no doubt influences the shade, but whether merely by its own colour or as a mordant, is perhaps questionable, though it will act as a mordant for other colouring matters. To form chromic salts, such as nitrate, acetate and aceto-nitrate, etc., bichrome is, however, largely used; these salts are formed by the reduction of the bichromate in presence of a suitable acid, by some such reducing agent as glucose, glycerine, alcohol, etc. The object in producing these bodies is to obtain a chromium salt of such a nature that it easily yields its oxide to the fabric, and the more basic it is the more easily will it dissociate on dilution, or heating, or both. The great obstacle to the extended use of chromium salts in dyeing cotton, has been the difficulty of fixing a sufficient quantity of the mordant to produce good shades; they have, however, been considerably used by calico printers, being fixed by steaming. For dyeing purposes, various processes of precipitation have been proposed, and one of the latest and most successful consists in steeping the cotton in some chromium solution, drying, and then passing it through a solution of carbonate of soda. The other methods have not been satisfactory.

More recently, Koechlin (this Journal, *1885*, 115) recommends a mordant prepared by adding excess of caustic soda to chromic acetate, the goods being passed through this and then thoroughly washed in running water. Schmid has modified this so as to obtain it more cheaply, but there is still the difficulty of working in such alkaline solutions, which will no doubt prevent its general adoption. Mons. E. Blondel (Abst. *Dyers and Colourists' Jour.*, Dec., 1886) suggests the employment of a basic double nitrate of chromium and calcium, which is easily dissociated when sufficiently dilute. Whether this can be used in the cotton-dyeing trade here is a question for someone practical to settle; but it presents interest because of the presence of the earthy metal in it, and we know that in certain cases—*e.g.*, in alizarin dyeing, there is produced on the fibre a lake containing lime in its composition.

In concluding I would draw your attention to some very interesting work of Liechti and Suida, of which an abstract is given in this Journal (*1885*, 586—590), and which is well worthy of the attention of all practical men.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Improved Means of preventing Incrustation of certain Parts of Steam Boilers. S. Fox, Leeds. Eng. Pat. 2376, Feb. 18, 1886. 8d.

This is an appliance for keeping the upper surfaces of horizontal cylindrical fire-boxes and flues of boilers clear from deposit, by the use of scrapers fixed to chains which are laid across the flues, their ends held down by weights. The chains are occasionally moved over the flue from one side to the other by suitable gearing, for the purpose of scraping off and preventing any accumulation of deposit.—B.

Improved Apparatus for indicating or regulating Temperature, Pressure or Volume of confined Fluids. J. Thomson, Glasgow. Eng. Pat. 2520, Feb. 20, 1886. 8d.

This is a development of a previous patent (J. Murrie, Eng. Pat. 303, 1885), in which use is made of a hollow chamber inserted in the enlarged part of a tube which is connected to both the liquid and vapour spaces of a vapour generator. The hollow chamber is fixed at the height of the ordinary level of the liquid in the generator, and as its immersion varies with changes in the level of the liquid, it receives more or less heat, whereby the tension of the enclosed air is altered and noted on an outside dial. From this indication the change in the level of the liquid may be deduced, and the same principle can also be applied to other purposes, several of which are referred to.—B.

An Improvement in Glass Hydrometers. S. A. Calderara and A. J. Calderara, London. Eng. Pat. 3594, March 13, 1886. 8d.

This refers to the manufacture of glass bulbs of hydrometers by blowing them in moulds with the view to the production of any desired shape or size of bulbs.—B.

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* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.........	½d.
Above 8d., and not exceeding 1s. 6d...	1d.
,, 1s. 6d., ,, ,, 2s. 4d...	1½d.
,, 2s. 4d., ,, ,, 3s. 4d...	2d.

Improvements in Filtering Funnels. W. C. Nickels, London. Eng. Pat. 8375, June 25, 1886. 8d.

THE improvement consists in making filtering funnels double, with a space between the two cones, the inner one, on which the paper rests, being perforated with small holes, so as to allow free escape of the liquid all over. A slight vacuum may also be maintained in the space between the two cones by artificial means, which greatly accelerates the filtering process, without injury to the paper.—B.

II.—FUEL, GAS, AND LIGHT.

Professor Seger's Pyroscope and Observations on the Temperature in the Interior of Gas Retorts. A. Heintz. Journ. f. Gas. u. Wasservers. **29**, 894.

FOR description of the applications of the above instrument, see this Journal, 1886, 489–491.

Improvements relating to the Purification of Illuminating Gas and other Fluids, and to Apparatus therefor. F. Lux, Ludwigshafen, Bavaria. Eng. Pat. 15,478, Nov. 26, 1886. 8d.

THIS invention is based upon the principle of alternately contracting and expanding the gaseous current, and is carried out by dividing the said current into several streams and passing these through series of chambers (preferably contiguous to one another), the enclosing walls of which, being convoluted, continually change the sectional area in the direction of the current. It is claimed that the sudden changes of velocity produced in the gaseous current by this alternate expansion and contraction of its channel cause a most complete deposition of the mechanically carried solid or liquid matters. This deposition may be aided by the insertion of baffle plates where the channel is widest.—A. R. D.

Improvements in the Manufacture, Blending, or Treatment of certain Mineral Hydrocarbons or Compounds of Hydrocarbons. S. Banner, Liverpool. Eng. Pat. 603, January 14, 1886. 6d.

THIS invention consists in adding any one or more hydrocarbons of one chemical series, say the paraffins, to any one or more of the nearly corresponding hydrocarbons of another series, say the olefines. The specific gravity of the mixture thus produced is higher than the mean of those of the separate liquids, and there is a corresponding improvement in the index of viscosity and the flashing point.—A. R. D.

Improvements in Incandescence Gas Lights. F. L. Rawson, and T. V. Hughes, London. Eng. Pat. 1195, Jan. 26, 1886. 8d.

THE improvements consist in maintaining a constant relation between the area of the incandescent material and the amount of gas, or gas and air, used in the burner. This may be done by so connecting the incandescent envelope with the tap controlling the gas supply that the envelope and burner are moved relatively to one another as desired. The waste heat is used to warm the air required for the burner.—A. R. D.

Improvements in Incandescence Gas Lights. C. von Buch, London. Eng. Pat. 1235, Jan. 27, 1886. 8d.

THE inventor uses a framework of platinum wire to support the material that is to be made incandescent. In the case of woven or fibrous material the wire is introduced into the texture at suitable intervals, the lower rim of the frame, or projections therefrom, being conveniently attached to the mouth of the burner.
—A. R. D.

Improvements in Apparatus for the Manufacture of Artificial Fuel. S. W. Allen and G. Breflit, Cardiff. Eng. Pat. 2807, Feb. 26, 1886. 8d.

THIS invention relates to the desiccation of the materials used in the manufacture of the fuel. The desiccating apparatus is surmounted by a vertical steam pugg, the central revolving shaft of which is continued downwards and carries a series of bottomless saucers or annular plates. Each saucer (except the top one) has a smaller inverted saucer interposed between it and the larger saucer next above. The hot gases from some furnace of convenient construction are made to ascend through the desiccator, thus drying the fuel on the saucers. In operation the raw material is treated in the pugg and let down through regulated openings on to the topmost saucer, whence it is scraped by proper scrapers, so as to fall over the intermediate saucer (which thus acts as a spreader) on to the larger saucer next below. Falling thus from saucer to saucer in zig-zag course, the material may be desiccated to any desired degree.—A. R. D.

Improvements in Gas Producers. F. Radcliffe, Plumstead. Eng. Pat. 7377, June 2, 1886. 6d.

THE inventor supplies the producer with fuel from below by means of a hydraulic ram or screw. The ram works in a charging-box connected with the bottom of the producer, and this box is filled from a spout or hopper. Before the ram begins its upward stroke the filling aperture of the box is closed with a slide. When a charge has been forced into the producer, and the ram is about to descend, the fuel is prevented from following by an iron plate which was laid loosely on the ram-table before the charging-box was filled, and is now caught by two horizontal bars (which are passed through holes in the casing) and held till the box is filled again and the ram ready to begin its upward stroke. The plate is then drawn out by a suitable slot, and all is ready for the insertion of another charge.—A. R. D.

Improvements in Apparatus for Distilling or Refining Mineral Oils. R. Tervet, Musselburgh, N.B. Eng. Pat. 8494, June 29, 1886. 8d.

THIS apparatus consists of a horizontal cylindrical vessel divided by vertical partitions into a number of compartments corresponding to the number of stages of the distillations to which the oil is to be subjected. To take one modification for example, the cylinder is divided into five compartments, and the oil is fed into the central one for the first stage. After this it passes, by any suitable connections, to the two adjacent compartments for the second stage, and from these to the two outer or end compartments for the third stage. From these it is transferred to ordinary coking-stills. The transference of the oil from compartment to compartment may be either continuous or periodical, and may be accomplished by gravitation only or by the aid of steam pressure. The graduation of the heat employed in the distilling process may be attained by placing the fires under the end compartments and using the fire gases first to heat the intermediate compartments and then the central one. Or a separate fire may be placed to each compartment and regulated as required.—A. R. D.

An Improved Method and Apparatus for rendering a Liquid Hydrocarbon Gaseous. Jas. Roots, London. Eng. Pat. 13,967, August 16, 1886. 8d.

A CYLINDER, having a tightly-fitting piston, is provided with an inlet and an outlet valve. Air and benzoline in suitable proportions are drawn into the cylinder by one stroke of the piston, and, by the next, are forced out again into and through a vessel packed with fine wire gauze, asbestos, cotton, or the like. This packing ensures the fine division of the hydrocarbon, and so materially aids in impregnating the air with the vapours thereof. Other hydrocarbons besides benzoline may be used. With the heavier ones the aid of heat is required.
—A. R. D.

Improvements in the Purification of Coal-Gas and in Apparatus therefor, the same being in part applicable for the Preparation of Caustic Ammonia Solutions. W. Young, Peebles. Eng. Pat. 16,052, Sept. 29, 1886. 1s. 3d.

THIS is an improvement on the known processes for using gas liquor to purify coal-gas. By these, as hitherto conducted, gas liquor is freed from its carbonic acid and sulphuretted hydrogen by being raised to a temperature somewhat below 100° C. The remaining caustic ammonia solution is used to absorb the acid gases from a fresh portion of coal-gas by being passed through a scrubber in a direction opposite to the flow of the gas. The chief objections to these processes are that at ordinary pressure the temperature that is required to drive off the carbonic acid and sulphuretted hydrogen is very apt to drive off the ammonia also, and that the ammonia solution entering the scrubber and meeting the comparatively pure gas leaving the same, is also very apt to part with ammonia, which goes forward with the gas and has to be scrubbed out again with water. The patentee obviates these difficulties by conducting the operation under a pressure of from 30 to 50lb. This pressure raises the solubility of the ammonia far more than that of the carbonic acid and sulphuretted hydrogen, and so enables much stronger gas liquor to be dealt with. In the subsequent operation the caustic ammonia solution is caused to pass through the scrubber in the same direction as the gas. By this means the strongest ammonia liquor is brought into contact with the crudest gas, and the less volatile carbonates and sulphides formed at once. For particulars of the elaborate apparatus with which the patentee carries out his invention, the specification with its drawings must be consulted.—A. R. D.

An Improvement in the Purification of Coal-Gas. H. Bowater, Cradley. Eng. Pat. 2892, Nov. 2, 1886. 4d.

THE gas is passed through a heated passage, and the higher the temperature to which it is raised the more perfect is the realisation of the advantages claimed. These are chiefly: That inferior coal can be made to yield gas of the best quality; that the hydraulic purification may be dispensed with; and that all noxious smells are destroyed.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

On Russian Bakuols. J. Jlimow. Chem. Zeit. **10**, 1459—1460.

MENDELEJEFF gave the name of bakuol to a product of distillation of the Caucasian petroleum, which had the specific gravity of 0·820 to 0·900, and represented a mixture of several fractions. More than 50 per cent. of bakuol can be obtained from the crude oil of Baku, whereas the yield of kerosene, which is usually employed for illuminating purposes, does not exceed 30 per cent. For determining the illuminating power of bakuol, different kinds were burned in a common German lamp, and their lighting effect was measured by a Bunsen photometer. At the same time commercial kerosenes were examined under precisely the same conditions, and it was found that the bakuols were decidedly preferable to kerosenes as illuminating agents. The following table contains the results of the experiments :—

No.	SPECIMEN OF OIL.	Specific Gravity at 17·5° C.	Flashing Point at 760mm.	Illuminating Effect in Candle-units.	Consumption of Oil in Russian Pounds per Hour.	
					For the Lamp.	For Candle-units.
1	Oil Fine (Nobel)	0·8218	29·5	9·00	0·0667	0·0074
2	,, ,,	0·8268	32·0	8·65	0·0720	0·0083
3	,, ,,	0·8200	27·0	9·20	0·0670	0·0073
4	Kerosene (Schibajew)	0·8225	27·0	8·01	0·0662	0·0077
5	,, (Mirzojew)	0·8125	32·0	7·85	0·0690	0·0088
6	,, (Ropes)	0·8188	35·0	9·25	0·0650	0·0070
	Astrolin	0·8108	57·0	8·20	0·0687	0·0083
8	Pyronaphtha (Kordig)	0·8157	47·0	7·70	0·0658	0·0085
9	,, (Ragosin)	0·8508	73·0	7·30	0·0610	0·0083
10	Bakuol No. 1	0·8280	36·0	7·40	0·0588	0·0080
11	,, No. 2	0·8310	37·5	10·10	0·0633	0·0060
12	,, No. 3	0·8360	39·5	9·84	0·0633	0·0061
13	,, No. 4	0·8310	49·5	8·30	0·0675	0·0081

The table on next page contains the fractions, with their specific gravities, of four different kinds of kerosenes and bakuols.

Considering the great illuminating power, combined with the high-flashing test of the bakuols, and principally the greater yield of bakuol to be obtained from crude oil, the author expresses the hope that petroleum distillers will find it more profitable to manufacture bakuol from Caucasian petroleum, than to distil the latter for kerosene after the American fashion.—S. H.

On Pyrene. E. Bamberger and M. Philip. Ber. **19**, 3036—3040.

IN a previous communication (this Journal, 1886, 595) it was shown that by the oxidation of pyrenic acid, naphthalenetetracarboxylic acid $C_{14}H_8O_8$ is obtained. In treating a large quantity of this acid, a second oxidation product is obtained, forming long orange needles with a vitreous lustre melting at 191°. Owing to the want of material, however, the investigation of this substance could not be pursued. When *naphthalenetetracarboxylic acid* is gradually heated to 150—170°, two molecules of water are liberated with formation or *naphthalenetetracarboxylic dianhydride* $C_{10}H_4(CO.O.CO)_2$. This substance crystallises from glacial acetic acid in white lustrous needles. Naphthalenetetracarboxylic acid therefore contains two pairs of carboxyl groups in ortho-position, a circumstance which receives confirmation by the formation of *naphthalenetetracarboxylic diimide* $C_{10}H_4(CO.NH.CO)_2$ from the dianhydride by treatment with ammonia. On oxidising pyrene ketone $C_{15}H_8O$, prepared by distilling pyrenic acid with lime, a dibasic acid $C_{10}H_6(COOH)_2$ is obtained which is decomposed into naphthalene and carbonic anhydride when distilled with lime. This acid melts at 265°, yields a characteristic imide, and appears to be idenfical with the naphthalic acid obtained by Behr and Van Dorp from acenaphthene. By determining the position of the acid groups in naphthalic acid the authors expect to decide the constitution of pyrene.

—D. B

Improvements in the Manufacture of Coke for Metallurgical Purposes. H. Barclay and R. Simpson, Harrington Iron Works, Cumberland. Eng. Pat. 2307, Oct. 28, 1886. 6d.

THE coal to be coked is put through a suitable disintegrator and mixed with 4 or 5 per cent. of slaked lime in fine powder. The coke produced is less friable and more compact in structure than that made in the ordinary way. This invention is only applicable to ovens of the Bee-hive type.—A. R. D.

Fractions. °C.	Percentage of Fractions.							
	Kerosenes.				Bakuols.			
	Nobel.	Schibajew.	Mirzojew.	Astrelin.	No. 1.	No. 2.	No. 3.	No 4.
From 120° to 150°	8·0	4·8	4·5	2·4	2·0	3·6	4·6	1·1
,, 150 ,, 180	23·2	23·7	25·6	24·8	14·5	17·5	10·6	7·4
,, 180 ,, 210	25·3	21·7	23·9	21·7	27·5	18·6	17·7	13·8
,, 210 ,, 250	25·5	26·0	27·3	32·7	27·8	31·7	27·2	32·8
Above 250°	18·0	23·8	18·7	18·4	28·2	28·6	39·9	44·9

Fractions. °C.	Specific Gravity of the Fractions at 17·5° C.							
	Kerosenes.				Bakuols.			
	Nobel.	Shibajew.	Mirzojew.	Astrelin.	No. 1.	No. 2.	No. 3.	No. 4.
From 120° to 150	0·7669	0·7613	0·7698	0·7579	0·7839	0·7701	0·7723	0·7852
,, 150 ,, 180	0·7925	0·7915	0·7855	0·7720	0·7933	0·7990	0·7974	0·7967
,, 180 ,, 210	0·8125	0·8137	0·8075	0·7832	0·8152	0·8175	0·8162	0·8121
,, 210 ,, 250	0·8255	0·8355	0·8260	0·7981	0·8315	0·8350	0·8370	0·8315
Above 250°	0·8573	0·8580	0·8477	0·8230	0·8580	0·8592	0·8599	0·8585

IV.—COLOURING MATTERS AND DYES.

The Manufacture of Methylene Blue. Otto Mühlhäuser. Dingl. Polyt. J. **262**, 371—379.

THE two processes in use for the manufacture of methylene blue are based upon two reactions, the one discovered by Caro in 1876 being the oxidation of dimethylparaphenylenediamine in acid solution in the presence of hydrogen sulphide; the other, described by Oehler in 1882, being the oxidation of a base containing sulphur, and which is obtained by treating a strong sulphuric acid solution of nitrosodimethylaniline with sulphuretted hydrogen.

PROCESS WITH "SODA WASTE."

The apparatus for the raw colour consists of two series of three wooden vats, the upper one provided with cover with manhole, stirrers, and draught connected with the flue for the removal of gases; also two sets of three filter boxes. For the purification, there are two vats for the extraction and two for the precipitation of the colours, and the requisite filters. The vats each hold about 3000 litres (660 gallons).

Nitrosodimethylaniline Solution.—Into each vat 1200 litres of water are run and a mixture of dimethylaniline hydrochloride added. This mixture is made by diluting a carboy of hydrochloric acid with 50 litres of water in an enamel pan, and well stirring into this 10kilos. dimethylaniline. Each vat is also provided with a vessel with run-off cock in which 6·6kilos. nitrite of soda are dissolved in about 150 litres of water. The temperature of the solution in the vats is regulated by ice or steam to about 8—9° C., and then, whilst well stirring, the nitrite gently run in through lead funnels which reach to the bottom of the vat. This requires about two hours, after which two carboys of hydrochloric acid are added to each vessel.

Reduction and Saturation with Hydrogen Sulphide.—Fresh, moist, "soda waste" supplies the latter, and can be measured conveniently in a wooden pail to hold about 35kilos. "waste." Two such pails of "waste" are required to expel excess of nitrous acid from all three vats; ⅓ pail is added at a time to each vat, whilst stirring well. Thereupon two more carboys hydrochloric acid are added to each batch, and a pailful of "waste" thrown in, and then the stirrers thrown out of gear so that the evolution of gas can take place slowly and regularly. With panses of 1½ to 2 hours, 4 to 5 pails altogether of "waste" are added, and the reduction is then complete, a drop of the solution on filter paper no longer showing the yellow nitroso-edge. During this operation the colour of the liquor changes from yellow, through dark green, brown, black, blue, and red to a milky white, and the temperature rises about 5°—viz., from 16° to 21°.

The Oxidation.—For this purpose a solution of ferric chloride of 1·16 to 1·17 sp. gr., containing 20—21 per cent. Fe_2Cl_6, is added in slight excess to the solution in the vats. The odour of H_2S must then entirely have disappeared, and the liquid must appear deep blue, also the clear solution from a sample precipitated with salt and zinc chloride should give a slight blue colouration with ferrocyanide of potassium. The colour thus formed is then salted out with 180kilos. rough salt and about 25kilos. of zinc chloride solution, containing 44 to 49 per cent. $ZnCl_2$ (1·5 sp. gr.). A drop on filter paper must show blue flakes on a *red* ground. The filtration is then proceeded with, stirring constantly, and takes two or three hours. The raw colour collects on the doubled woollen filters, the red mother-liquor runs into the lower series of vats for further treatment, and in the top vats there remains a residue, which is washed with the water to be used afterwards for the purification. The red filtrates are kept well stirring, and into each vat 12kilos. of zinc-dust, made into a paste with water, are added every 10 minutes—an iron ladleful at a time. Hydrogen sulphide is given off, and the solution becomes colourless. A carboy of ferric chloride (=70kilos.) is then added, and the colour which precipitates at once filtered off. This is termed the *zinc-colour.* The filtrates are allowed to run away.

Purification.—The *raw colour* from six vats, consisting of methylene blue "waste" residue, sulphur, and other impurities, is well stirred up in the upper purification vat, with water which has been warmed to 24°, and to which 18kilos. ferric chloride solution have been added. After standing 12 hours the solution is syphoned off on to the filters, the filtrate precipitated with 200kilos. salt and 30kilos. zinc chloride solution, and the colour then filtered off. A second liquor, containing another 18kilos. ferric chloride, is taken off the residue of the raw colour and treated exactly as the first one. A third extraction is then made, using only 9kilos. ferric chloride; from this the purest and strongest colour is obtained. It is seldom necessary to make a fourth extraction. The residue of the raw colour is then stirred up in a half vat-ful of water with 15kilos. hydrochloric acid, and heated to the boil, sulphurous acid is given off, and the liquid becomes pale or even colourless; 30kilos. ferric chloride are then added and the whole solution filtered into the lower vat, where other 8kilos. ferric chloride are stirred in, and the colour thrown down with 150kilos. rough salt and 30kilos zinc chloride. This is the weakest colour. The *zinc-colour* from six batches is put in the boiling-up vat and well stirred with cold water, and after 12 hours rest filtered into the lower vessel where the colour is thrown down with 10kilos. ferric chloride, 150kilos. salt and 30kilos. zinc chloride, and then filtered off. Instead of a second extraction this residue is generally boiled up with the residue from the raw colour. The purified colour thus obtained is allowed to drain well on the filters, and then is stirred up with cold water until the colour just begins to dissolve; the resulting thick paste is drained in filter bags, wrapped up in strong calico cloths and pressed in the hydraulic press. The cakes are cut up and dried on zinc trays in a stove heated to about 60°. The yield of colour obtained as above is about 5 to 6kilos. per vat.

PROCESS WITH ZINC SULPHIDE.

When hydrogen sulphide is passed into sulphuric acid of 40—50° B., precipitation of sulphur takes place, according to the two following equations: $H_2SO_4 + H_2S = SO_2 + S + H_2O$ and $SO_2 + 2H_2S = 2H_2O + 3S$
When these reactions take place in the presence of sulphate of nitrosodimethylaniline a colourless base containing sulphur is formed, which on oxidation yields methylene blue. The nitrosodimethylaniline is made in three enamelled iron vessels of 400 litres capacity, provided with stirrers and cooling jacket, by stirring 10kilos. dimethylaniline into 75kilos. sulphuric acid of 25° B. (23 strong acid to 50 water), cooling with ice to 6° to 8° and running in slowly a solution of 6·25kilos. $NaNO_2$ in 30kilos. water, whilst stirring well. When this reaction is complete 175kilos. of 60° B. sulphuric acid (150 strong acid to 22·5 water) are poured into each vat. During both operations the temperature must not rise above 12°. The contents are then blown by air pressure into three iron vessels of 1500 litres capacity, provided with covers, pressure gauge, manhole, cooling jacket, draught pipes for removal of gases, and stirrers, which, like the vessels, are covered with lead. Whilst well stirring, 100kilos. of finely ground dry zinc sulphide are gradually added, the temperature being kept at about 20—25°. When all the sulphide has been put in, the vessels are closed and the contents digested at 35—40° until the solution has become colourless. The contents of the three vessels are then blown into a settling vat holding about 3000 litres, well mixed and allowed to stand for 12 hours. The solution is then filtered off from the sulphur, etc., the latter afterwards boiled up with 5kilos. sulphuric acid and 1000 litres water, allowed to settle and filtered. The united filtrates after oxidation are salted out, and otherwise treated as before described. The colour, obtained in this manner is much stronger than that yielded by the "soda waste" process.—T. L. B.

Method for the Spectroscopical Investigation of Tar-colours. P. Schoop. Dingl. Polyt. J. **262**, 424—427.

THE method of testing the strength of dyestuffs by test-dyeing requires great practice, and even then it is difficult in many cases to determine differences of five per cent. with anything like accuracy. The investigations of K. Vierordt and G. Krass have rendered it possible to determine with accuracy and rapidity the amount of colouring matter in a solution. The basis of their method is as follows: Every substance can only absorb those rays of light which have the same rate of vibration as its own molecules, producing, therefore, in the spectrum of the light reflected by it, absorption-bands in certain places. With light from the same source, the absorption-band is the darker the greater the amount of absorbing (coloured) substance is contained in the unity of space, and the relation between the light absorption and the quantity of colouring matter is a very simple one. If $\frac{1}{4}$th of the rays of a beam of light pass through a 1cm. thick stratum of colour solution, a second similar stratum will allow only $\frac{1}{4}$th of this $\frac{1}{4}$th to pass through it, and so on. The same result is obtained if, instead of the light passing through two such layers of solution, it passes through one layer of solution of double strength; in each case the amount of colour is the same. Therefore, if the amount of light which passes through a 1cm. thick layer of a solution containing, say, one milligramme of colour in the litre, be equal to a, then the amount of light which passes through an x-times so concentrated a solution, is $b = a^x$ (where x equals the number of milligrammes of colouring matter in one litre solution), or $\log b = x \log a$ or $x = \log b : \log a$. The quantities a and b are easily and quickly obtained by the spectroscope. Schoop's instrument consists of a tube with slit, prism, and telescope, which is so arranged that any position in the spectrum can be examined and determined. The slit is in two halves, the upper movable and the lower fixed, and immediately in front of the latter is a vessel with parallel glass sides 1cm. apart, for the solution to be tested. When in use, by regulating the height of the solution in this vessel, two spectra are obtained, one of the source of light, and the other the absorption spectrum of the solution. The darkest part of the latter is then found, and the movable slit regulated until the amount of light in each spectrum is equal. The amount of movement is shown on a drum connected with the micrometer screw, and serves as measure for the intensity of the light, that admitted by the fixed part of the slit being taken as unity. Having in this way determined the intensity of light for a normal solution of any colour, a similar determination for the solution to be tested, with the use of the above formula, gives the amount of colour contained in it. It is advisable to regulate the concentration of the solutions so that about 60—70 per cent. of the total light only is absorbed. The apparatus can be used to detect commercial mixtures of two or more colours, as also to determine the end of the reaction in the formation of colouring matters, such as in the magenta and blue melts, etc.—T. L. B.

Toluene di-sulphonic Acids. P. Klason. Ber. **19**, 2887—2890.

BY heating toluene-*m* sulphonic acid with fuming sulphuric acid, two isomeric di-sulphonic acids are formed which can be separated by the different solubilities of their barium salts.

The *first* is identical with the so-called "β" acid isolated by Hakausson (*Ber.* **5**, 1088) from the mother-liquors obtained in the preparation of the α-di-sulphonic acid by further sulphonation of toluene *p*-sulphonic acid. Its barium salt $C_7H_6(SO_3)_2Ba + H_2O$ is a crystalline powder: 100 parts of water at 15° dissolve 3·9 parts of the anhydrous salt. The potassium salt $C_7H\ (SO_3K)_2 + H_2O$ forms readily soluble crystals. The chloride is sparingly soluble in ether and crystallises from carbon disulphide in rhombic tables melting at 96°. The amide is sparingly soluble in water, and melts at 224°.

The *second di-sulphonic acid* is identical with the acid obtained by Limpricht and Richter (*Ber.* **18**, 2177) by reduction of the iodo-toluene-di-sulphonic acid, formed by sulphonation of *p*-toluidine-*m*-sulphonic acid, diazotisation, and treatment with HI. Its barium salt $C_7H_6(SO_3)_2Ba + 3\frac{1}{2}H_2O$ forms easily soluble prisms. The chloride melts at 95° and the amide at 214°.

The author also shows that the so called "γ," di-sulphonic acid of Senhofer (*Ann. Chem. Pharm.* 164, 129) obtained by direct sulphonation of toluene is identical with the above-mentioned α-acid. Hence 5 isomeric toluene di-sulphonic acids are at present known.

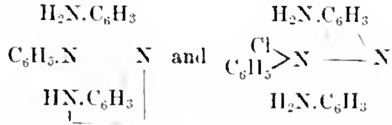
—A. G. G.

Formation of Aniline and Diphenylamine from Phenol. V. Merz and P. Müller. Ber. **19**, 2901—2917.

THE following is a summary of the authors' results:—On heating a mixture of phenol and ammoniacal zinc chloride to a temperature of about 350°, aniline and diphenylamine are obtained, the yield amounting to 70 per cent. of the weight of phenol employed. When sal ammoniac is added to the mixture, the reaction takes place at a lower temperature, and the yield of amines is increased. The best results are obtained at 330°. The main reaction is completed in twenty hours, and the yield in this case is more than 80 per cent. of the weight of phenol used. A small amount of carbonaceous matter is invariably formed. Its quantity increases considerably when the temperature is carried above 340—350°. As to the ratio of aniline and diphenylamine in the product of the reaction, it is shown that the quantity of the latter increases with a diminution in the amount of ammoniacal zinc chloride and sal-ammoniac, if the temperature and period of heating be increased. On heating diphenylamine with sal-ammoniac, or preferably sal-ammoniac and ammoniacal zinc chloride, aniline is formed. When phenol is heated with zinc oxide and sal-ammoniac it yields aniline and diphenylamine, although the amount is less than in the case of ammoniacal zinc chloride. The zinc oxide may be replaced by magnesia, in which case the yield is still further reduced. Sal-ammoniac *per se* has little or no action on phenol at 350°. At a temperature of 400°, however, the action is more energetic, with formation of aniline and diphenylamine. Concentrated hydrochloric acid does not act on diphenylamine at 300°. At 320° a large proportion is decomposed into aniline and phenol.—D. B.

On the Constitution of Safranine. R. Nietzki. Ber. **19**, 3017—3022.

THE author supplements his earlier work on this subject, and discusses the formula lately proposed by Andresen and Bernthsen—viz.:



$$\begin{array}{c} H_2N.C_6H_3 \\ C_6H_5.N \qquad N \\ HN.C_6H_3 \end{array} \quad \text{and} \quad \begin{array}{c} H_2N.C_6H_3 \\ {}^{Cl}_{C_6H_5}{>}N \;\text{—}\; N \\ H_2N.C_6H_3 \end{array}$$

One NH_2 group of (pheno-) safranine can be readily diazotised, and is eliminated by boiling with alcohol. The product $C_{18}H_{13}N_3$ is a dyestuff of bluer shade than safranine, and has no fluorescence in alcoholic solution.

It dissolves in concentrated H_2SO_4 with yellowish-brown colour, which on dilution first becomes green and then red. It forms a well-crystallised double zinc chloride. Its mono-acetyl derivative is violet, and yields yellow crystalline salts.

The second NH_2 group can only be diazotised in strongly acid solution; on decomposition of the product with alcohol a base is obtained which, although as yet not analysed, is in all probability the true mother-substance or basis of safranine. It is reddish-violet, and dissolves in dilute or concentrated acids with a yellow colour. The same colour reactions are shown by di-acetyl safranine, or the mono-acetyl derivative of the base $C_{18}H_{13}N_3$, in which the NH_2 groups, though not removed, are neutralised by acetyl.

By oxidation of 1mol. of symmetrical di-alkyl-*p*-phenylene diamine, with 2mols. of aniline, or of equal mols. of *p*-phenylene diamine, di-alkyl aniline, and aniline, isomeric di-alkyl safranines are obtained.

Both products allow themselves to be readily converted into blue di-acid diazo-compounds. The explanation of these facts by either of the above formulæ appears to offer some difficulty.—A. G. G.

Improvements in the Production of Mixed Azo-colours. C. A. Martius, Berlin, Germany. Eng. Pat. 2213, February 15, 1886. 6d.

THE inventor has discovered that when salts of tetrazodiphenyl and its homologues act upon amines and phenols or their sulphonic acids, only one molecule of these compounds combines in the first place with one molecule of the tetrazo-salt, leaving one diazo-group free, so that combination is possible with a second molecule of the same or a different amine, phenol or sulphonic acid. By this means a series of secondary azo-colours, containing similar or dissimilar radicles, can be prepared, a list of available amines, phenols, sulphonic and carboxylic acids being given in the specification. The general process of manufacture consists in combining one molecule of the tetrazo-salt with one molecule of the amine, phenol, etc., and then combining this intermediate product with the second molecule of the amine or phenol. The following examples of mixed azo-colours are given:—(1) Tetrazodiphenyl, α-naphthol-sulphonic acid and α-naphthylamine-sulphonic acid; a brown violet. (2) Tetrazodiphenyl, β-naphthol-disulphonic acid R and β-naphthylamine-sulphonic acid. (3) Tetrazoditolyl, α-naphthol-sulphonic acid and β-naphthol-sulphonic acid R. (4) Tetrazoditolyl, α-naphthol-disulphonic acid and β-naphthol. (5) Tetrazodiphenyl, sulphanilic acid and salicylic acid; dyes cotton yellow from a soap bath. (6) Same constituents as in last sample, but order of combination reversed. (7) The sulphanilic or salicylic acid of 5 and 6 replaced by amidobenzoic acid. (8) Naphthionic acid replaced by amidobenzoic acid. (9) Tetrazodiphenyl-sulphonic acid, β-naphthylamine and β-naphthylamine-sulphonic acid. (10) Tetrazoditolyl-disulphonic acid, α- and β-naphthylamines.—R. M.

Preparation of Paramidodiphenyl-sulphonic Acid. T. Carnelly, Dundee. Eng. Pat. 3890, March 16, 1886. 6d.

THIS acid is prepared by treating benzidine with four times its weight of ordinary oil of vitriol and heating the mixture to 130° C. for about 30 minutes. The product, when cool, is mixed with water, and the precipitated acid collected and washed. This sulphonic acid can be used for the preparation of azo-dyes according to the known processes.—R. M.

Process for the Production of Azo-colours from Ortho-sulpho- or Orthocarbo-Acid of Benzidine. C. D. Abel, London. From the "Actiengesellschaft für Anilin Fabrikation," Berlin, Germany. Eng. Pat. 13,780, Oct. 27, 1886. 6d

THE acids referred to in this specification are prepared by reducing metanitrobenzene-sulphonic and metanitrobenzoic acid in alkaline solution with zinc dust, whereby hydrazo-compounds are first produced, and these, by the action of acids, are converted into the isomeric benzidine-disulphonic or dicarboxylic acid, just in the same manner as benzidine is produced from hydrazobenzene. These two acids can then be used for the preparation of azo-colours, of which the following are given as examples:—(1) Benzidine-disulphonic acid (diazotised) and β-naphthol, a yellowish red; (2) the same tetrazo-compound and α-naphthol-sulphonic acid, a bluish red; (3) the same tetrazo-compound and diphenylamine; (4) the same tetrazo-compound and α-naphthylamine; (5) the same tetrazo-compound and naphthionic acid; (6) benzidine dicarboxylic acid (diazotised) and α-naphthol-sulphonic acid, bluish red; (7) the same tetrazo-compound and α- and β-naphthylamine-sulphonic acid, yellowish brown.—R. M.

Improvements in the Manufacture of Colouring Matters, and Vehicle therefor. A. M. Clark, London. From Dr. A. Müller-Jacobs, New York, U.S.A., through Wirth & Co., Frankfort-on-Main, Germany. Eng. Pat. 2878, Feb. 27, 1886. 6d.

THIS invention is carried out by first preparing a neutral resin soap, dissolving in water, and precipitating by adding a solution of zinc or aluminium sulphate, or any

other salt of a metal. The precipitate is washed and dried, and then forms a fine powder consisting of the "resinate" of zinc, aluminium, etc. This "resinate" is coloured by adding a colour solution to the solution of the soap, or to the solution of the metallic salt before precipitation, or by washing the dry powder with an aqueous or alcoholic solution of the colour. The coloured resinates are said to be soluble in benzene, carbon disulphide, etc., oils and oil varnishes, and can be applied for varnishes, printing inks, dyeing and printing, etc.
—R. M.

A Process for the Production of Mixed Azo-colours from the Diamido Combinations of the Ethers of Diphenol. C. A. Martius, Berlin, Germany. Eng. Pat. 7283, May 31, 1886. 6d.

THE patentee has discovered that the diamido-derivatives of dimethoxy- and diethoxy-diphenyl may be used for the production of mixed azo-colours in a manner similar to benzidine and its homologues. The colouring matters are produced by combining first 1 molecule of an amine, phenol, or their sulphonic or carboxylic acids, with the tetrazo-salt of the methoxy-base, and then combining this intermediate product with 1 molecule of the same or a different amine, phenol, etc. Two examples of the process are given. 1. Tetrazodiethyldiphenol-ether is combined with 1 molecule of β-naphtholdisulphonic acid (R) (*Ber.* 17, 462; see also this Journal, 1884, 245), and the product is then combined with 1 molecule of α-naphtholmonosulphonic acid, when a blue colouring matter is produced. 2. In the preceding example the α-naphtholsulphonate is replaced by an equivalent quantity of sodium naphthionate, when a violet colour is formed. The sulphonic acids of the methoxy- or ethoxy-base may be used instead of the bases themselves.—R. M.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

An Improved Manufacture of Artificial Silk-like Filaments from Viscous Liquids, and Apparatus for that purpose. Comte H. de Chardonnet, Besancon Doubs, France. Eng. Pat. 2211, Feb. 15, 1886. 8d

THIS invention relates to the manufacture of artificial filaments resembling silk, by forcing, at a pressure of 2 to 3 atmospheres, a viscous solution of cellulose-nitrate in ether-alcohol through a fine jet made of glass, and subsequently through a current of water, where it solidifies. The filament is seized by a delicate pair of pincers and led over a reel or bobbin.—E. J. B.

Improvements in Waterproofing Fabrics. G. F. Redfern, London. From E. Chevallot, Bordeaux, France. Eng. Pat. 3095, March 4, 1886. 6d.

THE fabrics or other material to be treated are passed through a bath containing soap and a compound of caseïn and lime. When thoroughly saturated they are withdrawn, and freed from excess of the solution by passing them between rollers. They are then dipped in a bath of acetate of alumina, afterwards immersed in boiling water, or dried and hot pressed. Full directions are given for the preparation of the different baths employed.—E. J. B.

Improvements relating to the Treatment of Fibre, and to the Manufacture of Imitation Straw Plait therefrom. C. and J. Halter, Mellingen, Switzerland. Eng. Pat. 14,647, Nov. 12, 1886. 4d.

THE imitation straw plait is made from the flat ribbon-like bast of the Raphia. The fibre is boiled in a weak solution of caustic soda, washed, treated with dilute hydrochloric acid, and again washed. The fibre is then cut into narrow strips, which are tied together and wound upon bobbins. If desired, the strips can be bleached with hydrogen peroxide. The strips are then made into a round or flat plait in the ordinary manner. The plaits may be made upon cotton or other threads, or upon brass or steel wire in order to render them sufficiently stiff.—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Improvements in Dyeing Tissue and other Papers, and in Apparatus therefor. J. Fletcher, Stoneclough, Manchester. Eng. Pat. 13,598, Oct. 25, 1886. 6d.

HITHERTO, owing to the manner in which pulp for tissue paper has been dyed, there has been a very considerable waste of colouring matter, and also a want of brilliancy in the coloured paper produced. This patent relates to mechanical arrangements for dyeing paper after manufacture, by pressure, which forces the colouring agent through the fibres of the paper. At the same time it is claimed that, besides being more economical, this method produces richer and darker colours than is possible when paper pulp is dyed in the engine.
—H. A. R.

VII.—ACIDS, ALKALIS, AND SALTS.

Manufacture of Potassium Sulphate and Ammonium Chloride from Potassium Chloride and Ammonium Sulphate. K. Schmidtborn. Chem. Zeit. **10**, 1499.

Mutual Decomposition of the Raw Materials—The apparatus consists of a large round lead-lined tank, which is provided with a false bottom, covered with filter cloth, a mechanical agitator, and a leaden steam coil. 2½ tons of ammonium sulphate are put into the tank and dissolved in water to a solution of 1·142 sp. gr. This is heated to a boil, and while the boiling is kept up, an equivalent quantity of potassium chloride (95—97 per cent. KCl) is gradually added, and the agitator set in motion. The mutual decomposition commences at once, and potassium sulphate is precipitated in an amorphous state. In the short time of 10 minutes after the addition of all the potassium chloride, the decomposition is complete, when the agitation is discontinued, and the mixture allowed to settle for one hour.

Production of Potassium Sulphate and its Purification.—The hot liquor is then run through a tap at the bottom into a lead-lined cooling vessel, whilst the precipitate of potassium sulphate remains in the tank on the filter cloth, where it is systematically washed with warm water, until it only contains up to a half per cent. of ammonium salts. In this manner 70 per cent. of the total potassium sulphate is directly recovered. The washings are employed for dissolving new quantities of ammonium sulphate.

Treatment of the Filtered Liquor.—The liquor in the cooling vessel is allowed to crystallise, yielding another crop of potassium sulphate, which is purified by washing with water. The mother-liquor is concentrated until potassium sulphate is plentifully salted out; and the salts thus obtained are washed, together with those left on the filter of the dissolving vessel. The hot concentrated liquor is filtered and allowed to crystallise slowly. After several days the mother-liquor is run into a reservoir, and boiled down along with other liquors of the same origin. The crystals obtained consist of two different layers, which are quite distinct from each other, and are easily separated. The top layer, about three-fifths of the total bulk, consists of 94 per cent. ammonium chloride, and 6 per cent. foreign salts, principally potassium sulphate and chloride, and sodium sulphate and chloride, whereas the bottom layer is composed of 78 per cent. ammonium chloride and 22 per cent. potassium sulphate. The top crystals are pure enough to be further purified by washing, whilst the bottom salts are treated with the washings of the potassium sulphate obtained at a previous stage of the process. These washings, containing both ammonium chloride and potassium sulphate, are heated to 100° C., and the crystals, placed in perforated drums, are suspended in the hot liquor. The ammonium chloride dissolves almost immediately, whilst potassium sulphate is only sparely dissolved and is left behind on the drums in a state to be easily purified by washing. The hot washings, after cooling, deposit pure ammonium chloride, and the mother-liquor is used over and over again for the same purpose. Both the potassium sulphate and ammonium chloride are jigged in a hydro-extractor, the former being then ready for being packed; whereas the latter requires drying in a heated chamber. It is claimed for this process that the potassium sulphate produced is worth more than the potassium chloride employed, that no hydrochloric acid is necessary for the ammonium chloride, which, moreover, is directly obtained in a pure state without expensive refining, and that the manufacture of ammonium chloride is not dependent on the proximity of a gas works—*i.e.*, a cheap supply of ammoniacal liquor.—S. H.

A New Process for the Preparation of Crystallised Carbonates. L. Bourgeois. Compt. Rend. **103**, 1088.

THE process is based upon the precipitation of superheated solutions of salts by ammonium carbonate. If the solution of an ammonium salt, in which a carbonate is suspended, be boiled, the latter gradually dissolves, changing into ammonium carbonate. If the heating be performed in a sealed tube, ammonium carbonate collects in the empty part of the tube, and on cooling a re-formation of the original carbonate takes place, which is, however, deposited in a crystalline state. In this manner the author prepared artificially calcite, strontianite, witherite, and cerussite. Cadmium carbonate, which was previously only known as an amorphous body, was thus obtained in rhombohedral crystals, whereas the carbonates of lithium, magnesium, zinc, manganese, iron, nickel, cobalt, and copper could only be produced in the amorphous state. If the solution of an ammonium salt be heated with the equivalent quantity of urea in a sealed tube, at 140° C., at which temperature the latter is decomposed to ammonium carbonate, the formation of the crystallised carbonates takes place suddenly.—S. H.

Improvements in obtaining Ammonia and Hydrochloric Acid from Ammonium Chloride. L. Mond, Northwich. Eng. Pat. 65, Jan. 2, 1886. 6d.

AMMONIUM CHLORIDE is volatilised and its vapour passed over nickel protoxide while heated to about 400° C. The chlorine then combines with nickel, ammonia being set free, and passing on, can be utilised in any convenient manner. Superheated steam of about 450° C. is then passed over the heated nickel chloride, when a re-formation of nickel protoxide takes place, while the chlorine is given off in the state of hydrochloric acid gas, which can be condensed by the usual methods. The nickel protoxide is thus again in a state to decompose ammonium chloride. Besides nickel, a large number of the oxides of heavy metals possess the property of decomposing ammonium chloride in the manner stated. For carrying out this invention, a number of cast-iron retorts are set obliquely in one common furnace, and heated by direct fire or generator gases. The retorts pass through the walls of the furnace at both sides, and are at both ends provided with covers and openings for the inlet and outlet of the gases.—S. H.

Improvements in obtaining Ammonia and Chlorine from Ammonium Chloride. L. Mond, Northwich. Eng. Pat. 66, Jan. 2, 1886. 6d.

THIS patent is a modification of Eng. Pat. 65, 1886 (see preceding abstract), by the same inventor. Vapours of ammonium chloride are passed over nickel protoxide heated to 400° C., when nickel chloride is formed and ammonia is set free. Air previously dried and heated to 500° C. is then passed over the heated material, when the oxygen combines with the nickel, forming an oxide of nickel, and the chlorine is given off in an uncombined state. The nickel oxide can be used over again for the first stage of the process. The gas given off in the second stage is said to contain from 5 to 7 per cent. of chlorine.

Oxides of other heavy metals possess similar properties as nickel oxide. The apparatus recommended is practically the same as that described in the abstract of Eng. Pat. 65, 1886.—S. H.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

The Influence of an Addition of Sugar on the Solidity of Cement. Th. Hankey. Glaser's Ann. 1886, **19**, 187.

EQUAL parts of finely ground lime and brown sugar are said to form a mortar equal in strength to Portland cement. According to R. Cornish, it has been the custom in India to add a certain amount of raw sugar to mortar; and works made with such mortar can hardly be destroyed, except by blasting. The celebrated Chunam polished walls of Madras are said to have been made with a cement to which sugar was added, a slight addition improving the quality of cement appreciably.—T. L. B.

X.—METALLURGY, Etc.

Phosphorus Compounds in Pig-iron. Leopold Schneider. Oesterr. Zeitsch. f. Berg. u. Hüttenw. **34**, 735.

THE author has treated various kinds of crude iron (specular, white, and grey pig-iron, ferro-manganese etc.) with aqueous copper chloride solution, which has little action on phosphorised iron, and has examined the washed residue. In 100 parts of iron he obtained—

18·6	phosphorus	—	manganese	18·5	phosphorus	—	manganese
18·6	,,	—	,,	20·5	,,	5·7	,,
18·2	,,	—	,,	37·7	,,	52·8	,,
18·2	,,	—	,,	38·8	,,	54·4	,,

From these numbers he concludes that phosphorus forms with iron a compound Fe_3P, but with manganese the compound Mn_3P_2. The same compounds are no doubt present in steel and wrought-iron, although they could not be separated from the latter, because of the small quantity of phosphorus contained therein.—A. R.

Improvements in the Means of and Apparatus for the Extraction of Metals from their Ores, particularly in the Treatment of "Blue Stone" and similar Complex Ores, and for Electrolytically Refining Copper, and for the Manufacture of Sulphuric Acid by Electrolytic Action. W. & A. S. Elmore, London; and H. Barrett, Dulwich. Eng. Pat. 15,988, Dec. 29, 1885. 6d.

FOR the treatment of ores containing zinc, lead, copper, silver, gold, iron, sulphur and gangue, the process is as follows:—The finely-crushed ores are roasted in a reverberatory furnace with free access of air, the gaseous products being led into a condensing chamber where, mixed with steam, they pass between pairs of suitable platinum combs insulated from each other, and connected with opposite poles of an electrical machine. The ozone produced by the discharge acting on the sulphur dioxide of the gases in the presence of steam, forms sulphuric acid, which condenses at the comparatively low temperature of the chamber, and may afterwards be concentrated. The roasted ore is next agitated with water or dilute acid to dissolve copper and zinc, which are generally accompanied by iron and some silver. The copper and silver are then precipitated with metallic zinc, washed free from the latter metal, and cast into anodes. The solution of iron and zinc is, if necessary, freed from excess of the former by the addition of calcium carbonate, air being forced through the liquid during the precipitation. It is then electrolysed for zinc, with lead anodes and zinc cathodes in tanks provided with an inlet pipe at the bottom and an outlet above, through which a circulation is effected to rectify the increasing acidity of the bath whilst zinc is deposited; the more acid liquid leaving the tanks is returned to the roasted ore, and becoming saturated, passes through the above cycle of operations before re-entering the tank. The residue from the leaching vats is treated in the usual way for lead, silver and gold. The argentiferous copper anodes are used in a vessel divided into two compartments by a porous partition. This vessel is first filled with solution of cuprous chloride in hydrochloric acid or brine, from which copper is constantly deposited on the cathode, and into which, but in the other compartment, the copper and silver of the anode dissolve.

When sufficiently treated, the silver is exactly precipitated by means of a soluble iodide, and the filtered solution of copper is returned to the cathode side of the vessel.—W. G. M.

Improvements relating to the Recovery of Tin from Scraps of Tinned Plate. H. H. Lake, London. From Wirth & Co., Frankfort-on-the-Maine. Eng. Pat. 2402, Feb. 18, 1886. 6d.

In recovering the tin from the mixed solutions of stannous and ferrous chlorides resulting from the treatment of the plate with hydrochloric acid, the liquid is to be agitated with finely-divided calcium carbonate until the tin is completely precipitated as oxychloride, thus :—

$$2SnCl_2 + 3H_2O + CaCO_3 = SnO.SnCl_2.3H_2O + CO_2 + CaCl_2.$$

This operation is to be performed in closed vessels in an atmosphere of carbon dioxide to prevent precipitation of the iron. The insoluble tin salt is then filtered under pressure, and the precipitate suspended in water in a closed vessel as before, and boiled with another equivalent of calcium carbonate, by which means pure stannous oxide may be obtained :—

$$SnO.SnCl_2.3H_2O + CaCO_3 = 2SnO + 3H_2O + CO_2 + CaCl_2.$$

From the calcium ferrous chloride filtrate the hydrochloric acid and ferrous sulphate may be recovered by treatment with sulphuric acid after evaporation to dryness.—W. G. M.

Improvements in the Manufacture of Iron and Steel. J. H. Johnson, London. From La Société Anonyme de Commentry-Fourchambault, Paris. Eng. Pat. 2867, Feb. 27, 1886. 6d.

The object of this invention—namely, to obtain a good metal from impure mixed scrap—is accomplished in four stages. Firstly, the scrap is melted in a special circular gas regenerative furnace with basic lining and spherical roof; with the charge is added a limestone flux and subsequently a pure oxide of iron; thus silicon is completely eliminated. Secondly, sulphur is removed by the addition of a suitable proportion of a ten per cent. spiegel, with soda and lime or similar mixture, at an increased temperature. Thirdly, the metal is tapped into a deep ladle, with a lime and soda lining above the usual refractory materials, wherein the last traces of sulphur are extracted, and by which the iron is conveyed to a basic Siemens furnace of ordinary construction. Finally, in this latter furnace the phosphorus and carbon are eliminated in the usual way, manganese is added and the metal poured as in the Siemens process.

—W. G. M.

A Process for Deoxidising Metals. P. Jensen, London. From The Deoxidised Metal Company, Bridgeport, Connecticut, U.S.A. Eng. Pat. 7796, June 10, 1886. 6d.

Homogeneous, hard, sonorous and sound castings are made by adding to the melted metal a depth of one or two inches of horn (or hide) clippings, or analogous material. In casting bronze or brass the addition is made after the fusion of the copper and prior to the introduction of tin or zinc. The alloy thus produced is to be called "deoxidised bronze."—W. G. M.

Improvements in the Manufacture of Mineral Wool and in Apparatus therefor. J. T. King, Liverpool. From H. Kennedy, Sharpsburg, Pennsylvania, U.S.A. Eng. Pat. 15,154, Nov. 22, 1886. 8d.

A wool, consisting almost wholly of fibre, and therefore requiring no separation from shots, is made by surrounding the stream of molten slag with jets delivering steam or air in such manner that a swirling motion is given to the slag, which thus becomes more perfectly converted into fibre. The jets are preferably in the form of vertical and horizontal slots, so disposed at different angles as to impart the desired motion to the liquid.—W. G. M.

Improvements in Making Steel. J. T. King, Liverpool. From D. Brose, Pittsburgh, Pennsylvania, U.S.A. Eng. Pat. 15,357, Nov. 25, 1886. 4d.

In order to ensure a thorough mixture of the final charge of ferro-manganese or spiegel with the iron after treatment in the Bessemer converter, limestone is added with the manganese, by which a violent ebullition is caused. Of preference a calcareous marl from Western Pennsylvania should be employed, and should be introduced with the manganese into the empty ladle, before the contents of the converter are poured into it.

—W. G. M.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

Experiments on the Preservation of Pig Fat in Ointments. E. Mylius. Pharm. C.H., N F. **7**, 533.

Since there is a tendency to abandon the use of vaseline in ointments in favour of animal fats, these experiments have just now a special interest. After experimenting with the most diverse preservatives, the author finds that the best results are given, for lead ointment with 3 per cent. of boric acid, and for potassium iodide ointment with 10 per cent. of glycerin and 0·1 per cent. of oil of cloves.—W. G. M.

Improvements in the Preparation or Treatment of Oils for use in treating Wool, in the Manufacture of Soap and Lubricants, as Mordants for Dyeing, and for analogous uses. J. Y. Johnson, London. Eng. Pat. 449, Jan. 11, 1886. 6d.

By this invention heavy hydrocarbons or mineral oils, of the type C_nH_{2n+2}, can be oxidised so as to produce saponifiable oils. To produce the effect the mineral oil is heated to about 160° C., with a varying percentage of oxyoleic acid, or with any very rancid animal or vegetable oil. Resin oils may be similarly treated. Another process, to be used alone, or in combination with the above, consists in passing a current of gaseous chlorine through the oil, oxides of the alkalis or of the alkaline earths being also present. Oils thus oxidised, with the addition of from 2 to 10 per cent. of fixed vegetable oils, may be employed as mordants in dyeing vegetable fibres.

—W. L. C.

Improved Method and Apparatus for obtaining Alizarin Oil from Oleaginous Seeds. A. Bruenstein, Moscow, Russia. Eng. Pat. 510, Jan. 12, 1886. 11d.

The seeds are decorticated, crushed in a roller mill, and there thoroughly incorporated with from 40 to 60 per cent. of sulphuric acid, distributed from a leaden and glass box, care being taken that the temperature does not rise above 50° C. After the mass has lain some hours in a lead-lined tank, much oil collects at the surface. After the removal of this the mass is stirred up with water, and after subsidence, more oil is removed. Oil thus prepared is said to be 10 per cent. better than the ordinary alizarin oil prepared from *Ricinus*, and the cost of preparation to be from 2s. to 4s. per pound less. Drawings are given.—W. L. C.

Lubricants for Steam Cylinders. J. Dewrance. Eng. Pat. 2178, Feb. 15, 1886. 4d.

Plumbago alone, as a lubricant in marine engines, is often washed away by the condensed water. The patentee, therefore, mixes it with an insoluble soap of lead or lime.—W. L. C.

An Improved Process for the Saponification of Fatty Bodies. E. Edwards. From L. Rivière, Paris, France. Eng. Pat. 2762, Feb. 25, 1886. 8d.

The novelty of the process consists mainly in the apparatus (a drawing of which is given) employed for the purpose of mixing fats with (1) alkalis for the production of hard and soft soaps; (2) milk of lime for the ultimate production of stearic acid; (3) sulphuric acid; (4) steam

or aqueous vapour alone. Two supply tanks hold the liquids to be mixed (for soaps, fat at 80° C., and alkaline ley at 10 per cent. strength and 80° C.), whence the liquids run into an "integrator" and thence into a reaction vessel. All the vessels are air tight, and communicate with each other by pipes furnished with cocks to regulate the flow of the liquids. For some purposes a series of integrators and reaction vessels is provided.
—W. L. C.

Making Self-extinguishing Candles. R. Ashton, Heaton Mersey, near Manchester. Eng. Pat. 9294, July 17, 1886. 8d.

DIVIDERS—*i.e.*, hollow cones or discs, or saucer-shaped pieces of non-combustible material (usually tin plate)—are attached to the wick before the combustible material is put round it. These dividers are kept in their places by fine wire, twisted on the wick. This arrangement extinguishes the flame when the latter burns down to it.
—W. L. C.

The Treatment of Spent Soap Lyes, Crude Glycerine, and other Solutions containing Glycerin, for the Removal of Impurities and the Recovery of Glycerin and other Products therefrom. G. H. Allen, Sheffield, and B. Nickels, London. Eng. Pat. 11,069, August 31, 1886. 6d.

THE patentees claim the use of a soluble salt of copper (either cuprous or cupric) for the precipitation of impurities from the lyes, which may or may not be subjected to a preliminary purification by treatment with acid, and with an iron salt. The precipitates thus formed are separated by subsidence or filtration, and the copper recovered therefrom by roasting and treatment with sulphuric acid. Instead of using iron and copper salts, a current of electricity (E.M.F. at least 4 volts) may be passed through the lyes, with an anode of iron or iron alloy, and copper or copper alloy.—W. L. C.

An Improved Wash or Dip for Sheep and other Animals, the same being applicable for Washing Fabrics or other Materials. A. MacArthur. Eng. Pat. 14,984, Nov. 18, 1886. 4d.

NAPHTHA, soft soap, and pearl ash, with or without the addition of ether, benzene, benzoline, or creosote, are mixed and diluted with water.—W. L. C.

XII.—PAINTS, VARNISHES, AND RESINS.

An Asphaltic Protective and Preservative Covering for the Decks of Ships and similar Craft, and Methods of treating and applying the same. E. F. Wailes, Newcastle-on-Tyne. Eng. Pat. 2060, Feb. 12, 1886. 6d.

THE covering consists essentially of asphalt or bitumen (natural or manufactured), or of asphaltic or bituminous compositions, in which asphalt or bitumen forms the chief ingredient, treated by two different processes, termed by the inventor the dry and liquid process respectively. In the dry process, the asphalt or bitumen, or compound containing one of these substances, is ground to powder and roasted in a furnace; then, the ship's deck having been rendered perfectly clean and dry, and holes or defective places having been filled up or made level, the powder is spread, whilst hot, over the surface to the required thickness, and consolidated by applying heavy weights by a roller or otherwise. The surface may then be smoothed by the application of heated irons—flat or as rollers—and, if necessary to give a firm footing, it may afterwards be sprinkled with sand, powdered granite, or any gritty substance, etc. According to the liquid process, the asphalt or bitumen or composition is melted in a furnace boiler, together with oil, coal-tar, pitch, etc., in such proportions as to give the consistency required for the conditions under which it is to be used, especially having regard to the changes or temperature to which it may be exposed. Being thoroughly melted and mixed, the composition is run on to the surface of the deck, in its heated state, the deck having been previously prepared and cleaned as above described. When set, or nearly so, the surface of the composition may, if required, be consolidated and smoothed by application of a roller, or may be treated by sprinkling sand, powdered granite, etc., upon it.—E. G. C.

Improvements in obtaining Pigments. D. Swan, Braeside, N.B. Eng. Pat. 2310, Feb. 17, 1886. 4d.

ONE of the objects of this invention is the utilisation of ferrous chloride arising in the galvaniser's and other industries, but it is also advantageously applicable when the protochloride is specially made for the purpose of producing pigments. The solution of ferrous chloride is mixed with carbonate of lime or some other alkaline earthy carbonate, and the mixture is submitted to agitation and aëration. The result of the operation is to form a solution of chloride of calcium or other metal, and a precipitate which is of a yellow colour, and well suited for use as a pigment. If the mixture contain as much ferrous chloride as corresponds to 56 parts by weight of iron with 100 parts by weight of carbonate of lime, the resulting pigment will be of a deep yellow colour inclining to orange, whilst if there be a larger proportion of carbonate of lime the colour will be a pale or lighter yellow. If a red colour is desired it can be obtained, as is well known, by heating or calcining the deep yellow pigment, the result being a pure oxide of iron. The precipitated pigment is finished by washing and drying; whilst the chloride may be utilised in any known way.—E. G. C.

An Improved Anti-fouling Composition for Ships' Bottoms. W. Carter, Sunderland. Eng. Pat. 15,561, Nov. 29, 1886. 4d.

THE composition is prepared in two forms, one of which is for a priming or first coat, which protects the iron from corrosion, and the other for application on the top of the first, forming a second coat. The "priming" or first coat consists of the following ingredients in approximately the proportions given—viz., for 112lb.: pure zinc, 20lb.; "Turkey red," 6lb.; resin, 39lb.; mineral turpentine, 15lb.; and boiled oil, 32lb. The second coat consists of the following constituents:—For 112lb: "Turkey red," 20lb.; mineral green, 10lb.; resin, 30lb.; mineral turpentine, 25lb.; and boiled oil, 27lb. The ingredients in each are mixed in a furnace pot—the zinc and Turkey red in the first coat, and the Turkey red and mineral green in the second coat—with boiled oil; then the resin, having been dissolved, is added, and the consistency is further reduced by the boiled oil. After cooling, the turpentine is added, and the whole thoroughly mixed and stirred, and put into casks for use.
—E. G. C.

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

Treating and Preserving Hides and Skins. E. A. Brydges, Berlin, Germany. Eng. Pat. 14,946, Nov. 17, 1886. 4d.

THIS invention consists in the application of "fossil-meal" or "Kieselguhr" for preserving hides or skins during transport from putrefaction or the attacks of insects. Raw fossil-meal, simply dried, can be used, or it may be calcined either in absence or presence of air. The calcined meal is extremely hygroscopic, absorbing the moisture of the hides or skins. The hides to be dried are spread out on a layer of fossil-meal, and covered with a second layer of it.—B. H.

An Improved Process of Tanning. H. H. Lake, London. From A. Millochau and F. Chailly, Paris, France. Eng. Pat. 15,200, Nov. 22, 1886. 6d.

THE chief object of this invention is to shorten the time of tanning. The tanning is effected in a pit of ordinary construction, and air is injected at the bottom of each pit through a pipe connected with a fan. The hides are suspended from bars at the upper part of the pit, which can be hermetically closed by a hinged cover or other means. The air can be drawn from the top of the pit by the pump, and injected again at the bottom, or fresh air can be injected. The liquor can be prepared in the same pit as the hides by introducing the material and water, or it may be prepared in another pit fitted with the air injecting apparatus.—B. H.

XIV.—AGRICULTURE, MANURES, Etc.

On Manures. K. H. Neuffer. Chem. Zeit. **10**, 1057.

THE author has observed that sugar-beet, growing in clayey marl, was improved by manuring with potassium phosphate. The amount of sugar also increased. Potassium phosphate is probably advantageous as a manure in soil rich in lime, raising both the quantity and quality of the plant. The author then remarks on the different action of potassium phosphate and superphosphate as manures. The latter, moreover, usually contains chlorine, and in dry seasons this is sometimes very disadvantageous. Manure containing sulphates must not be used in soil rich in gypsum. Potassium phosphate has no effect in soil containing much potash and little lime. In such soil, Thomas-slag, etc., should be employed.—A. R.

Treatment of Thomas-slag. L. Blum. Chem. Zeit. **10**, 1556.

TO avoid grinding the slag it is proposed to act on the fluid slag, as it runs out of the converter, with a jet of steam, under a pressure of 2—4 atmospheres. It is a well-known fact that slag-wool is made in this way, but Thomas-slag always contains a large excess of lime, so that the slag is reduced to a fibrous and powdery mass, which needs no further disintegration for manuring purposes. Should the slag be very fusible (when fluorspar or alkalis have been added), it can be run off into a waggon, and then treated with steam. With regard to the chemical action of the aqueous vapour, it is found that the metallic granules are oxidised, and some of the sulphur is eliminated as H_2S.—A. R.

XV.—SUGAR, GUMS, STARCHES, Etc.

Purification of Syrups and Molasses. Journ. Fabr. Sucre, **27**, 46.

DUREAU describes a method, successfully employed at Bresles, for purifying syrups and molasses. The green syrup is treated according to purity, amount of sugar it contains, and alkalinity with dilute hydrochloric acid and milk of lime, of 25° B., then boiled up with steam, diluted to 2—3°, again heated to 75°, and filtered through Puvrez's sack-filter. A quantity of the thin purified juice corresponding to about 40kilos., is now introduced, by means of the forcing pump, into the fourth diffuser. The diffusion battery has 12 vessels of 25 hectolitres capacity. In a charge, 77 vessels are filled with 1280kilos. of beet, and each time 1800 litres of liquid extract of 4° B. are drawn off. The rest of the process is that usually adopted. At Bresles 5 per cent. of the syrup, reckoned on the weight of the beet, is returned to the extract, and a yield of 1 per cent. higher in sugar is thus obtained without any extra outlay.—A. R.

Abnormal Beet and the Quantity of Pulp in the same. Deutsche Zuckerindustrie, **11**, 1778.

IN consequence of the frequent assertions that beet poor in juice contains only 88—90 per cent. of the latter, whence it should follow that there must also be 10—12 per cent. of pulp, Lippmann has made several direct determinations of pulp in such beet, and the results agree with previous analyses of other chemists. In examining 38 separate specimens of beet, certified poor in juice, the amount of pulp was in 3 cases less than 4 per cent., and in 30 cases less than 5 per cent.; the heads of very big beet contained no more pulp than the rest of the beet (always below 5 per cent.); normal and spuig beet, after lying for a week in the store, had hardly gained 1 per cent. in pulp. The so-called lack of juice can therefore not be due to the quantity of pulp in the beet, but only to its quality. In determining the quantity of pulp, the temperature of the extracting medium has a considerable influence on the results obtained; thus water of 60°, 80 and 100° gave 4·63, 4·12, 3·72 per cent. pulp respectively.—A. R.

Purification of Beet Juice with Aluminium Bisulphite. Suchomel. Deutsche Zuckerind. **11**, 1820.

BEET JUICE is doubly saturated with 3 per cent. of lime, carbonic acid being passed in simultaneously. Saturation is carried to within 0·02 of alkalinity. For every 3000 litres of this juice 1 litre of the bisulphite solution is added; the syrup of 20—24° B. is treated for every 2000 litres with 4—5 litres of the bisulphite, then with 1 litre milk of lime, and saturated to 0·08—0·10, then passed through filter-presses and boiled down. The bisulphite solution had a sp. gr. of 20—24° B., and contained 6·73 per cent. SO_2, 1·12 per cent. SO_3, 3·34 per cent. alumina, and was able to neutralise about 0·1 potash or soda alkalinity. The favourable action of the bisulphite is not one of purification but of decolourisation, and juice thus treated has an extraordinary lustre and is only slightly alkaline. Very little sulphuric acid passes into the juice, so that the boiled sugar mass and the sugar are very much freer from gypsum than when calcium bisulphite or SO_2 gas are employed, the efficiency of which cannot, moreover, be determined so readily.—A. R.

The Amount of Saltpetre contained in Sugar Beet. Sucrerie Indigène, **28**, 489.

FAUCHER has recently drawn attention to the large amount of nitrates, especially saltpetre, contained in beet, and he gives analyses by Ladureau and Corenwinder, according to which the quantity of nitrates in the beet is practically independent of the nitrates contained in the manure. Thus the former analyst found in 100kilos. of beet, grown in soil manured with nitrates, 113grms. saltpetre, in soil manured with stable manure 305grms. saltpetre. The nitrates pass into the molasses and from these into the osmose-water, so that by evaporating and crystallising the latter, crystallised salts containing 46—50 per cent. saltpetre can be prepared, which is of course a very useful by-product.—A. R.

Analysis of the Filter-press Cake from the Manufacture of Sugar from Beet Root. Sidersky. Bull. Ass. Chim. **4**, 295.

THE press-cake contains soluble and insoluble sugar. In order to determine the quantity of each kind, two samples of the cake, each weighing 16·2grms., are ground with about 50cc. of water to a homogeneous paste. One sample is put directly into a 100cc flask, treated with a little basic lead acetate, made up to 100cc., filtered and polarised. To the other sample, acetic acid is gradually added, stirring continually, until the reaction is just neutral and a light scum appears on the surface. It is then treated with lead acetate and so forth, as mentioned above. The result of the first polarisation represents the soluble sugar, that of the second the total sugar; the difference of both results is the insoluble sugar.—S. H.

XVI.—BREWING, WINES, SPIRITS, Etc.

Barley for Brewing Purposes. Maerker. Wochensch. f. Brauerei, 1886, **3**, 685.

THE barley for brewing purposes has improved in the province of Saxony, the best being "Chevalier" barley. Then follow barley seed, Danish barley, finally Slovacian barley. Of foreign barley, the Scotch pearl and golden melon barley are preferable. A good barley should be comparatively heavy (68·5—69·6kilos. per hectolitre). The percentage of albumen should not exceed 8·5, with 15 per cent. of water in the grain. The numbers refer to good and best barley of this year's growth. It is a fact that excellent barley is generally poor in proteïn substances. Concerning the effect of manure, the author says:—Excess of nitrogen is more harmful for barley than other cereals. Moderate quantities of Chili saltpetre have no worse effect than ammonium sulphate, nor does the quality of the barley seem to be improved by manuring with phosphates.

—A. R.

A New Method for Preventing Secondary Fermentations in the Industrial Production of Alcohol. U. Gayon and G. Dupetit. Compt. Rend. **103**, 883.

The secondary fermentations, which diminish the yield of alcohol, and also give rise to the production of a spirit of unpleasant flavour, may be entirely avoided by addition of small quantities of bismuth salts. A fermentation of a mixture of soluble maize and beet molasses, to 1 litre of which 0·1grm. bismuth nitrate had been added, gave the following results:—

	Acidity		Absolute Alcohol per litre.	Bacteria developed in the field of vision.
	At the beginning.	At the end.		
Fermentation with Bismuth	9	11	54·0cc.	0
Fermentation without Bismuth	9	33	50·3cc.	100

In distilleries at Bordeaux and Courrières, experiments were conducted on a large scale, and 0·1grm. bismuth nitrate was employed for every litre of wort. The fermentation in presence of this salt was characterised by the yeast remaining pure, and by the regularity with which the process could be carried out. The acidity was only slightly increased, and the yield of alcohol was greater.

	I. Fermenting Tub.		II. Fermenting Tub.		III. Fermenting Tub.	
	With Bismuth.	Without Bismuth.	With Bismuth.	Without Bismuth.	With Bismuth.	Without Bismuth.
Contents of Tub	600hl.	600hl.	200hl.	200hl.	200hl.	200hl.
Nature of Molasses	Beet.	Beet.	Cane.	Cane.	Cane.	Cane.
Specific Gravity of the Wort ..	1075	1075	1060	1060	1060	1060
Proportion of Maize Wort	1/10	1/10	¼	¼	¼	¼
Specific Gravity of Maize Wort	1031	1031	1029	1030	1035	1034
Max. Temperature of Ferment	35°	35°	32°	33°	33°	32·5°
Increase of Acidity	2·5	13·0	6·7	26·5	4·5	36·0
Per cent. Alcohol of Product ..	5·87%	5·74%	4·94%	4·71%	4·96%	4·37%

—A. R.

The Turbidity of Beer due to the Formation of Starch-Dextrin, and how to prevent it. Reinke. Wochensch. f. Brauerei, **3**, 738.

Attention is drawn to the formation of starch-dextrin in beer wort, which occurs when the washing is carried on too rapidly and the diastase is destroyed through allowing hot water to run in too fast while mashing, or when the sprinkling is done at too high a temperature, etc. The starch-dextrose is hardly visible in the wort, which runs off practically clear, but may be recognised during the mashing process by its reaction with iodine: it can be removed during the actual brewing process by careful mashing, and by slowly raising the temperature of the wort in the hop-boiler. The proportion of maltose to non-maltose is generally also normal in worts with starch-dextrin, on account of the small quantity of the latter. As soon as the beer becomes richer in alcohol during fermentation, the turbidity appears, due to separation of starch-dextrin. In place of the usual remedy—viz., malt powder as such, which with the adhering dust would again introduce sporules into the beer—the author recommends a cold aqueous and filtered decoction of 1grm. malt for every 1 hectolitre of beer; even better is the addition for each hectolitre of turbid beer, of 0·03grm. pure diastase prepared according to Lintner. The saccharification, which now proceeds very rapidly, may be traced by the iodine reaction.—A. R.

On the Alcoholic Fermentation of Dextrin and Starch. U. Gayon and E. Dubourg. Compt. Rend. **103**, 885.

The alcoholic ferments (*saccharomyces*) are well known to be without action on dextrin or starch solutions, as well as on the dextrin of wort. The authors have discovered a new ferment in a specimen of mucor which possesses the double property of saccharifying both dextrin and starch and of fermenting the products; but this mucor cannot invert saccharose and convert it into alcohol. To a 10 per cent. dextrin solution some pure mucor was added on the 17th August; the fermentation proceeded regularly:—

	Reducing Sugar.		Pure Alcohol.
September 6	0·32 %	....	2·8 %
,, 14	1·67	....	4·0
October 1	2·38	....	4·2

When old beer, on which ordinary yeast no longer acts, is treated with the mucor ferment, after driving off the alcohol the fermentation begins anew, and continues until all dextrin and sugar is decomposed. A certain Bavarian beer was subjected to this fermentation on the 24th July:—

	Rotation.		Reducing Sugar.		Dextrin.		Alcohol formed.
July 24	69·5 %	..	0·96 %	..	3·16 %		—
Sept. 1	0·0	..	traces	..	traces	..	3·7 %

The same beer retained its original composition, if, after removing the alcohol, it was treated with saccharomyces. Worts gave, as was to be expected, a beer much richer in alcohol when the mucor was employed than with ordinary yeast; thus, in the former case the beer contained 6·5 per cent. alcohol, in the latter 5·2 per cent. Starch ferments less energetically than dextrin and glucose; it, however, becomes partly soluble, and alcohol is formed with evolution of carbonic acid.—A. R.

On the Reduction of Copper Sulphate during the Fermentation of Wine-Must. H. Quantin. Compt. Rend, **103**, 888.

Cuprous sulphide is the only compound of copper which is absolutely insoluble in wine-must. Copper sulphate, which has been dissolved in wine-must, separates out as sulphide. On a small scale 0·05grm. copper sulphate was converted into sulphide by 1 litre of the must. On a large scale the amount of sulphate would no doubt be larger; however, the above quantity already exceeds what would be considered necessary when treating for mildew. The reduction of copper sulphate by means of the ferments therefore suffices for eliminating all copper which may have found its way into the must. Naturally air must be excluded to prevent oxidation of the sulphide. —A. R.

On Plastering of Must. A. Andoynaud Compt. Rend. **103**, 1028.

Experienced wine-growers have found that to plaster the vintage, after putting it into the fermenting vat, not only gives it a fine colour, but also makes it keep better. The author has made comparisons, by fermenting must with and without addition of gypsum. He finds that gypsum raises the efficiency of the ferment considerably, since the plastered musts ferment more rapidly and more thoroughly. The author proved that it was really the gypsum itself and not a larger proportion of acid which caused the rapid fermentation. In consequence of this shortened process of fermentation the secondary ferments, which in a later stage are liable to change the wine, are checked in their development, with the result that the wine keeps so much better.—A. R.

Improvements in the Preparation of Grain or Cereals for Use in Brewing, Distilling, and Vinegar Making. J. Fordred, Tottenham. Eng. Pat. 4891, Nov. 8, 1884; amended April 5, 1886. 6d.

The preparation of torrefied grain—more particularly barley—to be used as a substitute for a portion of the malt employed in making mashes for the above manufactures. The torrefaction is effected in hollow cylinders revolving on hollow trunnions, and which are heated in the usual way. When the barley is sufficiently torrefied, which is known by its friable texture, its colour, smell and flavour, it is crushed by means of rollers. In some cases the grain is moistened before or during the process of torrefaction (see also this Journal, 1883, 293). —G. H. M.

Improvements relating to the Manufacture of Malt and to Apparatus therefor. H. H. Lake. From J. W. Free, Boston, U.S.A. Eng. Pat. 13,738, Oct. 26, 1886. 8d.

This is a modification of the entire process of malting, together with apparatus for carrying out the same. The chief features of the process are a building with four storeys—the steeping tank being in the third; the germination promoted by steam-heat, and when sufficiently advanced checked by cold air; a mechanical stirrer which aërates the grain and also breaks off the rootlets when they become dry; drying the malt on the floors at a low temperature and screening the grain by means of an exhaust blower.—G. H. M.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(*A*) CHEMISTRY OF FOODS.

Improvements in preparing a Nutrient or Digestive and Medicinal Substance from Malt. J. Marshall, and T. A. Marshall, Govan, Lanarkshire. Eng. Pat. 13,758, Oct. 27, 1886. 4d.

The preparation of a malt flour or "ptyaloid" from malt by grinding, and separating the husks, etc., with fine sieves.—G. H. M.

(*B*) SANITARY CHEMISTRY.

Chronic Poisoning with Carbon Bisulphide. Jas. Ross, M.D., LL.D. Medical Chronicle, **5** [4], 257—269.

Two cases are reported. The first was that of a man aged twenty-four years, unmarried, and who had never suffered from any serious illness up to date of the seizure in question. He was admitted to the Manchester Infirmary, 5th May, 1886. He had commenced to work, about eight months before, in an indiarubber factory, and in this situation he was employed in the "curing-room," where he inhaled the vapours given off from the materials used there, more or less of these fumes consisting of carbon bisulphide. After working for a few weeks here, the man suffered from a burning sensation in the hands and face: these were also hot to the touch, and of a red colour. He found, however, that on putting his hands in cold water they immediately turned a livid colour, and became cold and numb, as if dead, or they looked just as if frost-bitten; in fact, he was compelled to use warm water in washing. This numbness and weakness extending gradually to his feet and legs, and being troubled with mental disturbances, he was compelled to leave work for two or three weeks, during which time he rapidly recovered. He now returned to his old work. His old symptoms soon returned, but with redoubled force, and now he soon experienced the greatest difficulty in walking, and could scarcely hold anything in his hands, which, besides being feeble, trembled a good deal, more especially when the man attempted to grasp anything. The senses of sight and hearing remained unaffected, but everything seemed to smell of the vapours of the factory he had left, and his food either seemed devoid of taste or to taste only of the loathsome vapours. The sight of food was a burden; he lost a stone in weight, and observed the wasting of his arms and legs was out of proportion to that of the rest of his body. On leaving work in the evening, he often walked like a drunken person, and talked much nonsense. The memory almost entirely failed; at night he was restless, or, if sleeping, was disturbed by horrid dreams. In the mornings he felt miserable and depressed, and even found, on return to work, some relief from again inhaling the gas—at first, at least. Sheer feebleness at length prevented this man from crawling to his work, and he was laid up for four weeks. He next got employment at a tarpaulin factory, but soon found himself unable to work, so feeble had his hands become. Not only had there been a great loss of power of the brain centres regulating memory, but those affecting important nervous functions had also much suffered; sexual appetite, for example, had been lost. He contracted colour-blindness, also, to some extent. The paralysis of principal muscular centres was, of itself and alone, such as to reduce the patient to a condition of pitiable weakness and helplessness.

The second case much resembled the first as regards the premonitory symptoms of tingling, paralysis of muscles, tremblings, livid condition of hands if dipped in cold water, loss of taste for food, of memory, and in addition the sight became affected. The man could not read, as the words all seemed, as he said, "to run together." At length he became so feeble that he could scarcely walk, and often fell down. Sexual appetite entirely failed; shooting pains along nerve courses; little sleep possible, and that disturbed by horrid dreams; violent headaches, and a longing to get back to work, where the noxious fumes brought temporary relief, and even an exaggerated feeling of pleasure. This soon gave way to a feeling of intense apathy and wretchedness. These cases were not exceptional ones, for this man was not affected, he declared, so much as some of his fellow-workmen. He stated that some of these, under the effects of the gas, became very talkative, and often talked a great deal of nonsense. One man, *e.g.*, coming to work in the morning, declared he was in Liverpool the night before, a statement that could not possibly have been true. Another workman, apparently eager to escape from some imaginary danger, jumped through a window, ran across an open court, and having crept under a joiner's bench, tried to hide by covering himself with shavings. One or two of the workmen had gone quite mad, and had been sent to the lunatic asylum. The colour-vision of the patient here considered was defective; purple he called white, and could not distinguish red from blue.

Dr. Ross states that these cases of paralysis from the inhalation of carbon bisulphide show that such paralysis belongs to the group which is caused by various toxic agents, such as alcohol, lead, arsenic, and certain animal poisons like that of diphtheria. This paralysis, in fact, resembles alcoholic paralysis more nearly than it does any other form of multiple neuritis. Sometimes symptoms are found closely resembling those of delirium tremens, as in the case of the workman jumping through the window to hide himself in a joiner's shop. The statements and cases are well authenticated, and neither alcohol nor lead played any part whatever in the cases of these two patients, as causes or adjuncts in the paralysis observed.

Dr. Ross concludes:—"If it be true, then, that we have in our midst certain workshops in which the process of manufacture is so deleterious to the health of the workmen that a certain proportion of them is reduced in a few months to the pitiable condition of paralytic helplessness manifested by these two unfortunate men, it is hardly necessary for me to maintain, in the face of all recent factory legislation, that these workshops ought to be placed under the most stringent regulations, and be subject to the frequent visits of a Government inspector."—W. S.

XVIII.—ELECTRO-CHEMISTRY.

Improvements in Voltaic Batteries. D. G. FitzGerald, London. Eng. Pat. 335, Jan. 8, 1886. 8d.

THE inventor proposes a new peroxide plate, formed from oxide of lead and glycerine, admixed with water or with suitable saline or acid solutions. He also proposes a compound plate, having a core made in the above way, surrounded by one of the more porous oxide of lead compositions mentioned in Eng. Pat. 4671, 1885. Contact is made with the plate by platinum strips attached to a piece of ebonite, and so arranged as to make contact both with the core and the outer composition. The part of a peroxide plate at which contact is to be made may be coated with plumbago, which fills the pores and makes the contact more perfect.—E. T.

A Secondary Voltaic Battery. O. Imray, London. Eng. Pat. 611, Jan. 14, 1886. 8d.

THIS secondary cell consists of a shallow leaden trough, suitably insulated in a wooden frame, in which are placed ebonite troughs parallel to each other. These troughs contain leaden frames (the lead may be alloyed with a little tin or other white metal) on the upper side of which are numerous grooves, divided by partitions, having lips projecting over the grooves to retain the material packed in the grooves. The material consists of spongy lead or peroxide of lead mixed with metallic lead. The insulated frames united together form one electrode, while the leaden trough constitutes the other. The spaces between the ebonite troughs may be filled with frames similar to those in the troughs.—E. T.

An Improved Construction or Formation of Plates with Composition for Electric Batteries. J. H. Noad, Upton, and R. Matthews, London. Eng. Pat. 1054, Jan. 23, 1886. 4d.

ACCORDING to this method, plates of woven wire, serving as one of the poles of a battery, are coated with a compound consisting of litharge formed into a paste with glycerine. The plates thus formed are baked in an oven at a temperature of about 300° F. to oxidise the glycerine. —B. T.

Improved Construction of Secondary or Storage Batteries. G. E. Dorman, Stafford. Eng. Pat. 1610, Feb. 4, 1886. 8d.

THESE secondary batteries are formed of lead strips piled one above another, but separated from each other by wooden or vulcanised strips, and by pads or cushions of a permeable material such as glass-wool, the alternate strips being connected together in the usual way. —B. T.

XIX.—PAPER, PASTEBOARD, Etc.

Improvements in extracting Moisture from Pulp produced from Wood or other Fibrous Materials. J. T. and J. M'Dougall, Manchester. Eng Pat. 1795, Feb. 6, 1886. 6d.

IT is proposed to reduce the proportion of water usually found in well-pressed wood-pulp—generally about 60 per cent.—by pressing the pulp in bags or wrappers, and by which means it is claimed a larger proportion of moisture will be removed than has been hitherto the case.—H. A. R.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

On Dextro-Hexyl Alcohol from Roman Oil of Camomile. P. v. Romburgh. Rec. des Trav. Chim. des Pays-Bas. **5**, 219.

Two kilos. of oil of camomile were saponified, and the alcohols thus produced separated by fractional distillation. 80grms. of Köbig's hexyl alcohol were obtained, the specific gravity of which was 0·829 at 15° C. It boiled at 154°, and turned the plane of polarisation to the right —$\alpha_d = +8·2°$. On oxidising by means of chromic acid, the alcohol yielded caproic acid, $C_6H_{12}O_2$, a colourless liquid of unpleasant smell, boiling at 196—198°, and also turning polarised light to the right—$\alpha_d = +48·92°$. The amido-derivative of this acid crystallised in long needles, fusing at 124° C. The author believes that this hexyl alcohol is ββ-methylethylpropyl alcohol, $(CH_3)(C_2H_5)CH—CH_2—CH_2OH$, and its acid is ββ-methylethylpropionic acid, $(CH_3)(C_2H_5)CH—CH_2—COOH$. —S. H.

Hipe Nuts from the Cameroons. Chem. Zeit. **10**, 1528.

THIS drug consists of the cotyledons of the seeds of *Vateria indica L.*, which belongs to the class of *Dipterocarpeæ*. The plant has been known for a long time, and is extensively used in India for extracting the oil it contains. The seed, like so many other drugs containing tannin, is used as a remedy against colic. It is worth noticing that the tannin contained in these seeds becomes yellow on addition of potash, and the colour changes to a bluish-green on warming.—A. R.

On Cinchonine. W. J. Comstock and W. Koenigs. Ber. **19**, 2853—2859.

CINCHONINE combines with 1mol. of bromine to form a di-bromide, $C_{19}H_{22}N_2OBr_2$, which on boiling with alcoholic KOH loses 2HBr, and is converted into *dehydrocinchonine*, $C_{19}H_{20}N_2O$. When the latter base is treated with PCl_5 it yields *dehydrocinchonine chloride*, $C_{19}H_{19}N_2Cl$, which by boiling with alcoholic KOH is converted into *dehydrocinchene*, $C_{19}H_{18}N_2$. Dehydrocinchene can also be obtained from cinchonine by conversion into cinchene, and heating the di-bromide of the latter with alcoholic KOH.

Cinchonine dibromide, $C_{19}H_{22}N_2OBr_2 + H_2O$, was earlier mistaken for di-bromo-cinchonine, and described under that name. With cold concentrated H_2SO_4 it forms an ethereal sulphate, sparingly soluble in cold water.

Dehydrocinchonine, $C_{19}H_{20}N_2O$, crystallises from dilute alcohol in colourless needles, which melt at 202—203°, and can be sublimed. It is easily soluble in alcohol, acetone, ether, and benzene, scarcely soluble in water or petroleum spirit. The hydrobromide, $C_{19}H_{20}N_2O,HBr_2$, forms colourless prisms, and the hydrochloride, $C_{19}H_{20}N_2O,HCl$, long silky needles.

Dehydrocinchonine chloride, $C_{19}H_{19}N_2Cl$, is derived from the dehydrocinchonine by the replacement of OH by Cl. It is very soluble in benzene, alcohol, and ether, but is insoluble in petroleum spirit. It crystallises from benzene on addition of petroleum spirit, and melts at 148—149°.

Cinchene di-bromide, $C_{19}H_{20}N_2Br_2$, is obtained by the addition of bromine to a cold solution of cinchene in chloroform. It forms colourless crystals, which melt at 110—113°. The hydrobromide crystallises in colourless needles, sparingly soluble in cold water. The nitrate and zinc-double chloride are also well crystallised salts, sparingly soluble in cold, readily in hot water.

Dehydrocinchene, $C_{19}H_{18}N_2$, crystallises from dilute alcohol in long colourless needles (+3H_2O), which melt at about 60°. The hydrobromide, $C_{19}H_{18}N_2,H_2Br_2$, forms small prisms, very soluble in water, but sparingly in absolute alcohol. The platino-chloride, $C_{19}H_{18}N_2,H_2PtCl_6$, forms slightly soluble red tables. The acid tartrate is sparingly soluble in cold water.

—A. G. G.

Method for the Preparation of Lanolin and Anhydrous Lanolin from the Waste Liquors of Wool-washing Establishments, and from Commercial Wool Fat. C. D. Abel, London. Eng. Pat. 326, Jan. 8, 1886. 6d.

LANOLIN was first described in Eng. Pat. 4992, Oct. 22, 1882. For the process of its purification there described, treatment of the raw lanolin with acetone is now substituted. This dissolves out the pure fat, leaving the soaps, etc., undissolved, and the solvent may be recovered by distillation. According to another method, the crude mass may be treated with benzene, carbon disulphide, etc., when both soaps and fat are dissolved, and impurities left behind; from this, the addition of acetone precipitates the soaps, etc., leaving pure wool-fat in solution. Prior to treatment with solvents, the commercial wool-fat may be melted and heated with alkalis, alkaline earths or their hydrates, or even with oxides of heavy metals.—W. L. C.

An Improved Process and Apparatus for the Purification of Alcohol. J. A. F. Bang and M. C. A. Ruffin, Paris Eng. Pat. 783, Jan. 18, 1886. 8d.

AN improvement of Eng. Pat. 10,870, 1884. Heavy hydrocarbons boiling above 100° C. are used in place of the light petroleum spirit of the former specification; the hydrocarbons are also purified by means of strong rectified spirit instead of sulphuric acid. The apparatus used is also modified in such a way that a larger surface of hydrocarbon is exposed to the action of the alcoholic distillate, a vertical chamber divided into compartments by perforated diaphragms being used instead of separate vessels.—G. H. M.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

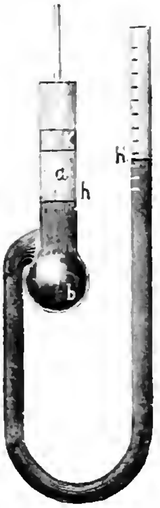
Arrangement for Combining the Operations of Heating with Reflux Condenser, and afterwards Distilling. Dr. H. Michaelis. Chem. Zeit. **10**, 1556.

THE author describes an apparatus very similar to Lintner's for simplifying this operation. The arrangement will be readily understood from a glance at the figure. The inner tube of the Liebig condenser is bent at right angles, and passes in a slanting direction through the cork.

—A. R.

Apparatus for Determining the Specific Gravity of Solids and Liquids. P. Raikow and N. Prodonaw. Chem. Zeit. **10**, 1556.

THE apparatus consists of a bent tube $a\,a^1$, the right limb of which is drawn out and provided with a cc. scale. The left limb is wider, and at b a bladder-shaped bulb is blown. Water being poured into the tube, owing to capiliary action, the heights h, h^1, to which the water rises in the two limbs, will differ. The difference being noted, the body, whose sp. gr. is to be determined, is brought into b. Part of the water is expelled, and the level of the water in both limbs is thus raised. On now compressing the air over the liquid by means of a piston k, until the original level of the fluid is again reached, the volume of water which is present over the original mark in the right limb will at once give the volume of the immersed body, whence the sp. gr. is calculated.



In determining the sp. gr. of a liquid, some fluid with which it does not mix is first brought into the tube, the heights in the two limbs noted, and the tube and fluid then weighed. Some of the liquid, whose sp. gr. is to be found, is now introduced into the left limb, the level of the fluid in a restored in the manner previously described, and the increase in volume in a^1 noted. If the tube be weighed with the two liquids, the weight of liquid last introduced is found, whence by division with its volume the sp. gr. is determined. The apparatus is said to be useful for determinations of sp. gr., where only small quantities of the liquid are at disposal.—A. R.

The Electrolytic Evolution of Arseniuretted Hydrogen for the Detection of Arsenic. C. H. Wolff, Pharm. Centr. Halle, **7**, 608.

THE author has designed a special apparatus for the detection of arsenic by the electrolytic evolution of hydrogen arsenide, which is decomposed into arsenic, thus producing the well-known arsenic mirrors. In this manner, even 0·00001gr. arsenic trioxide can be detected. With an equal strength of the electric current, the arsenic mirrors always show an equal intensity, and by comparing the mirrors obtained from known quantities of arsenic, the smallest amount may be estimated.

—S. H.

Volumetric Estimation of Zinc in Zinc-dust. F. Weil. Compt. Rend. **103**, 1013.

A COPPER SOLUTION is prepared by dissolving 12·519grms. of pure cupric oxide in a slight excess of hydrochloric acid and diluting to 1 litre, 10cc. of which contain 0·1grm. Cu. 50cc. of this solution are treated in a porcelain dish with ammonia until a slight permanent turbidity appears, but the liquid must still be slightly acid. 0·4grm. of the zinc-dust to be tested is now added, and the mass stirred from time to time with a platinum wire, until the wire no longer becomes covered with a black or red skin. The precipitation of the copper by zinc in a porcelain dish takes about one hour, whereas it can be completed in a platinum dish in ten minutes. A drop of acetic acid is added to clarify the solution, which is decanted, and after adding the washings of the copper precipitate, made up to 100 or 200cc. 10cc. of the washings are run into a flask to which from 20 to 30cc. of hydrochloric acid are added and the whole is boiled. The copper still in solution is then titrated back with a stannous chloride solution, 10cc. of which are equal to 0·04grm. Cu. By subtracting the copper thus found from the 0·5grm. Cu employed for the test, the quantity of copper is obtained which was precipitated by the zinc, and by multiplying this figure with the factor 1·0236 the quantity of zinc in 0·4grm. zinc-dust is found.—S. H.

Examination of Castor Oil for other Fat Oils. Finkener.

Chem. Zeit. **10**, 1500.

If pure castor oil be treated with concentrated sulphuric acid, a product is obtained which dissolves almost completely in forty parts of water, whereas other fat oils, such as sesame or olive oil, treated in the same manner, yield no clear solution, but an emulsion. If castor oil be mixed with one-fifth of sesame or olive oil, sulphuric acid does not detect the presence of the two latter oils, as the mixture gives sulphonic acids, which are soluble in water. But it was found that alcohol of a specific gravity of 0·829 dissolves at 17·5° C. castor oil in nearly any proportion, whereas other fat oils are only slightly soluble in the same reagent. The test is performed in glass cylinders of 100cc. capacity and 25mm. diameter, which have marks for 10cc. and 60cc., measured from the bottom. 10cc. of the oil to be tested are put into the cylinder, 50cc. alcohol added, and, after inserting the stopper, shaken, and then allowed to stand for two to three minutes. A strong turbidity, which does not disappear even at 20° C., shows that the oil was not pure castor oil, but contained at least more than ten per cent. of other oils.—S. H.

On the Determination of Sulphur in Albuminoïds. W. Kochs.

Chem. Centr. **17**, 894.

According to the author, it is the amount of sulphur in albuminoïd which decides whether it belongs to the albuminoïds proper or to the glutens. Furthermore, it is stated that one may calculate approximately the quantity of glutinous- and of albuminoïd-peptone in a mixture of albuminoïds, such as peptone preparations, when the amount of sulphur contained in the latter is known. The reason the numbers previously given by the author differ from those of Fresenius is due to the fact, that Carius' method is not well applicable to albuminoïds, since at the temperature employed all the sulphur is not converted into sulphuric acid. Whether the temperature is kept for two hours at 120°, or three hours at 200°, is immaterial to the final result. On heating higher, explosions generally occurred. Good results were, however, obtained with Liebig's method for determining sulphur. It may be assumed that muscular albumen contains from 1—1·2 per cent. sulphur, but that muscular gluten is quite free from sulphur. For certain bodies, particularly albuminoïds free from ash, Liebig's method is not practicable, owing to the violent evolution of gas. Such bodies are first evaporated with ten times their weight of nitric acid (sp. gr. 1·4) on the water bath, and the residue is melted in a silver crucible with caustic potash and a little saltpetre.—A. R.

On the Examination and Colorimetric Determination of Salicylic Acid. Frehse.

Journ. Pharm. Chem. **14**, 507.

The following precautions are necessary in order to obtain good results in the determination of salicylic acid by means of ferric chloride:—1. The standard solution which serves for comparison must frequently be renewed, since dilute solutions of salicylic acid and also its sodium salt are gradually decomposed. (A solution of 0·05grm. salicylic acid in 1 litre gave no colouration with ferric chloride after five months.) 2. The salicylic acid must first be extracted with ether, and no coloured solutions should be directly examined, for many bodies weaken the colour reaction or suppress it entirely, such as acids, alkalis, neutral salts—viz., phosphates, tartrates, oxalates, etc. 3. The ferric chloride solution must be very dilute, for with small quantities of salicylic acid a slight excess of ferric chloride destroys the colouration.—A. R.

Contribution to the Assay of Opium. E. Dieterich.

Pharm. C.-H. N. F. **7**, 529, 541.

Knowing that all processes in common use for testing opium give unreliable results, the author has examined the method employed by Flückiger with a view to its perfection. The chief objections to this process are:—The addition of alcohol hinders the precipitation of the morphia, and, on the other hand, promotes the separation of calcium salts. The deposition of the alkaloid is influenced by the duration and intensity of the shaking (*Chem. Zeit.* **10**, 1224). And finally, the author finds that on adding the ammonia slowly a flocculent precipitate of narcotine at first separates (the whole of this body being separable by accurate neutralisation), and is afterwards masked by the crystalline morphia precipitate. He therefore recommends the adoption of the following methods, which are expeditious and accurate:—

For Opium Powder.—6grms. of the dried substance are extracted with 60grms. of water with occasional shaking during 12 hours. After filtration 2cc. of normal ammonia are added to 50grms. of the solution, and the narcotine is removed by passing through a 10cm. filter. 44·4grms. of this second filtrate (=4grms. opium) are then mixed in a weighed Erlenmeyer's flask with 10grms. of ether and thoroughly shaken for one minute, then with 4cc. of normal ammonia, and again shaken; after standing for six hours the ether layer is poured off through an 8cm. filter, a further quantity of 10grms. of ether is then agitated with the liquid, and after separation filtered, and finally the aqueous solution is passed through the same filter, the crystals clinging to the walls of the glass vessel being disregarded. The flask and filter are each washed twice with 5cc. of ether-saturated water and dried at 100° C. The crystals of morphine may then be transferred without loss by means of a camel-hair brush from the filter to the flask, where they are heated at 100° until the weight is constant.

For Opium Extract.—3grms. are dissolved in 42grms. of water, and after one hour treated with 2cc. of ammonia and filtered as above; 31·7grms. of the filtrate (=2grms. extract) are then used for the subsequent stages of the process, which are conducted as in the case of the powder.

For Opium Tincture.—50grms. are evaporated to one half their bulk; the original volume is made up with distilled water, and the assay completed as already described, 44·4grms. (=4grms. tincture) of the filtrate from the narcotine being employed.—W. G. M.

Pure Butter and Artificial Butter. Professor Scheffer.

Pharm. Rundsch. **4**, 248.

Pure butter differs from artificial butter by containing very little or no stearine. The author has based on this fact an easy method for distinguishing between the two. He prepares a solution, which is a mixture of 40 parts by volume of rectified fusel-oil, and 60 parts by volume of ether (sp. gr. 0·725). 1grm. of pure butter dissolves in 3cc. of this mixture at 26—28° to a clear solution; the same weight of beef-suet requires 50cc. for complete solution, 1grm. lard 16cc., and 1grm. stearin as much as 550cc. of the solvent. In examining samples 0·5 to 1grm. of fat is introduced into a 12cc. test tube, 3cc. of the solvent are added, and the well-corked test tube heated in a water bath with frequent shaking from about 18° to 28°, and kept at 28° for some time. Pure butter dissolves to a clear fluid; if the contents of the test tube are not clear, more of the solvent is introduced from a burette, until all is dissolved. The greater the quantity of the solvent required for complete solution the greater is the adulteration of the butter. As is apparent from the following numbers, it is possible to estimate approximately the extent of the adulteration. Thus:—1grm. pure butter required 3cc.; 0·1grm. lard and 0·9grm. butter, 3·9cc.; 0·2grm. lard and 0·8grm. butter, 4·8cc.; 0·3grm. lard and 0·7grm. butter, 5·7cc.; 0·4grm. lard and 0·6grm. butter, 6·5cc.; 0·9grm. lard and 0·1grm. butter, 14·4cc.—A. R.

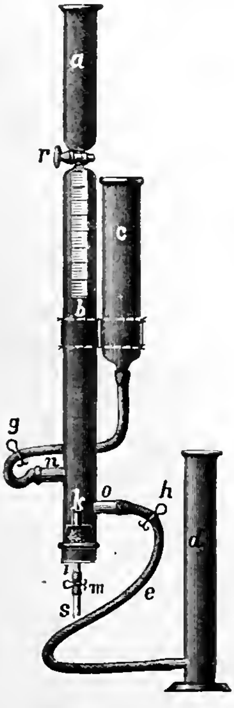
The Colour Reaction given by Morphine with Sulphuric Acid. Gasselin and Lévy. Pharm. Chim. **14**, 458.

According to Donath (this Journal, 1886, 618) morphine gives a colour reaction with sulphuric acid in presence of potassium arsenate. The authors find that the latter has nothing to do with the reaction, as the colouration is just as intense with pure sulphuric acid. Presence of various salts, such as phosphates, does not interfere with the reaction. As Jorissen has already pointed out, pure codeïne gives a similar colouration, but less intense.
—A. R.

New Apparatus for the Determination of Urea. G. Frutiger. Bull. Soc. Chim. [2], **46**, 611.

The lower end of the burette *b* is provided with two short side tubes, *o* and *n*; a stout piece of caoutchouc tubing connects *o* with the cylinder *d*, which is filled with mercury, and *n* similarly communicates with the tube *c*. This latter is fastened to *b* by means of brass wire. The lower end of the burette is furnished with a caoutchouc stopper, and through it passes the tube *k*·*l*, which reaches to the level of the side tube *o*, and is closed below by a stop-cock *m*.

In order to use the apparatus, water is poured into *c*, and a portion of it allowed to flow into the burette. *g* is now closed and *m* opened, so that the water passes out of the burette, care being taken that *k s* remains full of water, and that no air-bubbles can enter. The apparatus is then complete for use for any number of determinations. By raising *d*, the burette and a portion of *a* are now filled with mercury; stop-cock *r* is now closed and *d* again lowered. Should there be a film of water on the mercury in *a* it must be removed. 1cc. urine is now introduced into *a*, and, having opened *r*, is allowed to flow into the burette. After washing down with a little water, sodium hypobromite is introduced into *a*, and from thence passed into the burette, when the stop-cock is quickly turned off. The gas is set free, and some mercury is expelled into *d*. After the evolution of gas has ceased, the mercury still contained in the burette is removed by pouring water into *a* and slowly opening stop-cock *r*. When the mercury has reached the level *o*, the water containing hypobromite is expelled by again passing water from *a* through *r*, and opening *m* slowly. To prevent any air from entering, there must always be some water in *a*. For measuring the volume of gas, *r* and *m* are closed; *g* is then opened, and the level of the fluids in *b* and *c* adjusted by adding or removing water from *c*. The analysis is complete in a few minutes. About a pound of mercury is required.—A. R.



Examination of Different Extracts. Schweissinger. Pharm. Centr. Halle, **7**, 597 and 613.

Extractum Graminis.—Both the dry root and the extract contain mannite, fructose, dextrin, lactates, and triticin, a substance related to inulin. The aqueous solution of triticin turns the plane of polarisation to the left, upon which reaction an adulteration of the extract with dextrogyrate substances can be based. A 10 per cent. solution of the genuine extract polarised $a_d = -5·3°$; after inversion, $a_d = -7°$.

Extractum Trifolii. — The vegetable bitter can be easily separated by digestion with animal charcoal. 20grms. of extr. trif. dissolved in 150cc. of water and digested for two days with 10grms. of freshly-calcined charcoal are completely deprived of any bitter principle. By boiling the charcoal with alcohol, the vegetable bitter is dissolved, and remains behind after driving off the alcohol.

Extractum Colombo.—A few grains dissolved in water acidified with sulphuric acid form a clear solution of lemon-yellow colour. Chlorine water turns the solution red, which finally becomes colourless.

Extractum Hydrastis canadensis. — The solution of this extract gives the same colour reaction as that of extr. col., and this may be accounted for by the presence of berberine in both extracts. One drop of the liquid extract dissolved in 1cc. of water turns red with two drops of fuming nitric acid.

Extractum Ligni Campechianii.—Logwood extract is frequently adulterated with molasses or dextrine. Since a pure extract contains no substances which act on polarised light or Fehling's solution, these adulterations can be easily detected by precipitating the liquid extract with lead acetate and examining the filtrate.—S. H.

Remarks on Molisch's New Reactions for Sugar. Lenken. Apoth. Zeit. **1**, 246.

Molisch's reactions (*Chem Zeit.* **10**, 620) consist in the production of a violet or red colour by the action of sulphuric acid on α-naphthol or thymol in the presence of sugar. Normal urine treated in this manner turns violet or red, and Molisch therefrom concluded that normal urine contains sugar. Leuken closely examined these reactions, and showed that the colour obtained with grape-sugar is different from that obtained with urine, if the process be slightly modified. Sugar and the glycosides generally show similar colour reactions with a large number of aromatic compounds—menthol, for instance, giving more distinct colours than α-naphthol or thymol. Besides sugar, all those compounds which split off sugar by the action of sulphuric acid, such as amygdalin, salicin, piperin, cumarin, etc., give a violet-red colour with menthol and sulphuric acid. Alkaloids do not show this peculiarity, and this reaction is therefore suitable for the examination of alkaloids for sugar and glycosides. The author also showed that thymol and sulphuric acid produce a red colour with different compounds which are normal constituents of urine, and the red colour caused by thymol and sulphuric acid is therefore no proof of the presence of sugar in urine.
—S. H.

Notes on New Sugar Reactions. T. Seegen. Centralblatt. Med. Wiss. 1886, 44.

SOLUTIONS of peptone, pure egg-albumen, serum-albumen, and casein mixed with a solution of *α* naphthol or thymol give on addition of concentrated sulphuric acid in excess the same reaction, which Molisch has recently described as a reaction characteristic of sugar and other carbohydrates. Possibly the albuminoïds are decomposed by the sulphuric acid with formation of sugar. At all events, Molisch's reaction has lost value, and certain conclusions drawn from it have therefore become untenable—such, *e.g.*, as the assertion that "normal urine unquestionably contains sugar."—A. R.

Modifications of Kjeldahl's Method of Estimating Nitrogen. C. Arnold. Arch. d. Pharm. 1886, 792.

THE author recommends the following alterations:—

1. The flask in which the substance is heated with sulphuric acid is closed by a test-tube, the middle of which is expanded into a bulb in order to avoid loss by spirting (Fig. 1). This form of stopper is to be preferred to the tapering pear-shaped one, for it is less liable to be blown out by the bumping of the liquid, and as the condensed dilute sulphuric acid does not drop so readily from it into the hot liquid below, spirting is to a great extent avoided.

2. In the distillation of the ammonia, caustic soda may be carried over into the receiver, and many forms of apparatus have been devised to prevent this. The author recommends that of Dr. Müncke (Fig. 2). Pure caustic soda and zinc may be heated in it for hours, and even when frothing, bumping, or spirting occurs, no caustic is carried over. Attention must be paid to the following points: Caustic soda, when not purified by solution in alcohol frequently contains nitrites, which yield ammonia when heated with zinc. If mercury is employed, potassium sulphide must be added to the caustic alkali in order to decompose mercury-ammonium compounds. For 1grm. of mercury 10cc. of a 20 per cent. solution of potassium sulphide are required. The sulphide must be tested for nitrites and nitrates.

FIG. 1.

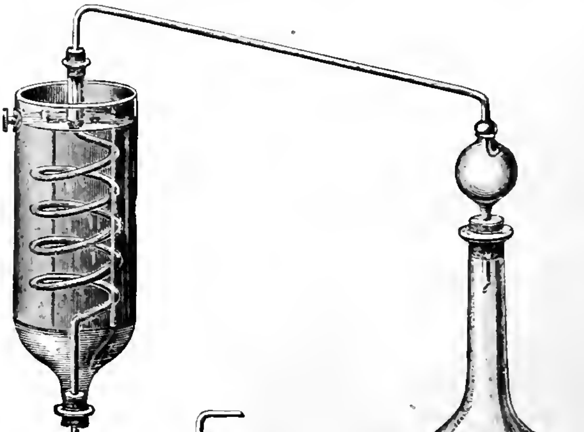


FIG. 2.

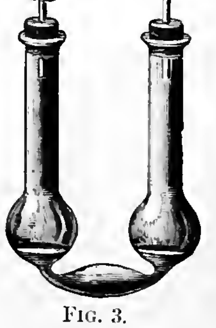


FIG. 3.

3. The ammonia is best collected in a Peligot's tube (Fig. 3). With this apparatus it is easy to ascertain whether the joints are air-tight, and the titration may be carried out in the tube itself.

4. The author employs $\frac{1}{5}$ normal solutions of hydrochloric or sulphuric acid and $\frac{1}{5}$ normal solution of ammonia, and recommends fluorescein as the best indicator. Neither organic acids nor fixed alkalis should be employed in the titration. With a black glass plate placed below the Peligot's tube, the fluorescence becomes quite visible on addition of a single drop even of $\frac{1}{5}$ normal ammonia solution, after the acid has been neutralised. The dilute solution of ammonia does not absorb carbon dioxide from the air, and complicated apparatus for the protection of the liquid is therefore unnecessary.—S. Y.

Notes on the Testing of Quinine. E. de Vrij. Nieuw. Tijdsch. v. d. Pharm. in Nederland, **2**, 365.

WHEN 4grms. of quinine sulphate are dissolved in 400grms. of boiling water, 1grm. of potassium chromate dissolved in a little water added, and the liquid put aside for several hours, quinine chromate is deposited in crystals, which are anhydrous, and have the composition $(C_{20}H_{24}N_2O_2)_2H_2CrO_4$. One part of this salt dissolves in 2733 parts of water at 14° C. For testing quinine for cinchonidine, 5grms. quinine sulphate are dissolved in 500grms. of boiling water, 1·2grm. potassium chromate dissolved in a little water added, and the liquid allowed to stand until the next day. The crystals of quinine chromate are then filtered and washed. The filtrate is warmed on the water-bath with sodium hydrate for some time, whereby the cinchonidine is precipitated, which is filtered, dried, and weighed. For determining quantitatively the amount of pure quinine in quinine sulphate, 2grms. of the latter are dissolved in 200grms. of boiling water and treated with 0·5grm. of potassium chromate, as previously described. The crystals are filtered, washed, dried, and weighed, and for every 100cc. of the filtrate 0·05grm. quinine chromate is added to allow for the slight solubility of quinine chromate. From the latter the amount of quinine can be directly calculated.
—S. H.

A New Reaction of Thymol. R. Stoermer. Pharm. Zeit. **31**, 744.

If thymol be dissolved in concentrated potassium hydrate solution, and the liquid slightly warmed, on adding a few drops of chloroform a violet colour is at once produced, which on shaking turns reddish violet. 0·01gr. thymol can be thus detected. The liquid soon separates in different layers: the lowest (chloroform) is red, the middle (potash lye) is scarcely coloured, and the top one (thymol) is dark violet.—S. H.

A New Reaction of Tannic Acid. J. E. Saul. Pharm. J. Trans. **3**, 387.

A USEFUL METHOD for distinguishing gallic acid from tannic acid is the following: 0·01gr. of tannin is shaken with 3cc. of water. Three drops of an alcoholic thymol solution and 3cc. of concentrated sulphuric acid are added. Pure tannin produces a turbid pink solution, whereas gallic acid remains colourless. Pyrogallol gives a dark violet solution.—S. H.

The Applicability of Nitroso-β-Naphthol for the Estimation of Ferric Oxide in the Presence of Alumina. Em. Breutel. Ber. österr. Ges. z. Förd. d. Ind. **8**, 129.

Ferric salts are completely precipitated by nitroso-β-naphthol, ferrous salts but slowly and incompletely. In a mixture of the two oxides, both the oxide and the protoxide are completely precipitated. The process is especially useful in the analysis of clay, which contains but little iron, and for the estimation of iron in aluminium sulphate. If so little iron is present that nitroso-β-naphthol only produces a very slight precipitate, the author determines the iron in the cold solution colourimetrically by means of potassium ferrocyanide. —S. H.

Method of and Apparatus for Determining the Quantity of Fat in Milk. C. G. P. De Laval, Stockholm. Eng. Pat. 8610, July 16, 1885. 8d.

The milk is warmed with an equal volume of acetic acid, containing one volume in twenty of sulphuric acid. It is then introduced into a fine glass tube, open at both ends, which is subjected to very rapid rotation in a centrifugal machine. The fine glass tube is graduated, and in this part the fat collects, so that its percentage can be easily read off. Twelve tests can be made simultaneously in ten minutes, or seventy-two tests per hour by the apparatus, which is described and figured. The speed of revolution is 6000 per minute. It is claimed that the results are accurate to within 0·5 per cent. of the total fat present, or within 0·02 per cent. on the milk.—W. L. C.

Determinations of Fat in Milk. M. Kretzschmar. Chem. Zeit. **10**, 1556.

The hard mass resulting from evaporating milk, etc., in which the fat is to be determined, with gypsum, is only with difficulty entirely removed out of the dish. The author proposes the following improvement:—A ball of cotton wool is made, the half of which must be somewhat larger than the interior of the evaporating dish. A square piece of tinfoil, about 14·8cm. in length (its thickness should be such that it weighs about 2·4 grms.), is placed on the dish (diameter for 20cc. of liquid about 8·7cm.), the foil firmly pressed into the dish by the aid of the cotton-wool ball, and fixed by turning its edges downwards over the edge of the dish. Gypsum is now spread over the foil, and the milk, etc., introduced. The milk can be readily evaporated without stirring. The whole mass, including the tinfoil, is then lifted out of the dish and pulverised. The tinfoil is cut up and extracted together with the powder.—A. R.

New Books.

Chemiker-Kalendar, 1887. Ein Hulfsbuch fur Chemiker, Physiker, Mineralogen, Industrielle, Pharmaceuten, Huttenmanner, u.s.w. Von Dr. Rudolf Biedermann. Achter Jahrgang. Mit einer Beilage. Berlin: 1887. Verlag von Julius Springer. London: H. Grevel & Co., 33, King Street, Covent Garden.

Small 8vo volume in pocket-book form, containing Calendar and table of frequently-used Atomic Weights in the cover, Title-page, Preface and Table of Contents; also Diary, followed by 28 blank pages for the record of notes, etc. Then follows a most complete set of data in tabulated form, supplying almost every imaginable need of the Chemist that can be supplied by such means, and the work closes with a few pages ruled for the recording of names and addresses, fly-leaves at the end supplying the German Post-office Regulations, and a complete Railway Map of the German Empire. The text covers 289 pages. A small paper-covered volume, forming an Appendix to the Kalendar, and termed the "Beilage zum Chemiker-Kalender, 1887," supplies also, in tabular arrangement, the wants of the Physicist, in giving all the more commonly required physical constants and other data, and closes with an Appendix specially interesting to students desirous of gaining information as to the Professors and Docenten in the various German Polytechnic Schools and Universities, and to the subjects taught in those institutions. Not even the limited means of the poorer classes of students are forgotten, and a tabulated list is given of the prices of the various sizes of the more important articles of chemical apparatus.

Trade Report.

France.

Duty on Paper Pastes.

The following decision, affecting the classification of paper pastes in the French Customs Tariff, has recently been given by the French Direction of Customs:—

Under the tariff, ordinary pasteboard at present pays the same duty as paper paste pressed and pasteboard simply moulded made of wood or straw paste, and imported in the shape of leaves moist or not. They are only admitted duty free when the sheets are torn so as to be absolutely useless except for the manufacture of paper, or again, when the importers consent to place them under the transit regulations. The greater part of the imported pastes are imported under these conditions.

Switzerland.

Classification of Articles in Customs Tariff.

(*Note.*—Quintal = 220·4lb. avoirdupois. Franc = 9½d).

Parts of apparatus for glass blowing, plates (frames) of lead perforated, for electric batteries—category, 105; duty, 4 francs per quintal.

So-called cobalt (artificial)—category, 159; duty, 5 francs per quintal.

Russia.

Classification of Articles in Customs Tariff.

(*Note.*—Poud = 36lb. avoirdupois. Funt = 0·902lb. avoirdupois Square arshine = 5·44 square feet. Gold rouble = 3s. 2d.)

The following decisions affecting the classification of articles in the Russian Customs Tariff have recently been given by the Russian Government:—

The following homœopathic medicines—ailanthus, buso, cannabis sativa, cedron, chamomilla, cyclamen, cynophalium polycephalum, lachesis, lactucin, pyrocarbon, symphytum racemosum, tarantula, viola odorata, and zincum—are to be included under Section 151, and to pay a duty of 10 roubles per poud gross, with an addition of 20 per cent. on each rouble of duty leviable.

The liquid "carbolineum avenarius," for soaking wood, Section 16, duty 5 copecks per poud gross, with an addition of 20 per cent. on each rouble of duty leviable.

Alloys of zinc and antimony, Section 124, duty 22 copecks per poud.

Italy.

Classification of Articles in Customs Tariff.

(*Note.*—Hectogramme = 3·215oz. troy. Kilogramme = 2·204lb. avoirdupois. Quintal = 220·4lb. avoirdupois. Lira = 9½d.)

The following decisions, affecting the classification of various articles which have been the subject of disputes, have recently been given by the Italian Customs authorities.

Sulphur of zinc mixed with sulphate of barytes to be included in Category III., No. 33 (oxide of iron, lead, pewter, and zinc), duty 2 lire per quintal.

Articles composed of wine, extract of meat, malt, etc., Category III., No. 56 (medicinal articles compounded, not distinguished), 120 lire per quintal.

Vermilion, dry, with the addition of aniline colour. Category IV., No. 64*a* (colours, etc., derived from tar in a dry state), 15 lire per quintal.

Extract of dyewoods. Category IV., No. 65 (colouring extracts of wood and all other dyeing stuffs), 12 lire 50 per quintal.

UNITED STATES.

Classification of Articles in Customs Tariff.

An article called "toluidine," known in commerce as a heavy aniline oil, a manufactured article, and a product of coal-tar (not a colour), is dutiable at the rate of 20 per cent. *ad valorem*, under provision 81 in Schedule A, as products of coal-tar.

Alizarin blue and gallein, which are coal-tar colours, are dutiable at the rate of 35 per cent *ad valorem*, under the provisions of Section 82, as "all coal-tar colours or dyes, by whatever name known."

Sulphate of antimony, which consists of an artificially-produced chemical compound well known as "golden sulphuret of antimony," or "pentasulphide of antimony," is dutiable at the rate of 25 per cent. *ad valorem*, under the provision in Section 92 for "all chemical compounds," etc.

Cocoa butter, which consists of an unctuous, fatty body, or concrete oil, derived by expression and heat from the seeds of the "Theobroma cacao," and which is in fact an oil expressed or rendered from such seeds, is held to be dutiable at the rate of 25 per cent. *ad valorem*, under the provision in Section 92 for "all preparations known as essential oils, expressed oils, distilled oils, rendered oils, by whatever name known," etc.

ROUMANIA.

New Commercial Treaty.

With reference to a statement that appeared to the effect that a new commercial treaty between Great Britain and Roumania was signed on the 26th November last, a letter has been received from the Foreign Office stating that the ratifications of this treaty were exchanged at Bucharest on the 31st December last.

Customs Formalities.

The *Journal Officiel* of 22nd December last draws the attention of its readers to the difficulties now thrown in the way of foreign trade in Roumania by the Customs formalities. It is now absolutely necessary that the weight of packages of goods should agree with the statements made in the bill of lading. If there are several articles in one package, the separate weight of each article must be stated, and unless merchants are aware of this regulation much expense and delay may be caused.

TUNIS.

Under the new Customs Tariff of Tunis—which came into operation in August last—the importation of the following articles is prohibited:—Nitrate of soda, saltpetre, gunpowder, dynamite and similar substances, salt, and manures (exclusive of guano, phosphate of lime in powder, etc.).

URAGUAY.

New Customs Tariff.

Articles paying a duty of:—

51 *ad valorem:* Perfumery, powder and ammunition, beer.
47 *ad valorem:* Drugs.
43 *ad valorem:* Candles, matches, and starch.
20 *ad valorem:* Mercury and tar.
12 *ad valorem:* Soda, potash, phosphorus in sticks, and sulphuric, nitric, and chloric (? hydrochloric) acids.
6 *ad valorem:* Scientific instruments; salt.
Free: Sheep dip

CUSTOMS TARIFF OF VENEZUELA.

Rates of Import Duty.

(*Note.*—Bolivar = franc, and is divided into centimes.)

10 *Centimes per Kilo.:* Sulphuric acid.

25 *Centimes per Kilo.:* Stearic and oleic acids and stearine; acetic and hydrochloric acids; nitric acid; colza oil and machine oil; white lead or carbonate of lead; alum; English yellow, or chromate of lead, minium, litharge, and manganese; sulphur in powder and paste; oxide of zinc; ale and cider; chloride of lime; fluid gas; paper of all kinds; paints (common) prepared in oil; potash, common or calcined; saltpetre and salts of nitre; soda, common or calcined; carbonate of soda cryst.; sulphate of iron or copperas; sulphate of copper or bluestone; turpentine, common; vinegar.

75 *Centimes per Kilo.:* Collodion for photographic purposes; varnishes; sperm oil and paraffin; gasoline and benzine; bone dust; baking powder.

1 *Bolivar* 25 *Centimes per Kilo.:* Oils and soaps perfumed; oil of sesame, castor, and other kinds not otherwise mentioned; cod-liver oil; tartaric acid in powder; arsenic and liquid ammonia; quicksilver; colours and paints not otherwise distinguished, such as indigo, ultramarine, etc. drugs, medicines, and chemicals not otherwise mentioned; essences and extracts of every kind not otherwise distinguished; glycerin; phosphorus paste; soap and perfumery; inks, except printing ink; candles.

Importation of the following prohibited: Cocoanut oil, dynamite, starch, white or brown sugar, sarsaparilla, salt.

TRADE BETWEEN SPAIN AND THE UNITED KINGDOM.

Imports from Spain.

PRINCIPAL ARTICLES.		Dec. 1885.	Dec. 1886.
Chemical Products unenumerated	Value	£7,033	£6,584
Copper Ore and Regulus—	Tons	4,291	3,341
	Value	£104,821	£53,270
Manganese Ore	Tons	520	--
	Value	£1,950	—
Pyrites of Iron or Copper—	Tons	55,173	46,671
	Value	£102,886	£90,037
Quicksilver	Lb.	7,420	—
	Value	£500	—
Total Value of Imports		£924,165	£867,183

The total value of imports during January, 1887, amounted to £818,935 as compared with £635,256 in the corresponding month of the year 1886.

Exports from the United Kingdom to Spain.

PRINCIPAL ARTICLES.		Dec. 1885.	Dec. 1886.
Alkali	Cwt.	24,948	24,613
	Value	£8,744	£9,156
Caoutchouc Manufactures	Value	£1,660	£2,057
Cement	Cwt.	8,200	5 000
	Value	£753	£175
Chemical Products, including Dyestuffs	Value	£5,310	£2,058
Products of Coal, including Naphtha, etc.	Value	£2,623	£1,735
Glass Manufactures	Value	£656	£532
Grease, Tallow, and Animal Fat	Cwt.	2,092	1,043
	Value	£2,627	£919
Manure	Value	£8,482	£1,325
Soap	Cwt.	508	251
	Value	£465	£221
Total Value of Exports		£241,868	£253,238

The total value of exports during January, 1887, amounted to £235,826, as compared with £240,097 in January, 1886.

INDUSTRIAL CONDITION OF RUSSIA.

Compared with 1880, the production of manufactured goods in 1884 was as follows:—

	Roubles.	
	1880.	1884.
Cotton	176,203,000	212,226,000
Wool	115,075,000	101,498,000
Linen	27,502,000	30,090,000
Silk	11,476,000	12,647,000
Dyeing	66,640,000	61,252,000
Paper	12,606,000	16,616,000
Chemical Products	15,136,000	22,882,000
Leather	48,819,000	44,791,000
Glass	8 307,000	10,310,000
Porcelain and Faience	2,219,000	3,913,000
Machinery	56,105,000	46,060,000

It will be observed that with the exception of wool, dyeing, leather, and machinery, all these branches of industry show a substantial increase.

ITALY.

Regulations affecting Bills of Lading.

According to the French *Moniteur Officiel*, the Italian Treasury Department has adopted a new system with respect to the presentation of bills of lading by merchants forwarding goods. Formerly, the Customs authorities only required that one bill of lading should be presented, but in future two bills of lading must be delivered to the Customs officers, and consequently the stamp duty is increased from 1 lire 10 to 2 lire 10.

Commercial School at Florence.

Mr. J. G. Kennedy, Her Majesty's Secretary of Embassy at Rome, writing under date of the 21st October last, says:—

"A recent Royal decree has established at Florence a special commercial school, the object of which is to afford special instruction to all intending to become manufacturers, Customs or other Government officials, and for whom a technical knowledge of trade and of commercial geography may be necessary.

"Candidates for the above school must have matriculated in chemistry, graduated at the Lyceum or technical institute, or have completed their studies in a commercial school. Officials of State Departments to whom such instruction may be useful will be admitted to the lectures.

"The course of study will be completed in two years."

GERMANY.

The German Iron and Steel Manufacturers' Union has just published the statistical figures relating to the production during the year 1886.

Pig-Iron Production of the German Furnaces in 1886.

(In tons of 1000 kilos.)

1886.	Puddled and Specular Iron.	Bessemer Pig.	Thomas Pig.	Foundry Pig.	Total Amount of Pig Iron in 1886.	Total Amount of Pig Iron in 1885.
January ..	160,797	39,575	63,287	30,610	296,869	319,801
February .	143,080	35,452	59,903	28,046	269,481	296,927
March	111,969	38,015	71,617	33,901	287,765	319,210
April	137,299	38,096	78,511	35,512	291,221	306,856
May	138,997	37,614	76,487	27,038	282,236	318,606
June	135,518	36,174	71,109	29,595	275,596	318,949
July	144,312	38,053	68,233	26,849	280,347	307,771
August....	140,373	25,780	65,350	30,299	261,902	308,956
September.	135,141	34,216	63,966	28,419	263,702	309,213
October ..	132,954	35,061	69,625	28,820	268,260	322,668
November	133,660	34,632	72,199	31,166	274,057	308,106
December .	141,339	33,900	74,558	33,570	285,367	314,679
Total....	1,685,439	426,428	835,178	363,858	3,339,803	3,751,775

The official statistics furnished by the Government do not as yet come up to the year 1886. During the seven previous years the production was as follows:—

Year.	Puddled Iron.	Bessemer and Specular Iron.	Foundry Pig.	Castings.	Total.
1885	1,885,793	1,300,179	486,816	14,645	3,687,433
1884	1,960,438	1,210,353	414,528	15,293	3,600,612
1883	2,002,195	1,072,357	379,643	15,524	3,469,719
1882	1,901,511	1,153,083	309,346	16,835	3,380,806
1881	1,728,952	886,750	281,613	16,694	2,911,009
1880	1,732,750	731,538	248,302	16,447	2,729,038
1879	1,592,814	461,253	161,696	10,824	2,226,587

During the next few days the Association of Producers of Pig Iron in Rhineland-Westphalia will hold a meeting in order to prolong the present combination, which terminates on June 30.

FOREIGN TRADE OF INDIA.

Chemicals, Drugs, Medicines and Narcotics, and Dyeing and Tanning Materials.

The returns are for the eight months—1st April to 30th November.

	1885.		1886.
Imports................	R 5,314,362	......	R 5,759,187
Exports................	R 83,521,504	......	R 87,686,867

DEPRESSION OF TRADE AND INDUSTRY.

Final Report of the Royal Commission appointed to inquire into the Depression of Trade and Industry; with Minutes of Evidence and Appendices.

This is the final report of the Royal Commission on the Depression of Trade and Industry. It contains a *resumé* statement of the information and evidence which are given in previous numbers, of which there have been three issued altogether, Vol. II. being the largest, and consisting of two separate parts.

After tracing the methods adopted by the Commissioners to obtain evidence from Chambers of Commerce, labour associations, foreign countries, and official witnesses on the four subjects or branches of trade selected by them for special inquiry, the report proceeds to give shortly the evidence of some of the principal witnesses on the subject of (1), the iron and coal trades; (2), textile industries; (3), agriculture; (4), shipping. It then deals briefly with the answers given by Chambers of Commerce, labour associations, and Her Majesty's representatives in foreign countries, and further summarises shortly the written and oral evidence given before it. Having thus sketched the evidence, the Commissioners proceed to their conclusions upon it; they review the nature and extent of the depression, and they observe that complaints of depression proceed in a great measure from the producing classes. A general increase of production is everywhere remarkable; statistics of our trade with foreign countries are largely quoted in support of this; also statistics of production, of goods conveyed by railway, and of tonnage entered and cleared are quoted in support of the statement that there has been general increase in production, agriculture alone being in this case an exception. Complaints of absence of profits are many, but against these they have to set the increase of the income-tax, always allowing for greater efficiency of collection. Supply of commodities is, no doubt, they add, in excess of demand, and there has been a reduction in the return to capital.

After giving a summary of the main features of the situation, which are stated to be:—

(*a*.) A very serious falling off in the exchangeable value of the produce of the soil;

(*b*.) An increased production of nearly all other classes of commodities;

(*c*.) A tendency to the supply of commodities to outrun the demand;

(*d*.) A subsequent diminution in the profit obtainable by production; and

(*e*.) A similar diminution in the rate of interest on invested capital.

The report then goes on to review the depression as it effects: (1) the producing classes, (2) the monied class, and (3) the working classes. Having thus dealt with the nature and extent of the depression, the report further remarks on the causes which have assisted to produce the existing state of things. Amongst these the first touched on relates to changes which have occurred in the distribution of wealth, a smaller proportion of profit falling to the share of the employers of labour than formerly, and the employment of labour having become from this cause not so full and continuous. Whether or not the aggregate amount of profit is increasing, the Commissioners think that there is no doubt that profits are becoming more widely distributed among the classes engaged in trade and industry; large capitalists are perhaps receiving a lower return, but the number of those who are making a profit, if but a small one, is much increased. In support of this, figures are quoted from the Reports of Commissioners of Inland Revenue to show that, taking the years 1874–75, 1879–80, and 1884-85, for purposes of comparison, the number of assessments under the head of Trades and Professions, Schedule D, at less than £2000 a-year, has increased at a more rapid rate than the population, whilst the number of similar assessments above £2000 has increased at a less rapid rate, and the number of similar assessments above £5000 has actually diminished, and the Commissioners remark further that the lower the income the more rapid has been the rate of increase. But in addition to this change in the distribution of wealth, there has been over-production—an over-production to which a stimulus was originally given by the great demand for all manufactured goods which followed the war of 1870–71. A demand only temporary was treated as if permanent, and manufacturers increased their power of production as if the demand was to be of a lasting character. Limited liability companies and the operation of the promoters of such companies had much to do with the continuance of this over-production, new companies always springing up, even on the ruins of the old. At the same time bad seasons and the competition of the produce of other countries caused the agricultural section of the community to become seriously crippled, and a lack of purchasing power resulted from the agricultural classes having to accept smaller prices for such produce as they had to offer. Added to this, the stimulus of protection in other countries has made foreign markets less profitable for our trade, in proportion as they became more subject to restrictive tariffs. A diminution of demand for our goods in the home market also took place at the same time as the diminution from abroad.

The diminution of the demand from abroad—not in bulk, but rather in value—has been caused in a great measure by German competition, more especially in the East. Other and minor causes have been at work, such, for instance, as deterioration in the quality of the goods supplied, low-priced goods of an inferior quality having replaced in a great measure those formerly supplied.

Fraudulent marking, practised chiefly by foreign firms, has been another cause at work, and some witnesses are of opinion that restrictions on the employment of labour, together with strikes and similar movements, are making production costly in this country. The Commissioners add, however, that in their opinion the condition of trade and industry cannot with justice, be attributed to the action of trades unions and similar combinations.

The Commissioners further state that they cannot attribute the depression of trade in any way to the incidence of taxation: in fact, we are in this respect in a more favourable position than the foreign countries who compete with us in the markets of the world.

Complaints have been numerous as to the prevailing depression being aggravated by the difficulties connected with the transport of goods. These complaints the Commissioners have divided into three classes:—

(a) That the railway companies regulate their charges so as to favour one district, or place, or trade, at the expense of another, and the importer of foreign goods at the expense of the home producer.

(b) That the cost of transit in this country is excessive, as compared with the charges made for similar services in other countries, and that, consequently, our home trade is being crippled and destroyed to the advantage of our foreign competitors, who are able to place their goods in our markets at a less expense than the home producers, who carry on their operations at a much less distance.

(c) It is contended that if the water communications of the country were properly developed, an effective competition would thus be established, which would obviate any monopoly now possessed.

The Commissioners examined into the arguments adduced to them, their conclusions generally being against those under heads *(a)* and *(b)*, but in favour of that under *(c)*. They then pass on to minor causes which have contributed to the depression, such as the royalties on minerals, which are stated by some witnesses to be excessive; the demand which formerly existed for railway material, and which has now fallen off, the substitution of steel for iron, and consequent economy of material.

Having thus reviewed the prominent features of our commercial position and the forces which have contributed to bring it about, the Commissioners proceed to enumerate certain definite recommendations which they have to make. Amongst these are:—(1) A cheapening of cost of production; (2) increased vigilance in competition with foreign countries; and (3) more particularly a search for new markets. They also consider that technical education is much neglected, and commercial geography might, they think, be studied to advantage.

Suggestions have been made to them that diplomatic and consular agents abroad might render assistance in foreign markets, and the Commissioners weigh the arguments for and against the course proposed.

Full statistics of internal or home trade, they think, might with advantage be collected.

With regard to the questions affecting the charges for railway carriage, the Commissioners remark *(a)* that greater facilities should be afforded to the public for readily ascertaining the rates which the companies profess to charge, together with any modifications of those rates which they make in favour of any individuals or any classes of their customers; *(b)* that a cheap and effective procedure should be provided for obtaining a legal decision on any disputed point, and for enforcing the decision when given; *(c)* that greater attention should be paid to the development of the water communications of the country, and that no railway company should be allowed, either directly or indirectly, to control or own a canal; *(d)* that every facility should be afforded by Parliament for the construction of light railways or tramways in those parts of the country which may be found to be insufficiently supplied with the means of communication, or which are susceptible of further development in this respect.

Legislation, the Commissioners think, might well be instituted with reference to counterfeit marking and fraudulent description of goods. The law relating to limited liability companies they also think capable of improvement, with a view to checking the creation of unsound companies, but they refrain from making specific suggestions, as they are of opinion that the subject requires to be further considered and discussed.

The foregoing report is signed by eighteen out of the twenty-three Royal Commissioners appointed, but of this number only seven sign it without reservations or remarks.

Amongst those who make reservation are Mr. Sclater-Booth, Mr. Cohen, Mr. Gibbs, Mr. Jamieson, and Mr. Palgrave, who consider the report too optimistic, and think that it minimises the depression which has been proved by the evidence to exist; Mr. Birtwistle, who makes some suggestions with regard to fraudulent marking and limited liability trading. Sir James Corry has also some remarks upon the latter subject, and Sir C. M. Palmer thinks that the minority report, signed by Lord Dunraven, Mr. Ecroyd, Mr. Lubbock, and Mr. Muntz, more accurately describes the extent and severity of the depression of trade and industry.

Professor Bonamy Price and Mr. Samuel Storey are also dissentients, but from one paragraph only in each case.

A minority report drawn up by the Fair Trade members of the Commission—namely, Lord Dunraven, Mr. Ecroyd, Mr. Lubbock, and Mr. Muntz, is also appended. It lays stress on some points which are lightly passed over in the majority report, and advocates import duties to countervail, as far as possible, the effect of foreign bounties and protective duties.

A third report is annexed, signed by Mr. Arthur O'Connor, who differs from the rest of his colleagues.

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

719 H. Woodcock and T. Riley, Birmingham. Mode of soldering or brazing earthenware and metallic pipes or other like objects for sanitary, chemical, or other purposes. January 18

751 J. Kendall, Shipley. Protecting flues and generating steam in vertical and other boilers, which he calls "The Kendall flue protector and steam generator." January 18

761 G. D. Hughes and D. Hughes, Nottingham. A furnace bar and smoke consuming furnace. January 18

791 A. H. W. Brown, London. Improvements in means for economising fuel and consuming smoke in steam boiler and other furnaces. January 18

820 W. Oram, Manchester. Improvements in hydraulic presses. January 19

827 St. John Vincent Day, Glasgow—From P. S. Swan, India. An improved door for furnaces to which hot air is supplied for the combustion of the fuel therein. January 19

832 H. J. P. Jolly, London—From G. Richmond, New York. Method and apparatus for artificial cooling. Complete specification. January 19

833 St. John Vincent Day, Glasgow—From P. S. Swan, India. Furnaces for heating air, and apparatus connected therewith. January 19

836 G. G. Campbell, London. Supplying heated air to bottoms of firegrates by means of a hot-air regulator. January 19

991 J. Y. Johnson, London—From H. J. Drory, Austria. Apparatus for spraying and burning liquid fuel for heating steam boilers, or for other purposes. January 21

1089 H. Dansey, London—From L. C. Auldjo, New South Wales. Apparatus for condensing in vacuo for ships' use. January 21

1112 J. Johnson and C. D. Greenland, London. Improvements in decorticating apparatus. January 24

1181 A. Conacher, London. Improvements in refrigerating machines. January 25

1211 J. Barber and J. Fortune, Manchester. Apparatus for preventing the incrustation of the tubes of boilers. Jan. 26

1249 W. L. Cooper, London. Apparatus for the purification and softening of water or other liquids. January 26

1315 W. Bergh, London. Centrifugal apparatus for separating fluids of different specific gravities. January 27

1326 E. Seger, London. An arrangement for driving separators and other centrifugal apparatus. Complete specification. January 27

1336 C. C. Barton, London. Method and apparatus for maintaining a proportional flow of liquids through pipes of the same or of different diameters. January 27

1136 A. W. Beonis, Liverpool. Improvements in or appertaining to apparatus for supplying fuel to furnaces. Jan. 29

1582 A. J. Boult, London—From S. W. Merryman, United States. Improvements in boiler cleaning compounds. Complete specification. February 1

1678 D. Duvilers, London. Improvements in carburettors. February 2

1702 J. Vicars, T. Vicars, and J. Vicars, jun., Liverpool. Improvements in apparatus for feeding fuel to furnaces. February 3

1770 J. Murrie, Glasgow. Improvements in apparatus for indicating or regulating temperature or pressure. February 4

1817 W. G. Hicks, Ramsgate. Improvements in taps for regulating the flow of tar or other like liquids. February 5

1914 E. Green, Nottingham. Improvements in firebars for furnaces. February 8

1915 W. Begg, Manchester. Improvements in the construction of furnaces. Complete specification. February 8

2075 W. Young, London. Improvements in filtering papers. February 10

2085 A. Purvis and W. Purvis, Glasgow. Improvements in hydraulic valves. February 10

2119 F. M. Spence and D. D. Spence, Manchester. Improvements in furnaces for heating, drying, or calcining certain mineral or other substances or materials. February 10

2127 J. Brock and T. Minton, London. Improvements in filter-presses. February 10

2131 P. M. Justice, London—From J. Macdonald, United States. Improvements in apparatus for pumping liquids. February 10

2150 J. Y. Johnson, London—From R. Seguela, France. Improvements in injectors. Complete specification. February 11

2151 P. Keil, Liverpool. See Class X.

2153 C. Johnson, Sunderland. Improved construction of furnaces and closed fires. February 11

2177 H. Holden and R. G. Brooke, London. Improvements in injectors. February 11

2192 H. D. Cooper, London. An improved form of washer especially suitable for the joints of tubes and fittings lined with glass or other material. Complete specification. Feb. 11

2211 F. N. Mackay and A. G. Christiansen, Liverpool. Improvements in means and apparatus for effecting refrigeration. February 12

2219 A. K. Irvine, Glasgow. Improvements in pressure regulators for gas and other fluids. February 12

2228 J. Gilmour, Glasgow. Improvements in and connected with forced blast steam-boiler furnaces. February 12

2231 J. Crosfield and E. Beck, Liverpool. Improvements in apparatus for mixing two or more granular or pulverulent materials in approximately definite proportions. February 12

2237 H. D. Cooper, London. Improved fittings for tubes lined with glass or other material. Complete specification. February 12

2251 J. H. Johnson, London—From A. Leon, France. Improvements in tubes or conduits for gas, water, electric conductors and the like. February 12

2316 H. H. Lake, London—From B. Roberts, United States. Improvements relating to smoke condensing apparatus for use in connection with steam-boiler and other furnaces. Complete specification. February 11

2319 A. Conacher, London. Improvements in refrigerating machines. February 11

2333 S. Kilby and H. Mobbs, Northampton. Boiler explosion preventer. February 15

2341 H. T. B. Sanderson, South Shields. Stopping tubes burst by external pressure. February 15

2398 T. Rawson, Sunderland. The circulation and purification of the water in steam boilers whilst at work, thereby preventing the formation of incrustation or scale. February 16

2433 P. Calliburces, London. Improvements in the system of hygrometers and other analogous instruments and apparatus. Complete specification. February 16

2437 F. Labbé, London. Improvements in furnaces for burning lime, and for other purposes. February 16

2471 J. M. McMurtrie, Glasgow. Improvements in apparatus for regulating fluid pressures. February 17

2485 J. J. Moffat, Birmingham. Improved apparatus for condensing steam. February 17

*COMPLETE SPECIFICATIONS ACCEPTED.**

1886.

1938 T. Derham. Certain improvements in hydrometers and saccharometers. February 9

2651 A. Myall—From J. McIntyre. Surface condensers. February 19

3270 C. S. Madan. Injectors for raising and forcing fluids, and feeding boilers. January 22

3731 C. W. Burton and F. T. Moison. Apparatus and method for purification of water. January 29

3801 J. Anderson and R. McKinnell. Apparatus for inducing or producing currents of air, water, or other fluid

3878 R. Hanson and J. Fernee. Improvements in open-hearth furnaces, applicable to other heating purposes. Feb. 2

3897 W. Sellar. Apparatus for heating, purifying and filtering water for feeding steam boilers, pumps, suction pipes, etc. January 26

4135 F. Mörth. Apparatus for supplying liquid or gaseous fuel to furnaces, etc. January 26

4244 A. C. Kirk, Glasgow. Improvements in feeding, and in feed-heating apparatus. January 26

4497 T. W. Beverley. Blowing apparatus. February 2

4518 M. Reuland. Apparatus for drying semi-fluid and other substances. February 2

4601 B. D. Healey. Gas-fired furnaces. February 5

4623 P. Hikely and J. Radcliffe. An improved filter. Feb. 19

4681 J. G. Kinghorn. Valves for air circulating, air compressing, and other pumps. February 2

4684 J. Ross. Valves and fittings for steam, water or other fluids. February 2

4700 E. N. Henwood. Construction and arrangement of furnaces for burning hydrocarbon oils in conjunction with compressed air or steam. February 5

4871 G. F. Redfern—From M. H. Simonet. An improved grinding and triturating machine. February 9

4878 W. F. B. Massey Wainwaring. Improvements in filter-presses, and in drying sewage sludge and other moist matters. February 9

5014 W. G. Wrench. Apparatus for removing scale from steam boilers. February 12

5114 J. Wright. Construction of steam and water taps. February 16

5251 C. E. Davis. Apparatus for mixing liquids. Feb. 16

5252 E. B. Donkin. Four-way bye-pass valves for gas and other fluids. February 16

5305 T. Gilmour. Feed-heating apparatus. February 16

5343 C. E Gittens. Filters. February 16

5515 A. Waldbaur. Centrifugal machines. January 26

7022 J. C. Mewburn—From J. Dietze, Germany. Surface cooling, heating, and condensing apparatus. January 26

9759 E. Jones and A. Beech. Filter-presses and mode of charging same. February 9

10880 T. D. Williams. Amalgamating apparatus. January 26

12371 H. Lane and R. H. Taunton. Manufacture of metallic vessels for containing gases and volatile liquids under pressure. February 16

13336 A. J. Boult—From W. A. O. Hegeman. Fluid pressure regulators. February 19

15787 H. Wilson. Apparatus for creating forced draught and forced combustion, and for injecting fuel into furnaces, and the like. January 29

16135 E. Kaslowsky. Apparatus for pumping and compressing air. January 22

16991 H. E. Newton—From W. M. Deutsch. Filtering apparatus. January 29

1887.

334 J. Simpson. Lids or closers for metallic drums or casks. February 12

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

816 W. Pursall, Birmingham. A new or improved means of illumination. January 19

927 S. Levy, London—From G. H. Kohn, United States. Improvements connected with the manufacture of water gas and other gases for lighting, heating, and manufacturing purposes, and in apparatus therefor. January 20

1132 F. Windham, London. Improvement in the manufacture of gas for use in gas engines. January 25

1134 J. A. Yeadon and R. Middleton, Leeds. Improvements in blocks or briquettes of fuel or materials for smelting, or analogous purposes. January 25

1139 J. J. Royle, London. Improvements in and apparatus for preparing coke for use in slow-combustion stoves. Jan. 25

1150 J. S. Sellon, London. Improvements in apparatus for lighting by the consumption of gas and air. January 25

1171 G. H. Fenner, London. Improvements in the manufacture of naphthaline into forms suitable for use in illumination, and in apparatus employed therein. January 25

1297 F. A. McMino, London. The manufacture of inflammable gas from oil. January 27

1376 E. Davies, London. Improvements in lighting and heating, and in apparatus therefor. January 28

1478 S. Wilkinson and J. Clarkson, London. Improved means of and apparatus for heating and diffusing air for warming and ventilating purposes. January 31

1479 A. G. Meeze, Redhill. Improvements in apparatus for the manufacture of gas from fluid hydrocarbons. January 31

1490 J. Atterton, Haverhill. Improvements in apparatus for charging gas retorts. January 31

1511 P. Ward and W. S. Oliver, London. Improvements in light-producing apparatus. January 31

1515 H. Schlichter, London. A method of lighting by means of gas, and apparatus therefor, which method and apparatus may be made to serve also for deodorising and disinfecting the atmosphere. January 31

1538 E. Sherring, Manchester. The application of asbestos to oil lamps and oil stoves and burners as a non-conductor of heat. February 1

1551 J. Torkington, J. A. Ewins, and C. Torkington, Birmingham. Improved means of economising gas for lighting and heating purposes. February 1

1684 W. H. Lindsay, London. Improvements in the manufacture of artificial fuel. February 2

1767 J. H. R. Dinsmore, Liverpool. Improvements in the manufacture of gas and apparatus therefor. February 4

1965 J. Birchall, London. Improvements in the manufacture of gas and apparatus therefor. February 8

2092 L. A. Brode, Glasgow. An improved method of utilising the waste and dross of coal in the manufacture of briquettes for use as fuel. February 10

2099 J. A. Drake, Halifax. Improvements in the method of and apparatus for generating heat in steam boilers, baking ovens, blast furnaces, gas retorts, and the like. February 10

2186 M. P. W. Boulton, Tew Park, Oxfordshire. A method and apparatus for the combustion of fuel. February 11

2210 S. F. Rhodes, London. Improvements in apparatus for converting into spray or vapour, hydrocarbon oils or other liquids, and for burning, gasefying, and evaporating the same. February 12

2313 C. D. Abel, London—From the Gas Motoren-Fabrik, Germany. Improvements in apparatus for vapourising liquids giving combustible vapours. February 14

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

2156 J. E. Mathewson, Sheffield. The separation of steam or other vapours or gases from liquids mixed with them. February 17

2766 W. L. Wise—From F. J. Lothammer. Portable apparatus for the manufacture of gas. January 29

3663 S. Pitt—From C. Haret. Preservation of inflammable matters, and composition for rendering bodies uninflammable, and for extinguishing fire. February 19

3697 F. Windham. Manufacture of gas for use in gas engines. January 22

4220 M. P. W. Boulton. Improved application of heat to generating and heating steam. January 22

4451 G. King. Fastenings for retort lids. February 5

4582 W. A. Barlow—From J. F. W. A. Jahnke. Lamps and lanterns for burning carburetted coal-gas. February 5

4617 J. Dillamore. Apparatus for removing tar from the hydraulic mains used in the manufacture of coal-gas. Feb. 5

5348 W. W. Box. Gas retort lids and fastenings. Feb. 16

10891 W. Finlayson—From R. H. Martin. Preparing asbestos for use as a non-conductor of heat and otherwise. February 12

16112 F. B. Fowler. Mode, means, and appliances for making oil-gas. January 22

16992 R. S. Lawrence. Carburettors and gas generators, January 29

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* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

1887.

740 A. Kitson. Gas apparatus, and process for generating illuminating gas. February 19

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

COMPLETE SPECIFICATION ACCEPTED.

1886.

3738 G. T. Beilby and J. B. McArthur, Slateford. Utilising hydrocarbon gases obtained in the distillation of petroleums, rosin, etc. January 29

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

875 G. Thomas, Manchester—From A. Zander, Prussia. The manufacture of dye matters from red sanderswood and certain other woods. January 20

968 A. G. Green, London. The manufacture of new azo and nitro colouring matters. January 21

1657 C. J. Smith and J. S. Tanner, London. Improvements in marking ink. February 2

1694 O. Imray, London—From the Farbwerke vormals Meister, Lucius and Brüning, Germany. Improvements in the production of alkylised diamidobenzophenon amine chlorides and conversion of the same into alkylised diamidobenzophenones and yellow colouring matters of the class of the "auramines." February 3

COMPLETE SPECIFICATION ACCEPTED.

1886.

4687 T. Maxwell and J. Young. Manufacture of colouring matter. February 5

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

1026 H. Ainley and G. W. Tomlinson, London. Improvements in means or apparatus for fulling, milling, scouring, and felting woollen and other fabrics or materials. January 22

1263 W. Cook, London. Improvements in and applicable to machinery for washing or scouring wool and other fabrics. January 26

1648 T. Speight, Bradford. Improvements in the method of and apparatus for removing the "bur" in wool and other fibres. February 2

2039 J. W. Smith, Bradford. Improvements in the method of and apparatus for preparing wool and other fibres for spinning. February 9

2089 T. F. Wiley, Bradford. A new or improved process for waterproofing textile fabrics and other porous materials. February 10

2257 F. H. Ford, A. N. Ford, and J. A. Archer, London. The manufacture of a new kind of textile fabric. February 12

2423 G. I. J. Wells and S. L. Howard, Liverpool. Improvements in treating Rhea bark, China grass, or other material of similar nature, and in apparatus applicable therefor. Feb. 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

2226 J. P. Land and C. P. King. Apparatus for carbonising and destroying vegetable matter in wool. February 16

16116 H. H. Lake—From H. R. Randall. Treatment of silk and other fibres. January 26

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

818 J. Walker, Halifax. Improvements in the method of and apparatus for dyeing or otherwise treating textile fibres. January 19

1222 A. Smith, Bradford. Improvements in apparatus for dyeing. January 26

1351 W. Birch, Manchester. An improvement applicable to machines for washing, soaping, dyeing, and dunging woven fabrics. January 28

1610 J. S. Sutcliffe and J. S. Smith, Manchester. Improvements in or applicable to sizing machinery. February 2

1816 A. J. Boult, London—From F. Rubay, Belgium. Improvements in the bleaching of vegetable tissues. February 4

1831 W. Birch, Manchester. Improvements in rollers used in washing, soaping, dyeing, and other similar machines. February 5

1990 E. Hermité, J. Paterson, and C. F. Cooper. See Class XVIII.

2123 H. H. Lake, London—From L. Whitefield, United States. An improved compound for producing designs upon textile fabrics and for similar purposes. Complete specification. February 10

2351 A. J. Boult, London—From H. K. de Pawlowski, France. Improvements in the process and apparatus for bleaching of vegetable and animal matter. February 15

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

6988 J. Smith. Dyeing cotton, silk, wool, etc., either in the raw or manufactured state, and apparatus therefor. Jan. 26

8219 T. Hauschel. Apparatus for washing, dyeing, drying, etc., wool, cotton, and other textiles or fibres. February 19

16596 C. Corron. Machine for dyeing hanks or skeins of textile materials. January 26

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

765 C. A. Burghardt and A. H. Tuer, Manchester. An improved process or processes for the purification of bisulphide of carbon. January 18

872 P. Hart, Manchester. Improvements in and relating to apparatus employed in the concentration of sulphuric acid. January 20

1749 R. Hamilton, Glasgow. Improvements in the recovery of ammonia and carbonic acid from liquors containing these, and in appliances therefor. February 3

1832 J. Mangnall, Manchester. Generating carbonic acid gas, and apparatus connected therewith. February 5

1856 T. Schmidt, London. A process for the manufacture of certain salts of sodium and potassium, producing also gypsum and hydrochloric acid. February 5

1973 W. B. Cogswell, Liverpool. An improvement in bicarbonate columns. February 8

1974 L. Mond and D. B. Hewitt, Liverpool. Improvements in the manufacture of caustic soda or caustic potash, and of carbonic acid from mono or other carbonate of soda or potash. February 8

1998 A. M. Clark, London—From J. Brown, F. Herreshoff, W. H. Nichols and G. H. Nichols, United States. Process of making pure sulphuric and strong sulphuric acid in one continuous operation. Complete specification. February 8

2402 C. Wigg, Liverpool. An improved process for obtaining bicarbonate of soda. February 16

2403 C. Wigg. The treatment of spent copper liquors and the application of the product for the purification of sewage and like matters. February 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

1832 A. M. Clark—From O. Eyckens. Producing lead salts, and especially carbonate or oxycarbonate of lead (white lead). February 9

3238 L. Mond. Obtaining ammonia, chlorine and hydrochloric acid from ammonium chloride. February 9

3956 J. H. Johnson—From E. Hermité. Producing ozone and hydrogen for bleaching purposes. January 22

3957 J. H. Johnson—From E. Hermité. Producing chlorine compounds suitable for bleaching purposes. January 22

4070 E. Arthur and E. M. Arthur. Process for obtaining crystallised sulphate of calcium. February 2

4737 G. J. C. Marie. Caustic powders for the removal of paint and other deposits. February 5

4742 H. L. Pattinson, jun. Treating tersulphides or polysulphides of barium and strontium so as to recover the barium and strontium, and obtain other products. February 9

5016 J. H. Johnson—From J. L. Kessler. Process for expelling sulphuric acid in excess from sulphates and bisulphates. February 12

7199 J. Brock and T. Minton. Manufacture of bleaching powder, and apparatus therefor. February 9

15436 H. Byk. See Class XX.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

830 J. P. Guy, Burslem. A saggar placing and drawing machine for potters' ovens. January 19

967 W. Cliff, London. Improvements in the manufacture of fire-clay enamelled baths. January 21

1015 R. E. Donovan, F. Hazlett and J. Johnson, Dublin. Improved apparatus for blowing glass by means of compressed air. Complete specification. January 22.

1151 C. M. Pielsticker, London. Improvements in the manufacture of plate glass. January 25

1339 H. R. Yeo, Plymouth. Producing transparencies on coloured or ground glass for ornamental or other purposes. January 28

1131 D. Rylands and B. Stoner, Barnsley. Improvements in means for blowing bottles or other hollow glass-ware. January 29

1411 P. Graham, Glasgow. Improvements in and connected with the manufacture of hollow clay-ware, and in potters' jollies, or machines therefor. January 29

1565 M. Wyatt, London. An impermeable earthenware coffin. February 1

1733 W. Reynolds, London. An improved substitute for stained glass. February 3

1911 J. Critchlow, T. Forester, W. Forester, H. Forester and L. Forester, Longport. An improved potters' filter-press. February 8

2111 O. C. Hawkes, London. New and improved machinery for bevelling and moulding the edges of plates of glass and for ornamenting the surfaces of plates of glass. February 10

2253 T. Wickham and J. Nall, London. Improvements in tools for forming the exterior of bottle necks. February 12

2256 T. Wickham and J. Nall. Improvements in tools for forming the interior of bottle mouths. February 12

2271 A. Fielding, Longport. An improved differential speed and reversing motion for potters' lathes. February 14

2292 W. P. Wilson, London. Improvements in apparatus or tools for shaping the necks of bottles and other like receptacles. Complete specification. February 14

2305 H. L. Doulton and W. Parker, London. Improvements in ornamenting pottery, tiles or glass. February 14

2330 J. T. Creasy, London. An improved tool for glazing the edges of the necks of glass bottles and jars of any configuration. February 15

2380 W. B. Fitch, London. Improvements in the manufacture of glass bottles, and apparatus therefor. February 15

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

3369 J. D. Denny. Embossed and geometrical tiles and mosaics, and appliances for making the same. February 19

3391 S. J. Payne. Manufacture of fire-bricks, retorts, crucibles, etc. February 2

3615 O. Lindner. Decoration of earthenware and other surfaces. January 29

4282 T. Ide. Moulds for bending plate and sheet glass. January 26

4325 H. Norris. Colouring glass, porcelain, china and other substances to imitate stained glass. January 29

5187 W. Walker. Ornamenting glass, and applying it to architectural purposes. February 16

16877 W. Boulton. Apparatus for making bats for use in the manufacture of various articles of pottery. January 26

1887.

1015 R. E. Donovan, F. Hazlett and J. Johnston. Apparatus for blowing glass by means of compressed air. February 16

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

781 H. McDonnell, J. J. Mallon, and G. W. Clark, London. Process of forming ornamental coverings for walls, ceilings, and other surfaces. Complete specification. January 18

979 W. E. Gedge, London—From J. Thorrand, V. Nicolet, and A. Bonnet, France. A novel artificial cement. Complete specification. January 21

1039 C. Schlickeysen, London. Improvements in apparatus for moulding bricks, tiles, and similar articles. January 22

1759 C. J. Ford, London. Improvements in surface tiles for walls, partitions, ceilings, floors, etc. February 4

1919 P. Cornish, Stratford. Improvements in road pavements and curb stones. February 7

2008 G. Evans, London. Improvements in roof tiles, single lap and weather-tight. February 9

2302 T. Smith, London. An improved method of utilising metallic and other cements, plaster of Paris, and such like substances. February 14

2363 D. N. Arnold and W. Young, London. Improvements in cements. February 15

2182 W. Tuffee, London. Improvements in the manufacture of Portland cement and apparatus therefor, applicable also for making bricks, tiles, and other similar articles, and for burning lime and other materials. February 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

1816 W. Joy. Method of charging cement kilns. February 9

2566 P. Bowden. Machinery for the manufacture of bricks and tiles. February 19

3121 W. Macleod. Laying pavements of wood, tiles, concrete, etc. February 5

3449 C. E. Davis. Improvements in tiles for roofing. Feb. 2

3569 J. Dyson, Wakefield. Construction of wall-bonds or bricks for preventing damp walls. January 22

3715 P. Freygang. Rotary drying and crushing apparatus for clay, etc. January 22

4245 J. Brierley. Floors of wood and earthenware combined. February 2

4332 G. H. Couch. Ridge, hip, and wall tiles. February 2

4547 W. Johnson. Machinery for manufacture of bricks from plastic and semi-plastic materials. February 2

4872 D. Coltier. Production of imitations of stone, marble, terra-cotta, etc., for decorative purposes. February 5

1887 S. G. L. Giles and W. J. Petrie. Method of decorating Lincrusta Walton, and other embossed materials for the decoration of walls. February 12

6126 W. Parry. Improved construction of floors, roofs, and arches of brick, terra-cotta, stone, etc. January 22

9536 E. T. L. Clark. Hardening and preserving plaster of Paris casts and moulds, and rendering the same impervious to water. February 16

15211 J. V. Johnson—From E. Coignet. Preparation and treatment of beton or concrete, and apparatus therefor. February 12

17098 W. Sonnet. Mode and apparatus for continuously manufacturing Portland cement. February 9

1887.

578 P. M. Justice—From C. Dietzsch. Furnaces or kilns for calcining limestone, etc. February 16

781 H. McDonnell, J. J. Mallon, and G. W. Clark. Process for forming ornamental coverings for walls, ceilings, etc. February 19

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

803 P. M. Justice, London—From W. V. Shelton, Turkey, Improvements in the production of alloys or bronzes. Jan. 18

815 J. H. Selwyn, London. Method or process of treating pyritiferous or other base ores to extract metals therefrom. January 19

921 C. D. Abel, London—From E. Fischer and M. W. Weber, Germany. Improvements in extracting gold and other precious metals from their ores, and apparatus therefor. Complete specification. January 20

943 A. E. Tucker and F. W. Harbord, Smethwick. Improvements in the manufacture of iron and steel. January 21

993 W. Jenisch and H. Lohnert, London. Improvements in mills for crushing, pulverising, grinding, or reducing. Jan. 21

1069 W. H. Edwards, C. Britton, and J. E. Williams, Birmingham. Improvements in miners' safety lamps. January 24

1078 A. Harper, London. A novel description of compound castings of iron and steel specially suitable for chill and grain rolls, and means for producing the same. January 24

1166 S. B. Stine, London. Improvements in coal mining machines. Complete specification. January 25

1211 R. Thompson, Liverpool. Improvements in getting, winning, or mining coal, and in drilling and other apparatus therefor. January 26

1258 W. S. Squire and S. C. G. Currie, London. Obtaining metallic zinc. January 26

1261 D. McCorkindale and G. Dougall, Glasgow. Improvements in and connected with stoppers used in the manufacture of steel. January 26

1270 H. H. Lake, London—From G. and A. Raymond, United States. Improvements relating to the pulverisation or reduction of mineral or other substances, and to apparatus therefor. January 27

1276 E. Cleaver, London. Improvements in the manufacture of aluminium and aluminium alloys. January 27

1279 W. Patterson, Durham. Improvements in miners' safety lamps. January 27

1290 F. W. Paul, Glasgow. Improvements in making iron or steel. January 27

1305 E. H. Cowles, London. Improvements in alloys of aluminium and chromium with iron or steel. January 27

1322 W. H. Tooth, London. Improvements in the manufacture and refining of iron, and the conversion of iron into steel, and apparatus connected therewith. January 27

1388 W. G. Olpherts, London. A novel application and mode in connection therewith of utilising old or waste railway rails. January 28

1121 C. Roy, London. Improvements in rolling mills. January 29

1181 J. Hayes, Broughton Moor. A mining level. January 31

1189 H. O. A. E. Grunbaum, London. Improvements in the means or a light improving safety lamp for magnifying the illuminants and preventing accidents. January 31

1535 C. M. Pielsticker, London. Improvements in apparatus for the continuous production of metal bars and rods direct from the molten metal. February 1

1700 J. G. Wright, Wolverhampton. Eliminating from pig or cast iron the impurities or metalloids, silicon, sulphur, and phosphorus. February 3

1750 and 1751 H. H. Lake—From Count R. de Montgelas See Class XVIII.

1918 A. H. Read, London—From H. G. Hicks, United States. Certain improvements in welding compounds. Complete. specification. February 7

1921 C. Dickenson, London. Improvements in chills for casting iron, steel, and other metals. February 7

2056 J. Douglas, London. An improved miners' safety lamp. February 9

2060 W. Gentles, London. Improvements in the manufacture of copper, February 9

2149 A. Feldman, London. Improvements in the production of fluoride of magnesium and fluoride of aluminium. Feb. 11

2151 P. Keil, Liverpool, New and improved furnace applicable for the reduction of zinc and other ores containing volatile metals, and for other dry distillation processes. February 11

2168 T. Freeman and D. R. Jenkins, London. Improvements in means or apparatus to be employed in, or connected with, the coating of plates with tin or terne, or other metals. Feb. 11

2190 F. N. Wardell and J. Mitchell, London. Improved apparatus for preventing the accidental descent of cages in the shafts of mines. February 11

2216 C. Poole, Blyth. Drilling coal. February 12

2220 E. V. Seebohm, London. Improvements in the manufacture of silicon steel. February 12

2230 W. W. Curley and J. Hall, Sheffield. Improvements in hardening steel or compound iron and steel for use in the manufacture of tools and other steel or iron and steel articles, and in furnaces or apparatus therefor. February 12

2245 F. M. Spence and D. D. Spence, Manchester. Improvements in certain furnaces for heating, drying, or calcining certain mineral or other substances or materials. February 12

2306 T. Slater, London. Improvements in metallic alloys. February 14

2312 R. Stanley, London. An improved boring or tunnelling machine. February 14

2390 H. Leipmann, London. See Class XVIII.

2447 C. Sheibler, London. Improvements in the manufacture of steel and iron, and in obtaining by-products of such manufacture. Complete specification. February 16

2488 W. Macfarlane, Leeds. An improvement in the production of steel. February 17

2499 C. Fairbairn and M. Wells, London. An apparatus for forging by rollers conoidal projectiles and other articles of circular transverse section. February 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

1102 W. Tooth. Method and means for extracting spelter, and apparatus for treating the waste products. January 26

1288 G. Perry—From M. Perry. Obtaining compounds of cobalt from solutions of the same. January 29

1289 G. Perry—From M. Perry. Obtaining compounds of cobalt from solutions containing the same. January 29

1173 H. H. Lake—From La Société de Laminage du Nickel. Uniting platinum or silver and nickel or alloys of these metals. February 5

2785 W. J. Smith. Safety electric lamp for miners. Jan. 22

3632 L. A. Groth—From C. Beckstein. Powder for hardening metals. January 29

3746 J. F. Hall, Sheffield. Armour plates. January 22.

3821 J. E. Williams. Safety lamps for use in mines. Jan. 26

3971 J. M. Macdonald—From T. D. Williams. Stamps for crushing quartz and other ores. February 5

3986 J. M. White. Furnaces for the manufacture of metallic sleepers. February 2

4113 G. Dyson, Leeds. Apparatus for securing the chaplets used in supporting cores for castings. January 26

4312 A. Howat. Miners' safety lamps. January 26

4379 C. T. Cayley. Hardening or tempering steel bullets and projectiles, and apparatus therefor. February 2

4602 J. S. Donald. Miners' safety lamps. February 12

5527 A. de Laude Long and R. Howson. A new manufacture of fibrous iron. February 9

6992 L. L. Sagendorph. Machines for corrugating sheet metal. January 29

15103 A. J. Boult—From La Société Anonyme de Métallisation Artistique des Animaux, Végétaux, ou Autres Corps, France. Preparation of organic matter for metallisation by galvanic deposit. January 26

16386 H. E. Newton—From J. J. Crooke and R. Crooke, United States. Process for treating and desilverising copper matte, and copper ores analogous thereto. January 22

XI.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

1033 S. S. Sugden, Woodford. Improvements in the treatment of fatty and oily matters for the production of glycerine, white lead, and soap. January 22

1057 R. Hunt and E. S. Wilson, Liverpool. Improvements in the treatment of cotton seed to obtain oil feeding cake and resin-like matter. January 21

1291 N. M. Henderson, Glasgow. Improvements in apparatus for treating or purifying paraffin wax. January 27

1461 H. M. Roberts and A. W. Doery, London. Improvements in separating fat from liquids and apparatus therefor. January 29

1589 P. Gill and T. Osman, Liverpool. Improvements in apparatus for scraping and cutting soap. February 1

1753 L. Hunter, London. An improved soap tablet. Feb. 3

1771 R. Hunt and E. S. Wilson, Liverpool. Improvements in refining and clarifying crude cotton-seed oil. February 1

1840 W. H. Stead, Liverpool. Improvements in refining cotton-seed oil. February 5

1893 W. Hicks, Middlesbrough. Improvements in the manufacture of lubricating grease. February 7

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

3166 A. Blackie. Preparation of emulsions of vegetable, animal, or mineral oils, of solid paraffins, waxes, etc., and of liquids and fatty substances insoluble or slightly soluble in water. January 22

3518 B. J. Hicks and J. Kirkwood. Lubricating composition. January 22

3719 A. F. Craig, A. Neilson, and J. Snodgrass, Glasgow. Apparatus for separating mineral and other oils from oils or substances of different specific gravities. January 22

4101 J. L. Wade. Lubricating compound. January 26

XII.—PAINTS, VARNISHES, AND RESINS.

APPLICATIONS.

955 H. H. Gunn, Glasgow. Improvements in the manufacture of sulphide of zinc white. January 21

1668 P. Ward and S. W. Oliver, London. Improvements in the pigments for, and in the method of, colouring photographs. February 2

2201 R. E. Donovan and J. McKenny, Dublin. The utilisation of a natural product in the manufacture of blacking, Japan black paint, and varnish, and other similar coloured materials. February 12

2157 O. Jeyes, Birmingham. Jeyes' anti-corrosive compound. February 17

2198 W. Dick, London. A novel protective varnish. Complete specification. February 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

1832 A. M. Clark—From O. Eyckens. See Class VII.

17026 J. H. G. Langenhagen. Leather polish. February 9

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

1009 A. Smetham, Liverpool. Improvements in the manufacture of water-proof leather. January 22

1163 J. H. G. Langenhagen, Liverpool. A new or improved dressing for leather. Complete specification. January 25

1371 A. Tissot, London. Improvements in tanning leather. January 28

1382 E. Page and G. Brayfield, London. The manufacture of a composition for varnishing and reviving leather. January 28

1562 E. Dunkley and A. Dunkley, Northampton. An improved method of making leather water-proof or flexible. February 1

XIV.—AGRICULTURE, MANURES, ETC.

APPLICATIONS.

780 C. E. Hearson and B. Field, London. Improvements in the vaporisation of volatile liquids for the destruction of insects, and in apparatus for the vaporisation of volatile liquids for tho said purpose, and for other purposes. January 18

1130 W. Thompson, Stratford-on-Avon. An improved fertiliser. January 25

2097 H. K. Spark and J. Warburton, Sheffield. See Class XVII.—B.

2457 A. Campbell, Upton Park. The economical mixing or compounding of phosphatic compounds for artificial manures. February 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

3167 A. Clemm. Method and means for the destruction of insects and animals injurious to plants and fruits. February 5

5031 N. B. Powter. Treating phosphatic earths and rocks for the manufacture of fertilisers therefrom. February 12

XV.—SUGAR, GUMS, STARCHES, ETC.

APPLICATIONS.

779 H. L. Sulman and E. E. Berry, London. Improvements in apparatus for the manufacture of starch. January 18

986 V. C. A. M. Bondonneau and A. J. M. G. Foret, London. Process and apparatus for acid saccharification of starchy materials. January 21

1931 M. A. Perret, London. Improvements in apparatus for extracting the saccharine or other matter from sugar-cane and other substances. Complete specification. February 7

2297 A. Brin and L. Q. Brin, London. Improvements in the treatment of saccharine and sacchariferous matters for the purpose of decolourising, purifying, or refining them. February 11

2298 A. Brin and L. Q. Brin. Improvements in the treatment of saccharine and sacchariferous matters for the purpose of decolourising, purifying, or refining them. February 11

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

3628 H. E. J. Solwig and K. A. C. B. Lange. Manufacture of sugar blocks and apparatus therefor. January 29

1679 C. W. N. Wallace and C. J. H. Barry. Manufacture of caramel. February 5

1801 C. D. Abel—From P. S. Sohne. Process for the desaccharification of molasses and sugar syrups, and the simultaneous production of oxalates from the salts contained therein. January 22

1918 O. Imray—From A. K. Kissel, Germany. Manufacture of an elastic compound in imitation of caoutchouc. Jan. 26

15400 J. Horning, C. Rabe, and F. J. Weiss. Evaporating apparatus for use in the manufacture of sugar, etc. Feb. 9

1887.

785 W. P. Thompson—From T. Kane. Manufacture of candy. February 19

XVI.—BREWING, WINES AND SPIRITS.

APPLICATIONS.

812 J. Klein, London. Improvements in apparatus for filtering beer and other liquids. January 19

1131 J. Foulis, Musselburgh. Improvements in non-alcoholic medicated liquors or cordials for use as a beverage. Jan. 25

1516 W. Adlam and F. Faulkner, London. Improvements in treating brewers' wort, and apparatus therefor. Jan. 31

1673 J. M. Anderson, Glasgow. Improvements in malting, and in drying malt and grain, and in apparatus therefor. February 2

1880 R. Wood, Cardiff. A process for preparing, moistening, assimilating, and malting barley, grain, and other farinaceous matter by steam. February 7

1992 G. Epstein, London. Improvements in the treatment of brewers' and distillers' grain. February 8

2005 C. Clinch, London. Improvements in brewing. Feb. 8

2057 W. Ansell, London. Manufacture of a non-intoxicating beverage. February 9

2109 H. Grote, London. Process for removing fusel oil from crude spirits, or from the mash containing crude spirits. February 10

2221 J. W. Bailey, Greenock. Manufacturing of a new brewing saccharine. February 12

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

4071 F. Faulkner and W. Adland. Aërating brewers' wort and other liquids, and apparatus therefor. January 26

4191 W. A. How. Apparatus for holding bicarbonate of soda for generating carbonic acid gas for use in aerating ale, etc. February 16

4311 W. W. Crawford. Maturing alcoholic liquors. Jan. 26

4529 E. L. Pontifex. Skimmer for removing yeast from wort in a fermenting vessel. February 2

1868 W. Bradford. Cowls for malt and other kilns, and brewery and distillery utensils. February 5

1887.

328 B. J. B. Mills—From C. Brada. Malt kilns. February 9

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

APPLICATIONS.

A.—Chemistry of Foods.

901 H. Gross and P. Hesemann, London. Process and apparatus for roasting coffee. January 20

1106 J. G. Tongue, London—From B. Drenckmann and W. Hildebrand, Germany. Improvements in the means employed to produce fermentation in dough for bread-making. Jan. 24

1772 J. France, Halifax. A new treatment of milk to prevent its turning sour. February 1

1996 J. Cornrick, London. Improvements in the process of and apparatus for manufacturing powdered milk. Complete specification. February 8

2413 W. Smith, London. Improvements in apparatus for separating cream from milk. February 16

2519 H. W. Hart, London. An improved method of treating coffee to prevent loss of its valuable constituents and to preserve the aroma. February 17

B.—Sanitary Chemistry.

799 E. B. S. Benest, London. Disinfecting apparatus. January 18

1333 W. Webslor, jun., London. Improved means of oxidising and decomposing by electrical action organic matter and inorganic salts in sewage, water, and other liquids. January 27

1515 H. Schlichter. See Class II.

1519 H. H. Lake, London—From L. L. Benson and W. T. Stilwell, United States. Improvements relating to means for expelling and rendering innocuous the gases or vapours from sewers and the like. Complete specification. January 31

1525 H. W. Newton, Newcastle-on-Tyne. Eliminating pernicious particles from atmospheric air inhaled. February 1

1699 D. Craig, Bradford. A new or improved means of utilising sewage sludge. February 3

2097 H. K. Spark and J. Warburton, Sheffield. A new or improved method and material to be used for universal sanitary and disinfecting purposes, the said material being afterwards applicable as manure and otherwise. February 10

2388 A. Angell, London. Improvements in the manufacture of precipitants and in the treatment of sewage. February 15

2403 C. Wigg, Liverpool. See Class VII.

C.—Disinfectants.

2235 P. Gros-fils, London. A novel composition for preserving organic substances and method of using the same. Feb. 12

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1886.

2461 W. A. Gibbs. Apparatus for withering and drying tea, coffee, wheat, and other granular materials. February 19

2646 A. M. Clark—From A. L. St. Aubin, France. Process and apparatus for treating coffee. January 22

4320 W. W. Nightingale. Manufacture of transparent ice. January 29

5162 H. Watkins. An improved baking powder. Feb. 16

10903 P. Jensen—From K. G. Duhl. Preserving milk, and vessels therefor. February 9

17075 C. S. Boynton and W. J. van Platten. Preparation of food products. February 9

1887.

122 H. F. von Konitz and J. Luntz. Manufacture of extract of coffee. February 5

B.—Sanitary Chemistry.

1886.

3826 J. G. Lorrain. Formation of organic oxides, and oxidation of matter suspended or dissolved in liquids. February 2

4878 W. F. B. Massey-Mainwaring. See Class I.

6331 A. Z. Germains. Apparatus for disinfecting, fumigating, etc. February 2

XVIII.—ELECTRO-CHEMISTRY.

APPLICATIONS.

881 F. H. Judson, London. An improved method of insulating the electrodes in electric batteries and forming the terminals thereof. January 20

925 J. Wodickz, London. Improvements in the inducing or magnetising parts of dynamo-electric machines and electromotors. January 20

990 S. W. Maquay, London. Improved means for feeding electric batteries and for removing the plates therefrom. January 21

1155 W. A. Phillips, London. Improvements in the manufacture of primary batteries. January 25

1333 W. Webster, jun. See Class XVII.—*B.*

1337 N. W. Perry, London. Improvements in galvanic cells. January 27

1390 R. C. Jackson, London. Improvements in dynamo-electric machines and electro-magnets. January 28

1595 W. Beissbarth, C. Fleischmann, and A. Beissbarth, London. Improvements in electrical batteries. February 1

1654 W. Kingsland, London. Closing or sealing secondary battery cells. February 2

1656 M. Bailey and J. Warner, London. Improved apparatus for preventing the escape of noxious fumes or other gases from primary, secondary, gas, or other batteries used for electrical purposes. Complete specification. February 2

1693 C. D. Abel, London—From La Compagnie Continentale Edison, France. Improvements in disc dynamo or magneto electric machines. February 2

1738 C. D. Abel, London—From Siemens and Halske, Germany. Improvements in dynamo-electric machines. Feb. 3

1741 O. Chauer and S. Rabay, London. Improvements in accumulators of electricity and in the manufacture of the same. February 3

1750 H. H. Lake, London—From Count R. de Montgelas, United States. Improvements relating to the electro deposition of aluminium and to apparatus therefor. Complete specification. February 3

1751 H. H. Lake—Count R. de Montgelas. Improvements relating to the extraction of aluminium from its chlorides, and to apparatus therefor. Complete specification. Feb. 3

1752 H. H. Lake—Count R. de Montgelas. Improvements relating to electric batteries. Complete specification. Feb. 3

1862 C. D. Abel, London—From A. Dun and F. Hasslacher, Germany. Secondary batteries. February 5

1929 C. D. Abel, London—From A. Dun and F. Hasslacher, Germany. Improvements in galvanic batteries. February 7

1982 G. E. Dorman, Stafford. Improvements relating to the transformation of heat into electricity by means of the thermopile.

1993 E. Hermite, J. Paterson, and C. F. Cooper, London. Apparatus for electrolysing bleaching solution. February 8

2028 P. John, Bristol. Improvements in electric batteries and containing vessels for liquids. February 9

2050 G. Wehr, London. Improvements in galvanic batteries. February 9

2134 A. Schanschieff, London. Improvements in galvanic batteries. February 10

2290 H. Leipmann, London. Improvements in the electrolytical treatment of ores for facilitating the extraction and recovery therefrom of gold, silver, or copper, and in apparatus therefor. February 15

2419 F. Bosshardt, London—From A. L. Hillaire-Desbois, France. Improvements in dynamo-electric machines. Feb. 16

2481 R. Marsh, Liverpool. Improvements in or appertaining to galvanic batteries and in electric connectors for other purposes. February 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

2075 N. Tesla. Dynamo-electric machines. February 2

3183 T. A. Garrett. Improvements in dynamo-electric machines or motors. January 29

3475 R. E. B. Crompton. Dynamo-electric machines. Feb. 2

3554 W. Hartnell. Dynamo-electric machines. February 5

3577 A. C. Henderson—From E. Bazin. Method of depolarising electric batteries. February 2

3671 A. F. Harris. Electro-plating apparatus. February 5

4522 W. S. Squire. Process for utilising the spent liquid from certain voltaic batteries. January 26

5731 A. Dun and F. Hasslacher. Improvements in galvanic batteries. February 9

6287 W. Taylor. Electric secondary batteries. February 19

15733 R. A. Parrish. Method and apparatus for producing and utilising electricity. January 26

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

956 R. F. Myddelton, London. Improvements in cigarette papers. January 21

1143 Eisentrant, London. An improved process for manufacturing composition from cellulose or ground wood, which can be given any desired form by employing heat and pressure. Complete specification. January 29

1808 H. H. Lake, London—From F. J. Marshall, United States. Improvements in machinery for the manufacture of paper pulp. Complete specification. February 4

2168 P. W. McGrath, Bradford. Improvements in the manufacture of paper. February 17

COMPLETE SPECIFICATION ACCEPTED.

1886.

16113 J. M. Walton. Boilers for treating wood and other fibre in the manufacture of paper and other pulp. January 22

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

1392 A. Morand. Manufacture of tannin extract and similar vegetable extracts, and apparatus employed therein. Feb. 2

15436 H. Byk. Manufacturing tannic acid in bright semi-transparent or translucent crystals or grains. February 9

XXI.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

783 L. Cornet and L. Youck, London. A new or improved explosive compound. January 18

1244 H. N. Morgan, London. A torpedo. January 26

1687 W. Anderson and J. G. Buebanan, London. Improvements in fuses for exploding shells. February 2

1798 H. E. Newton, London—From A. Nobel, France. Improvements in explosive compounds. February 4

1958 W. Ford, Sutton Coldfield. Improvements in cartridges. Complete specification. February 8

2295 P. Ambjorn, Compte de Sparre, London. Improvements in manufacture of cartridges. February 11

2318 H. H. Lake, London—From The Deutsche Sprengstoff Actiengesellschaft, Germany. Improvements relating to the gelatinising of nitro-glycerine. February 11

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

4116 J. Farnsworth. An improved signal and destructive bomb. January 29

4265 H. C. Seddon. Percussion fuses for projectiles. February 16

5330 H. E. Newton—From A. Nobel. Manufacture of explosive compounds. February 16

5331 H. E. Newton—From A. Nobel. Manufacture of explosive substances. February 16

6909 C. D. Abel—From W. Lorenz. Percussion caps, and means for securing the same in cartridges. February 16

UNCLASSIFIED.

APPLICATIONS.

1887.

1302 W. T. Whiteman, London—From G. A. Wilkins, United States. An improved amalgam for use in various manufactures. January 27

1569 F. H. Snyder, London. Improvements relating to the treatment of gas-carbon, and the manufacture of articles therefrom. Complete specification. February 1

1599 H. V. Stacey and J. F. Stacey, London. A new or improved process for hardening and treating bone. February 1

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NOTICES.

Notice is hereby given that the next Annual General Meeting will be held in Manchester in the month of July, 1887, instead of in Glasgow as originally arranged; the Annual General Meeting in Glasgow being postponed until 1888.

This change originated in a generally-expressed desire, resulting in a special invitation from the Manchester Section, supported by the cordial acquiescence of the Glasgow Section. It will enable members to visit both the Royal Jubilee Exhibition in Manchester, and the Glasgow Exhibition of 1888.

Full particulars as to the Manchester Meeting will appear in a subsequent issue.

The supply of copies of the Journal for January, 1882, and January, 1883, being now exhausted, the Secretary would be glad to receive communications from members possessing extra copies of those numbers, in good condition, with a view to purchase.

Should sufficient applications for complete sets be received, the numbers will be reprinted.

Authors of communications read before the Society or any of its Local Sections are requested to take notice that, under Bye-Law 43, they cannot receive the prescribed 50 copies of their communications unless they comply with the condition laid down in that Bye-Law—viz., that they give notice of their desire to receive such copies upon their manuscript before sending it to the Editor. Mention should also be made as to whether the Discussion is to be included in the reprint.

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W. H. Cowburn, 3, Clarence Street, Albert Square, Manchester, drysalter.

Andrew Duncan, Dawsholm Gasworks, Maryhill, Glasgow, chemist.

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Saml. S. Field, Eagle Villa, Westcombe Park, S.E., manager of chemical works.

D. Gamble, junr., Millbrook, Eccleston, Prescot, Lancashire, alkali manufacturer.

O. Herf, Main and Walnut Street, St. Louis, U.S.A., chemical manufacturer and merchant.

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Alex. E. Tucker, South Road, Smethwick, Birmingham, metallurgist.

W. F. Raphael Weldon, 11, Brookside, Cambridge.

Ernest Wheatcroft, 62, Page Hall Road, Sheffield, analytical chemist.

Deaths.

Geo. Atkinson, Aldersgate Chemical Works, Southall, Dec. 25th, 1886.

R. McKechnie, Thorndean, Elderslie, by Paisley, N.B.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

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The meetings of the London Section will be held on the first Monday in each month.

SESSION 1886—87.

Prospective Arrangements.

April 1.—Discussion on Papers read 7th March.
,, Dr. J. M. H. Munro, "Further Notes and Experiments on the Composition and Manurial Value of Filter-pressed Sewage Sludge."
,, Mr. A. Wingham, "English-grown Tobacco," 2nd Part.
,, Triennial Election of Sectional Officers and Committee.
May 2.—Dr. P. F. Frankland, "Recent Bacteriological Research in connection with Water Supply."
,, Dr. C. R. A. Wright, "The Action of Zinc Chloride on Castor Oil."
June 6.—Dr. H. E. Armstrong, "The Alkaloids—the Present State of Knowledge concerning them, and the Method employed in their Investigation."
,, Mr. Boverton Redwood, "Notes of a Recent Visit to some of the Petroleum-producing Territories of the United States and Canada."
July.—Annual Meeting in Manchester.

Notices of Meetings and Papers will be found in the Scientific Journals.

Notices of papers and communications to be made to the Local Secretary.

Meeting held February 7, 1887.

THE PRESIDENT IN THE CHAIR.

DISCUSSION ON MR WINGHAM'S PAPER: "ENGLISH-GROWN TOBACCO" (SEE FEBRUARY NUMBER, PAGES 76—79).

THE CHAIRMAN said the subject was interesting, not only because of a possible new industry, but as a matter of agricultural chemistry. The very remarkable variations in the quantity of ash indicated by the author deserved careful attention. Undoubtedly they brought forcibly home to one's mind the fact that tobacco was an exhausting crop; for a vegetable product, with 25 per cent. of ash, required a very liberal provision of mineral constituents in the soil.

Dr. WRIGHT wished for information with respect to the alkaloidal constituents of English tobacco, and as to the percentage of nicotine compared with those of foreign tobaccos. A cigar, which would not burn and which contained no nitrates, did not seem to be quite a desirable article; but he presumed that by manuring with nitrates that difficulty might be overcome. Or possibly a good summer might mature the leaf so far as to render it capable of being actually used. With reference to the process of fermentation which took place, he presumed it involved quite a different series of changes from those discussed earlier in the evening (Mr. Jago's paper). He would like to know the condition of the English samples after undergoing that process; they would then be more fairly comparable with foreign growths. He did not wish to pry into the secrets of the trade; still, there were fearful whispers going about to the effect that tobacco leaves were often treated with ingredients of a character perhaps more natural than artificial. If the statements as to the liberal uses of molasses and urine in the manufacture of tobacco were true, he could well understand the reticence of the author on that part of the subject.

Mr. Mackinnon, having had considerable experience in the curing of tobacco, thought it might be useful if he gave a brief account of the process. It was on that process that the smoking qualities, and especially the "bouquet" of the leaf, entirely depended, and unless the curing were properly done, the finest grown tobacco would be absolutely worthless. The leaves were first dried in the shade, and were then dipped in a mixture consisting of the refuse of the crop and a small quantity of urine: this mixture being in a state of fermentation. After immersion in this liquid the leaves were laid flat on boards in large piles, and allowed to remain so until fermentation had proceeded sufficiently, which an expert workman could ascertain by the temperature on placing his hand between the layers. The piles were then undone, and the temperature reduced by exposing the leaves to the air. After a few days, however, the temperature rose again, when the process was repeated and the fermentation was considered complete. The leaves were then in proper condition for manufacture into cigars. He had seen this process carried out in both Cuba and Paraguay, and believed it was the plan used in most tobacco-growing countries. In Paraguay two classes of tobacco were produced, one being made from the lower leaves of the plant, which were plucked first: the other from the three or four leaves left at the top. This latter was considered the best tobacco, and was so excessively strong that he had been intoxicated by smoking a very small part of one cigar made from it. This effect was due to the large quantity of nicotine contained in that portion of the leaf, an effect to which the natives were so accustomed that they could smoke twenty such cigars a day.

Mr. Giles wished to know whether there was any foundation for the widespread opinion that tobacco prepared for smoking in pipes had of late been largely adulterated with glycerin and nitrobenzol. The effect of adding glycerin would obviously be to keep the tobacco moist and prevent loss of weight. The addition of nitrobenzol would, he supposed, give that peculiar flavour possessed by the class of tobacco called "honey-dew." That description of tobacco certainly emitted a smell akin to nitrobenzol, or artificial oil of bitter almonds. He considered the addition of glycerin very detrimental, as it produced effects irritating to the mouth and nasal organ of the smoker.

Mr. Crowder thought that a little ash, more or less, was quite consistent with a good cigar. Without the results of fermentation on the English leaf, one was quite unable to compare it with foreign tobacco. He did not think the proportion of lime or potash had much to do with the matter, but the proportion of nitrates was important. It was well known that tobacco curers frequently used a small quantity of nitrates, and if a little too much was added, the result was that the tobacco smoked unpleasantly "hot."

Mr. Bernard Dyer asked if the author had looked for lithium in the ashes. It had been laid down that lithium was a normal constituent of the tobacco plant, which was supposed to have a power of discovering and assimilating it. He was, therefore, curious to know whether these English plants had this constituent. He agreed that these ash analyses formed an interesting contribution to existing knowledge of the subject generally, though he must also agree with Mr. Crowder that they did not throw much light on the quality of the tobacco. The process of combustion and destructive distillation carried on in a good briar pipe was probably the only way of arriving at a satisfactory solution of that point.

Mr. Mumford hoped that the outcome of this paper and discussion would be to lead the English tobacco grower to pay more attention to the composition of his soil and the fertilisers necessary to grow a crop capable of competing with foreign tobaccos. Such a course would be productive of valuable results. He believed that abroad tobaccos were generally grown on very siliceous soils. Probably these English samples were grown on calcareous soil. He would like to know whether the potash had been used in the form of "muriate" of potash. That course had been tried abroad, and the result had been very deleterious to the quality of the tobacco produced.

Mr. J. Newlands wished to draw attention to a method of estimating ash which was not so widely known as it should be. In the usual method of proceeding, great difficulty was experienced in getting rid of the last traces of the carbon, on account of the fusion of the alkaline salts present. The substance should be fused in a muffle and allowed to cool; it should then be ground. Water sufficient to dissolve the salts should then be added, when they could be separated out by evaporation. The residue would calcine into a white ash without difficulty, and without the use of a very high temperature. This method of working had been found very useful in analysing sugar before the introduction of the French system.

A Member asked if the author would name the different species of tobacco cultivated (represented on the black-board by the figures 1, 2, 3, and 4).

Mr. Wingham, in reply, said his remarks had been brought forward with a view different from that assumed by the meeting. He had not pretended to lecture on the art of tobacco cultivation; consequently, he was hardly prepared to answer all the questions put to him. He had carried out his experiments from a chemico-industrial point of view, and with the object of showing British tobacco growers what to do and what to avoid—to point out the probable effect of different soils and different manures on a tobacco crop. He had endeavoured to estimate the nicotine in the unfermented English examples by Schlœsing's method—by digesting the leaves with ether, evaporating off the ether and ammonia, and estimating the residue with sulphuric acid. But when he came to titrate the solution, he had found it to be already acid, and so nicotine appeared to be absent. The question of nicotine, however, was not to be regarded as settled, as his experiments in that direction were not completed. With respect to the aroma of tobacco, said to be due to its oil, he did not believe that either nicotine or nicotianine existed in unfermented leaves, but thought that both those alkaloids were produced during fermentation. If his view were correct, the English leaves tested contained neither substance. It was well known that the percentage of nicotine in any tobacco was in inverse proportion to that of the nicotianine, and that the goodness of a tobacco depended on the percentage it contained of the latter—its essential oil. He had not analysed the oils that came off during heating. From what had been said, one would be inclined to think that urine was employed to start fermentation, but he did not believe it was so. The chlorine found in the English specimens had, of course, come from the soil. He did not think it within his province to enter into the question of the alleged sophistication of tobacco by nitrobenzol and glycerin. The idea of testing for lithium had occurred to him, but unfortunately too late to try it on the present samples. Mr. Mumford was quite right in thinking that the samples tested had been grown on a calcareous soil, and also in saying that a siliceous soil would be more advantageous. The quality of the tobacco depended more on the constitution of the soil than on its richness. He thanked Mr. Newlands for his suggestion: his own method had been to heat the tobacco at a very low temperature in a capacious platinum vessel inclined to one side. The examples of English grown tobacco treated were all American species—chiefly Kentuckian. There were really only three species of tobacco, but many varieties.

◆

FERMENTATION IN ITS RELATION TO BREAD MAKING.

BY WILLIAM JAGO, F.C.S., F.I.C.

Fermentation has been made the subject of careful and systematic study in connection with brewing and the production of alcoholic liquors generally; but, in its relation to bread making, has hitherto received but comparatively little attention from scientists. In many cases it has apparently been assumed that yeast behaves in just the same manner in dough as it does in a malt or other wort, and consequently that the same laws apply with equal force to the phenomena of fermentation in either substance. But the fermentation of wort differs from that of dough in several most important particulars. The former is a liquid, rich in maltose, and well adapted for the sustenance and growth of yeast; the latter is a stiff, elastic, semi-solid mass, containing but little readily fermentable matter. In wort, by a process of budding, yeast rapidly multiplies; but when added to dough the yeast cells show no signs of any reproduction by budding, but, on the contrary, gradually disappear, owing to the breaking-down of the cell-walls. In the fermentation of wort but a small proportion of the effect is due to the yeast originally added, the greater part being produced by the new yeast cells formed as the progeny of those first introduced; but in dough the whole of the work is thrown on the yeast cells primarily introduced into the mass. These are so unfavourably situated as to have little or no power of reproduction, and consequently on their activity and vitality successful fermentation must depend. This being the case, it is evident that mature and vigorous yeast is more absolutely essential to the baker than even to the brewer; since, if the latter's initial fermentation be sluggish, the progeny of new cells may fairly be expected to be more active. On the other hand, absolute freedom from foreign ferments is not a point of such vital importance to the baker as to the brewer. In many cases, a yeast that on microscopic examination would be immediately rejected by the brewer, would be found capable of making good bread. I might even go a step further, and say that of two yeasts the one deemed the better of the two, judging by purity as revealed by the microscope, might be the less desirable yeast for bread-making purposes. It is a well-recognised fact that in some varieties of bakers' barms the presence of other organisms than the yeast plant is normal. In particular, this is so with Scotch flour barms, which consist of yeast allowed to develop in what is essentially a thin paste made from scalded flour. This barm invariably contains the lactic ferment in large numbers. Mr. Thoms, F.R.M.S., a Scotch master baker, who has for very many years investigated yeast most exhaustively from the bakers' standpoint, is my authority for this statement. Mr. Thoms further informs me that on brewing flour barm at a sufficiently low temperature to prevent the development of *Bacterium Lactis*, the barm produced is inferior in quality, and yields an inferior loaf. It should be added that in bread made on the Scotch system there is always a distinct, though very slight, acid flavour. This acidity is altogether different in character from what is known as sourness of bread in the London district. The flavour of Scotch bread more resembles that wetted partly with butter-milk.

With healthy, active yeast cells, fermentation, as conducted in the South, proceeds sufficiently rapidly in dough to allow the bread to be completely ready for the oven before the lactic ferments have had time to develop any sensible acidity. In deciding as to the quality of yeast for bread-making purposes the first requisite is, that the yeast plant itself shall be in a vigorous and active condition. Among foreign ferments, the presence of those producing lactic acid at least is not deleterious in small numbers to anything like the extent that holds in the case of yeast to be used for beer brewing. Apart from their own specific action, foreign ferments are, in brewers' yeast, an evidence of carelessness and want of strict cleanliness in the yeast manufacture, and to this extent their presence may be interpreted unfavourably when judging the value of such a yeast for the baker. The point I hope I have made clear is, that if the yeast itself is healthy and vigorous, foreign ferments are not capable of doing the same amount of harm during the fermentation of dough, as during that of beer; principally because the act of baking the bread effectually destroys all fermentative action before disease ferments have had time to set up any injurious chemical change.

In passing, the aim of the baker in availing himself of the action of yeast during bread making may be explained. If the question were asked, Why is yeast employed? the answer in ninety-nine cases out of a hundred would be, to aërate the dough and thus make the bread spongy. Now yeast possesses this property in common with various other substances. There are, in fact, several ways of aërating bread more or less satisfactorily, but fermentation seems to be the only method capable of inducing other changes which are essential to the production of bread of the finest quality. By the action of yeast, the gluten, which contains the principal nitrogenous constituents of flour, is softened and mellowed, undergoing a species of digestive action, partly physical, inasmuch as it is rendered softer, and, probably, partly chemical, as a change analagous to peptonisation apparently occurs. Another most interesting effect of fermentation is, that it imparts a characteristic and pleasant flavour to bread, absolutely unattainable by other means. In bread aërated by any other method the results of these specific changes are absent; and public opinion decides that, after a time, such bread raised otherwise than by the action of yeast has a raw, uncooked taste, of which the palate speedily tires. Although the average baker knows nothing of the nature of the chemical changes induced by yeast, it is of great interest to note that his methods take cognisance of the fact that such changes are produced. If the production of sufficient gas to aërate the dough were his only object, then it might be expected that as soon as that object was attained he would proceed to get his bread in the oven. Such, however, is not the case; after a time, as much as possible of the gas generated in the dough is violently knocked out of it; this operation being sometimes repeated two or three times. The baker knows by experience that other changes which he desires to have take place will not be completed until some time after sufficient gas to aërate the bread has been developed. Theory and practice therefore both show that the aëration of the dough is only one out of several important effects produced by fermentation. From time to time, those interested in other methods of bread manufacture insist on the great loss caused by fermentation; thus, Dauglish expressed the opinion that this loss amounted to from 3 to 6 per cent., which opinion has since been adopted by Dr. Richardson, in his work on the "Healthy Manufacture of Bread." In order to determine the maximum amount of loss possible, I recently made the following experiment:—100 parts by weight of soft flour from English wheats were made into a slack dough with distilled water, two parts of pressed yeast being added, and no salt used. This dough was allowed to stand for from eight to nine hours at a temperature of about 85° to 90° F.; fermentation proceeded violently, but toward the end of the time had apparently ceased. The dough was next placed in the hot-water oven, and dried until of constant weight; the same weight of flour and yeast, unmixed, and without water, was also placed in the oven. At the end of the time, the fermented dough was found to have lost 2·5 per cent. compared with the flour. In this extreme case, a soft flour was used with distilled water and no salt, and about six times the normal amount of yeast; the temperature was purposely maintained at a high point, and the fermentation carried on so long as any decided evolution of gas occurred. Yet, under these conditions, which far and away exceed in severity any such as occur in practice, the loss was less than Dauglish's minimum estimate. The percentage of loss closely corresponds with that of sugar in flour as determined in a series of experiments to which I wish to direct your attention. Mr. Williams, a practical baker of high authority, estimates, from a series of experiments he conducted on the large scale, that the loss of solid constituents of flour during fermentation, as practically conducted in bakeries, amounts to 1·37 per cent.

Having for some time been engaged on an investigation of certain problems connected with panary fermentation, I take this opportunity of laying a synopsis of my results before you. In these experiments an apparatus of the following description was employed: a 12oz. bottle was connected with corks and tubing to a glass jar, graduated into cubic inches, so arranged that any gas evolved in the bottle entered the jar through the top. When in use the bottle was placed in a water-bath, maintained at any desired temperature by means of an automatic regulator. The graduated jar, which was open at the bottom, stood in a trough of water. At the commencement of each experiment the air was withdrawn from the jar until the water stood at zero. Carbon dioxide gas was thus collected over water, but when the gas does not bubble through the liquid the rate of absorption is comparatively slow. In some direct experiments I found it to proceed at the rate of about a cubic inch per hour. Allen states that saturated brine absorbs CO_2 but very slowly; I think only at about 15 per cent. of the speed with which water effects its absorption; brine might thus be advantageously substituted for water. As the experiments were made with the object of determining the relative amounts of gas evolved under different conditions, rather than the absolute quantity, no corrections were made for variations of temperature, pressure, or absorption of gas by the water. Errors from these sources would practically affect each member of a series of experiments made at the same time, to the same extent; and so would not disturb the comparisons between them. Further, the total possible error in most instances, would only be a small percentage on the total quantity of gas being evolved. As the apparatus employed was designed for the use of bakers, as a yeast-testing instrument, the units of quantity selected for the first experiments were the ounce and cubic inch; when smaller quantities were added on to these, in certain cases, these were weighed in grammes: hence there is rather an anomaly in the weights sometimes employed. At the start, duplicate experiments were made, in order to determine the degree of accuracy of the method. The following are the results of a pair of such duplicates:—

In each case there were taken: Brewers' yeast, ½oz.; sugar mixture, ½oz.; water, 6oz.; at 30° C. (The sugar mixture consisted of the dry constituent of "Pasteur's Fluid, with Sugar.")

These were mixed, placed in the bottle of the apparatus, which, in its turn, was placed in the bath at 30° C. The quantity of gas evolved was collected at the end of each half-hour; the following are the results of these readings:—

Time.	Gas evolved in cubic inches.	
0	0·0	0·0
½ hour	0·7	0·5
1 ,,	6·5	6·0
1½ hours	14·2	13·8
2 ,,	22·0	22·0
2½ ,,	30·0	29·7
3 ,,	41·0	41·0
3½ ,,	47·0	46·7
4 ,,	54·5	53·7

One of the earliest comparisons instituted was between filtered flour infusion, unboiled and boiled malt wort, and solution of "sugar mixture."

No. 1 solution consisted of 6oz. of 40 per cent. flour infusion (sp. gr. 1007·2), warmed to 30° C., and compressed yeast, ¼oz.

No. 2, 6oz. unboiled malt wort, same density.

No. 3, 6oz. boiled malt wort, same density.

No. 4, 6oz. sugar mixture solution, same density.

All started at the same temperature, and with the same amount of yeast:—

Time.	Gas evolved in cubic inches.			
	No. 1.	No. 2.	No. 3.	No. 4.
0 hours	0·0	0·0	0·0	0·0
1 ,,	2·2	6·5	7·5	12·0
2 ,,	5·2	14·4	15·9	22·4
3 ,,	6·5	16·3	17·8	21·1
4 ,,	7·4	17·0	18·2	24·3
5 ,,	8·3	17·1	18·2	24·3

It will be seen that the filtered flour infusion evolved gas far more slowly than did either the boiled worts or sugar mixture solution of the same density.

The next series of experiments was made with the object of determining the relative powers of supporting fermentation possessed by different constituents of flour. Chicandard has affirmed in the *Comptes Rendus*, May, 1883, that the fermentation of bread does not consist in the hydrolysis of starch, followed by alcoholic fermentation, and is not determined by *saccharomyces*, but is the result of the solution, and after peptonisation of the gluten, this effect being caused by a *bacterium*, which develops itself normally in the dough, yeast merely accelerating its development. One of the objects I had in view during the making of these particular experiments was the examination of this theory. The best plan will be to first state exactly the nature of each experiment, and then to refer to the conclusions to be drawn therefrom.

No. 1. 20 per cent. filtered infusion of flour, 6oz. (170grms.), at 30° C.; compressed yeast, ¼oz.

No. 2. 34grms. flour; water, 6oz., at 30° C.; compressed yeast, ¼oz.

No. 3. Washed insoluble residue from 34grms. of flour; water, 6oz. at 30° C.; compressed yeast, ¼oz.

No. 4. 20 per cent. filtered flour infusion, 6oz. at 30° C.; wheat starch, 5grms. taken and gelatinised, cooled, then added to flour infusion. Mixture placed in bottle and maintained at 30° C. for 12 hours; then ¼oz. compressed yeast added, and fermentation commenced.

No. 5. Moist, thoroughly-washed gluten, 5grms., triturated in mortar with sand, in order to expose large surface; gluten, with 6oz. of water at 30° C., placed in bottle and maintained at 30° C. for 12 hours; then ¼oz. compressed yeast added, and fermentation commenced.

No. 6. 20 per cent. filtered flour infusion, 6oz. at 30° C.; wheat starch, 5grms., gelatinised; compressed yeast, ¼oz.

No. 7. 20 per cent. filtered flour infusion, 6oz. at 30° C.; wheat starch, 5grms. ungelatinised; compressed yeast, ¼oz.

No. 8. Wheat starch, 5grms., gelatinised; water, 6oz. at 30° C.; compressed yeast, ¼oz.

Time.	Gas Evolved in Cubic Inches.							
	No. 1	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.
0	0·0	0·0	0·0	0·0	0·0	0·0	0·0	0·0
1 hour	0·2	3·8	0·2	10·4	0·3	18·5	2·8	0·3
2 hours ..	0·6	8·2	0·6	29·5	0·5	20·8	5·1	0·4
3 ,, ..	1·2	11·5	1·1	35·0	0·6	28·1	6·3	0·5
4 ,, ..	1·8	14·0	1·8	37·3	0·9	31·5	7·0	0·6
5 ,, ..	2·2	16·0	2·7	37·5	1·1	32·8	7·6	0·7
6 ,, ..	2·5	17·5	3·0	37·5	1·3	33·7	8·2	0·9
7 ,, ..	2·9	18·5	3·2	—	1·3	33·7	8·5	1·0
8 ,, ..	3·3	19·6	3·3	—	1·5	—	8·5	1·2
9 ,, ..	—	—	—	—	1·5	—	—	—
21 ,, ..	—	—	—	—	—	—	—	7·0
22 ,, ..	—	—	—	—	—	—	—	7·8

No. 1, consisting of 20 per cent. flour infusion, gave off very little gas, the quantity amounting to only 3·3 cubic inches in eight hours. This is very much less than that obtained in the previous series of experiments in which a 40 per cent. infusion was employed; the latter gave off 8·3 cubic inches in five hours. No. 2, containing the whole of the flour, gave off gas much more copiously; in eight hours there being 19·6 cubic inches of gas evolved. After the second hour the evolution fell off slowly, but regularly. The washed residue gave off just the same amount of gas as did the filtered infusion; in fact, at the end of the fifth hour, No. 3 gave the higher reading. It will be noticed that the whole of the flour gives off three times as much gas as does the filtered infusion and the washed residue together. The reason is that, when flour is shaken with water and then filtered, the substances which, under the action of yeast, evolve gas, are not all removed in the filtrate. They consist in part of starch granules, in which the amylose is more or less exposed to the action of diastasic agents. With well washed and kneaded gluten but very little gas is evolved, the total amount in nine hours being only 1·5 cubic inches, and this, although the gluten for 12 hours previous to fermentation was digested with water at 30° C. In Nos. 4 and 6 the quantities used are the same, but the former of the two samples affords evidence of diastasis having been occasioned during the 12 hours for which the gelatinised starch was subjected to the action of the flour infusion. No. 6 at first proceeded somewhat the more rapidly, but evolved very little gas during the second hour. During the third, however, it recovered itself and proceeded regularly, until, at the expiration of six hours, the evolution of gas ceased, with a total of 33·7 inches. In No. 4 the fermentation proceeded rapidly and regularly, falling off towards the end, and finishing at five hours with 37·5 cubic inches. As a result of the previous diastasis, a large quantity of gas is evolved, but in each instance the greater part of the starch remained behind, as if 5grms. of starch were completely changed into sugar, and then, by fermentation, into carbon dioxide and alcohol. The yield of gas would roughly be about 85 cubic inches at 20° C. The diastasic action of the flour infusion will have more or less effected the hydrolysis of the starch into dextrin and maltose: the latter will have undergone fermentation, while the former is unfermentable. Experiment No. 8 shows that the diastasis of the starch is effected by the flour infusion, and not by the yeast; for where pure gelatinised starch and yeast alone are employed, exceedingly little gas is evolved; during eight hours but 1·2 cubic inches only having accumulated. This experiment was allowed to proceed overnight, and at the end of 21 hours 7·0 cubic inches had been evolved. Another reading was taken at the end of the twenty-second hour, and showed that 0·8 cubic inches had been evolved during the hour. It would seem that the diastasic action of yeast on pure starch increases somewhat after some hours, but within a limit of eight hours, which covers the time that flour is in most instances subjected to fermentation, little or no action has occurred. Very striking in connection with this is the result obtained in experiment No. 7, for when the ungelatinised starch was mixed with flour infusion and subjected to fermentation, 8·5 cubic inches of gas were obtained in eight hours. The flour infusion must, under these circumstances, have succeeded in hydrolysing some of the starch; for although starch is washed most carefully, there will always be a certain number of cells whose walls are sufficiently thin to permit diastasis to occur; and some investigators are of opinion that even unbroken wheat starch cells are comparatively readily attacked by hydrolysing agents. Summing up the results obtained in these experiments, it is found that:—

Filtered flour infusion supports fermentation slowly.

The frequently washed residue of flour supports fermentation at about the same rate.

The entire flour, mixed with water, evolves about six times as much gas as either the filtered infusion or the washed residue from the same weight.

Kneaded and washed gluten evolves practically no gas.

Flour infusion and gelatinised starch together evolve gas in considerable quantity.

The quantity of gas is increased when the infusion and the gelatinised starch remain together sometime before fermentation, which result is due to diastasis by the albuminoids of the infusion.

Ungelatinised starch, under the influence of yeast and flour infusion, evolves a moderately large quantity of gas.

Gelatinised starch alone undergoes little or no fermentation during a period of eight hours, but ferments slowly after standing some twenty hours.

In order to further determine the source of gas during the fermentation of flour infusion, the following experiments were made:—A 40 per cent. filtered infusion of stone-milled flour, from English wheat, was prepared by taking 600grms. of flour and 1500cc. of distilled water. These were several times shaken together during half-an-hour, and then allowed to subside. The upper layer of liquid was next poured off and filtered through washed calico. This was subsequently again filtered in the ordinary manner through paper until perfectly clear. On testing with iodine no colour was produced, thus showing the absence of both starch and erthyrodextrins. The specific gravity of the infusion was 1008·5, being somewhat higher than that of the 40 per cent. infusion used in a previous experiment. A portion of the infusion was tested for sugar before and after the inversion, and also for albuminoids. Six ounces of the infusion were then fermented with 25° C., with a quarter of an ounce of encore yeast. The experiment was continued for twenty-two hours, at the end of which time fermentation had entirely ceased. The clear liquid was then decanted off from the layer of yeast at the bottom, and tested for sugar and albuminoids, as was done in the separate portion of the original infusion. To the yeast remaining in bottle there was at once added half-an-ounce of sugar and six ounces of water at 25° C., and the testing apparatus set up and the quantity of gas evolved measured.

The sugar was estimated in the following manner:—A weighed quantity of the flour infusion was raised to the boiling-point, and maintained at that temperature for about five minutes, in order to coagulate albuminoids: the loss by evaporation was then made up by the addition of distilled water, and the solution filtered.

Quantities taken = 25cc. Fehling's solution.
50cc. water.
20cc. 40 per cent. flour solution.

Weight of cuprous oxide, Cu_2O, yielded = 0·1531grm. Assuming this precipitate to be due to maltose, then 0·1531 × 0·7758 = 0·1187grm. of maltose in 20cc. of the flour infusion = 1·48 per cent. of maltose in the flour.

In the next place, 50cc. of the flour infusion were taken, 5cc. of fuming hydrochloric acid added, and the solution inverted by being raised to 68° C. The acid was then neutralised by solid sodium carbonate, and the solution made up to 100cc. with water. This produced a 20 per cent. inverted solution.

Quantities taken = 25cc. Fehling's solution.
50cc. water.
20cc. 20 per cent. inverted flour infusion.

Weight of cuprous oxide, Cu_2O, yielded = 0·1860grm.

In 20cc. of a 40 per cent. solution there would be double this quantity = 0·1860 × 2 = 0·3720grm. From this must be deducted the amount of precipitate due to the maltose present.

0·3720 – 0·1531 = 0·2189grm. of Cu_2O due to a reducing sugar produced by inversion. Assuming this sugar to be cane sugar, or at least to have the same reducing power, then 0·2189 × 0·4791 = 0·1048grm. of cane sugar in 20cc. of the 40 per cent. infusion, = 1·31 per cent. of cane sugar in the flour.

The total sugar in the flour would thus be 2·79 per cent.

After fermentation, the upper liquid from the yeast bottle was also tested for sugars after filtration and coagulation of albuminoids as before. The uninverted solution gave no precipitate whatever with Fehling's solution. A portion was next inverted with acid in the manner already described. 20cc. of this solution gave a slight trace of precipitate with Fehling's solution, which was too little to weigh. So far, the practical result may be summed up in the statement that filtered aqueous flour infusion contains two or more varieties of sugar; these, during the act of fermentation, entirely disappear.

The infusion was tested for albuminoids by distillation with alkaline permanganate solution with the following results, calculated to the percentage present in the flour:—

In the infusion before fermentation ...... 0·76 per cent.
,, after ,, ... 0·78 ,,

Compared with analyses of other flours, the quantities are low. This is probably accounted for by a 40 per cent. infusion being made, whereas a 10 per cent. infusion is used in most analyses, the more dilute solution extracts the somewhat viscous albuminoids with greater readiness. The only deduction from these determinations is, that the amount of albuminoids in a filtered flour infusion is practically unchanged by the act of fermentation, there being no disappearance whatever of these bodies. The small increase observable is probably due to albuminous matter being yielded to the solution by yeast itself.

The following are the results of the fermentation experiments:—

No. 1. Flour infusion, 6oz.; encore yeast, ¼oz.: temperature, 25° C.
No. 2. Yeast from previous experiment after cessation of fermentation: Sugar, ½oz.; water, 6oz.; at 25° C.

Time.	Gas Evolved in Cubic Inches.	
	No. 1.	No. 2.
0	0·0	0·0
1 hour	1·7	5·0
2 hours	5·0	—
3 ,, ...	6 7	—
4 ,, ...	8·2	—
5 ,, ...	9·0	—
6 ,, ...	9·6	73·5
7 ,, ...	10 2	—
8 ,, ...	11·0	—
9 ,, ...	12·0	—
22 ,, ...	15·0	—

As six ounces of the 40 per cent. flour infusion would contain the soluble matter of 68grms. of flour, it follows that there would be present, according to the analysis, 1·89grms. of sugar. This quantity, if entirely converted during fermentation into carbon dioxide and alcohol, would yield about 32 cubic inches of gas at 20° C. By the method adopted for testing, 15 cubic inches were registered at the end of twenty-two hours; to this would have to be added a correction for the amount lost by absorption by the water, in order to obtain a correct estimate. It is difficult, when the total quantity of gas evolved is small, to determine with accuracy the loss of absorption, because the gas in the apparatus consists of a mixture in which air is predominant, consequently the rate of absorption is less than with pure carbon dioxide gas. If it were desired to accurately estimate the quantity of gas, collection over mercury would have to be adopted. This is of little importance in the present experiment, because the total measured comes well within the amount of gas that the sugar would theoretically yield. In other words, there is no need to go outside the sugar to find a source from which the carbon dioxide is obtained, as the whole of the sugar disappears, and in the act of fermentation is capable of yielding more gas than that observed to be evolved. That the cessation of fermentation is not due to the exhaustion of the yeast is proved by experiment No. 2, in which the same yeast has more sugar added to it, when a vigorous fermentation was immediately set up. That the cessation of fermentation is due to the exhaustion of the sugar, is proved by that compound being absent on analysis of the infusion after fermentation. Summing up the whole of the results—

FLOUR INFUSION.

Before Fermentation.	*After Fermentation.*
Sugar, 1·89grms. in the six ounces of infusion.	Sugar, absent.
Albuminoids, 0·517grm. present.	Albuminoids, 0·530grm. present.
	When fermentation had ceased, 15 cubic inches of gas had been evolved, and the yeast was still unexhausted, and capable of inducing fermentation in fresh sugar solution.

Reasoning on these results, together with those obtained in the series of experiments on flour and its various constituents taken separately, the only logical conclusion is that the fermentation of dough is essentially a saccharine fermentation.

It may be demurred that the circumstances are different in an aqueous infusion to those which hold in a tough elastic mass such as dough. But it is inconceivable that the fermentation actually immediately depends on the conversion of any but soluble constituents of the flour into gas; therefore, if those albuminoids, so soluble as to pass through filter paper, are not capable of yielding gas as a result of fermentation by yeast, it follows that the more insoluble albuminous compounds likewise will not yield gas. The fact that washed gluten yield no gas affords corroborative proof of this point. (The small quantity actually obtained by experiment may be accounted for by the well-known difficulty of actually freeing gluten from all starchy and soluble matters.) That the fermentation of the flour itself yields several times more gas than does the filtered infusion, lends no support to the theory that it is the albuminous matter that is evolving gas, because it has been shown that pure ungelatinised starch causes a marked evolution of gas, being doubtless first converted into dextrin and maltose by diastasis. The fermentability of the washed residue is also accounted for by its containing starch. Supposing even that in dough, after fermentation had ceased, sugar as such existed, and could be removed and detected by analytic methods, that of itself would be no proof of the evolution of gas being at the expense of the albuminoids, or peptones derived therefrom (for the argument equally applies to these latter bodies), because simultaneously with the fermentation produced by the yeast there is a production of sugar by diastasis of the starch. Fermentation of sugar in a stiff dough is rough work for yeast cells, and it may well be that after a few hours they are thoroughly exhausted, and disappear through disruption of their cell walls; the continuance of diastasis would still cause the slow production of more or less sugar. Further, the diastasis of the starch must throughout fermentation *precede* its subsequent conversion into carbon dioxide and alcohol; and so, if the reaction be stopped at any point, more or less sugar would, as a rule, be found. Again, drawing a conclusion, the fermentation of dough is in part due to the fermentation of the sugar present, in part to the diastasis of a portion of the starch of the flour and its subsequent fermentation. These sources are sufficient, and more than sufficient, for the production of all the gas evolved: these statements admit of experimental proof. There is no satisfactory evidence in favour of the gas evolved being in any sensible degree derived from the albuminous constituents of dough. It should be noticed that no assertion is made that no gas whatever is derived from the albuminous constituents of flour; it is possible that in extreme cases gas is produced from albuminous matters as a result of butyric and putrefactive fermentations; but in ordinary bread-making, as it holds in the United Kingdom, the amount of gas derived from this source is of no importance compared with that from sugar, and indirectly from starch. Whatever amount of gas there is, that is thus obtained, is the result, not of the action of yeast, but of *bacteria*. Further, the statement that albuminous bodies do not themselves evolve gas during panary fermentation must not be construed into meaning that they do not affect the quantity evolved. In their capacity as nitrogenous yeast foods, they aid the yeast in its development, and consequently in its production of gas, by decomposition of saccharine bodies.

These experiments seem to me to effectually dispose of Chicandard's theory of the panary fermentation being due to the action of *bacteria* on the albuminoids of flour.

I feel that the time already occupied over this paper precludes my dealing any further with the problems involved in its title. I only venture to hope that my work may have proved of interest sufficient to justify my having thus occupied so large a portion of the valuable time of this Society.

DISCUSSION.

The CHAIRMAN said probably the most ancient of fermentations, after the fermentation of the grape, was that of bread. He would like to know whether Mr. Jago had made any experiments on the fermentation of leaven. It was a matter of importance and interest, especially in view of the bold assertion of the French author quoted by Mr. Jago.

Mr. A. WINGHAM wished to ask the author how, if the fermentation of bread were entirely saccharine in character, he accounted for that peculiar "mellowing" of the gluten, mentioned in the paper, which occurred during the fermentation.

Mr. F. ADAIR ROBERTS understood the author to say that fermentation by means of yeast possessed other advantages beyond the mere aëration of the bread. As there was a company doing a large trade in bread in London who, he believed, claimed that they aërated their bread by purely mechanical means, he would be glad to know what were the additional advantages of yeast fermentation over such mere mechanical aëration.

Mr. B. E. R. NEWLANDS remarked that the whole of the author's results seemed to depend on the quantity of carbonic acid measured under certain described conditions. The gas was collected over water, which of course absorbed a quantity of it, varying according to pressure, etc. It would be an easy thing to put a little oil on the water, and thus prevent the absorption of carbonic acid; or, better still, to use Dr. Scheibler's well-known apparatus. This apparatus would give results sufficiently accurate if allowance were made for temperature, etc.

Dr. WRIGHT wished to know whether the author had made any experiments with the object of determining the relative proportions of the supplementary products of bread fermentation, more particularly of the alcohol formed. He believed that some years ago a process was brought out for the condensation of the alcohol expelled during the operation of baking. He had been given to understand, however, that the chief results produced were the exhilaration of the workmen and the spoiling of sundry batches of bread in consequence. He wished to point out that the determination of the ratio between these supplementary products and the carbonic acid might yield some evidence as to how far the albuminoids underwent change and contributed to the final result.

Dr. **Squire**: I am interested to learn that the author considers the formation which takes place in bread is due to the action of yeast on saccharine matter, and not, as has been pretended, to the action of bacteria. The bacteria theory is by no means a new one. Every three or four months one finds in the *Journal of the Chemical Society* extracts from foreign journals describing some particular kind of bacterium to which bread fermentation is supposed to be due. Although the germs of these special organisms are supposed to exist on the corn from which the flour is made, they, for some reason or another, do not find their way into brewers' or distillers' worts. I entirely concur in the view that bread fermentation is due to the alcoholic fermentation of saccharine matter produced by diastatic action. Some two years ago I pointed out, in this room, that an unmalted corn (especially rye) contains a certain proportion of diastase. In some parts of Russia a good deal of spirit is made from raw rye, without the admixture of any malted grain, the unmalted rye containing sufficient diastase to effect a tolerably good conversion of the starch present. It is true that the produce of spirit is from 15 to 20 per cent. less than when malt is used, and that this process is going out of use; but it is a striking illustration of the presence of diastase in raw grain. I do not, however, agree with the author in thinking that the starch is acted upon by the diastase when the granules are whole. Brown and Heron found that whole granules of starch were quite untouched by malt infusion; but when the granules were ground up with sand, so as to break the granules, the starch was rapidly attacked by diastase. In the process of making flour, a certain proportion of the starch granules must get broken, and these would no doubt be sufficient to supply the saccharine matter required for the fermentation. I do not gather that sufficient attention has been paid, in the course of the author's experiments, to the influence of dilution. Very dilute saccharine solutions ferment with difficulty, and when the dilution is so great that the saccharine matter does not exceed 1 per cent. all fermentation ceases. I have never yet met with a case in which the whole of the maltose could be removed from a solution by means of fermentation, and I was therefore rather surprised to hear the author describe his fermented preparations as being entirely free from saccharine matter. There is very little doubt in my mind that the fermentation of bread is due simply to the action of yeast or maltose produced by diastase pre-existing in the grain, and not at all to the action of bacteria, except in the case of sour bread, the acidity being then due, no doubt, to bacteria. If bread fermentation were produced by bacteria, what is the use of adding yeast?

Mr. **John Heron** asked whether the author had found carbonic acid to be the only gas produced during the process of fermentation. That operation being carried on under considerable pressure, it seemed to him that having regard to the presence of soluble albuminous matters, other gases, such as nitrogen and hydrogen, would probably also be evolved. Therefore, in estimating the strength of the yeast, one ought, as far as possible, to put it under the same conditions as would hold in practical work in the bakehouse. It seemed that the fermentation of dough was carried on by certain species of saccharomyces. He had made several experiments on the fermentation of flour and other substances from cereals, comparing the ferments of flour with those of malt wort, and he had found that it was possible to isolate from the flour a ferment which was, so far as he could judge, saccharomyces *minor*. He regarded that organism as the most perfect form of ferment for bakers' use. But ordinary bakers' yeast contained a large variety of yeast cells, as well as various forms of bacteria, and he thought Mr. Jago would have obtained more useful and interesting results if he had experimented with this ordinary yeast taken from the bakehouse, rather than with the purer materials he had really selected. One probable result would have been to arrive at what was the best ferment with which to carry on the fermentation of bread.

Mr. **Jago**, in reply, said he thought the remarks which had been made bore out what he had said in the introduction to his paper, that fermentation in its relation to bread had as yet received but little attention. References had been made to points, of which the parallel points in beer brewing had been satisfactorily worked out, but which had not yet been touched in connection with bread. If he might alter the order in which some of these remarks had been made, he would like to refer to some of his experiments on the possibility of diastatic action on ungelatinised starch. The starch used was prepared by himself from a sample of the finest Hungarian flour—about the most perfect wheat starch obtainable. It was washed out by hand. The starch was then washed every day, until, at about the end of a fortnight, the washings gave no precipitate with Fehling's solution. Then it was carefully air dried at 40° C. He thought that was as representative a sample as one could get of starch, in the condition of consisting in the main of whole cells. In his opinion the process was really one of attack of the amylose through the walls of the cells. Whatever stage one commenced at there would always be, in a sample of starch, a percentage of walls with cells sufficiently thin to permit of diastasis occurring; for while cells in their most perfect condition were not susceptible to this agency, there would always be a number with walls sufficiently thin, by abrasion or "pitting," to permit of diastasis. With regard to the fermentation of leaven, he would refer those interested in the subject to a paper shortly to be read on it by Mr. W. A. Thoms. A copy of that paper should be sent to the secretary, and if it were thought that an abstract of it would be useful to the members he would undertake to supply one. As to the mellowness of the gluten, and how it was effected if the fermentation was essentially saccharine, it had been seen that one of the objects of his experiments had been the investigation of the evolution of gas; but some of his first statements had been pointed to show that fermentation had objects beyond that. He thought that the yeast cell, pure and simple, must have a diastatic action on the gluten and certain other constituents. If bread were aërated by any other means, there was an absence of that characteristic flavour which fermentation by yeast gave it. That was not merely an idea of his own, or of the men who made bread, but its truth was proved by the fact that bread aërated by other means never held the popular taste for long. It was the experience of practical men that such breads would sell well for a short time, but sooner or later the people came back to yeast made breads. In his opinion, yeast fermentation had the advantage, not only of producing a flavour more pleasing to the general taste than any other, but its employment induced a more or less digestive process of the nitrogenous constituents of the flour, rendering the bread itself more digestible as well as more tasty. He thought that there were good grounds for the complaint made as to the want of tables and diagrams to illustrate the paper, and, speaking for himself, he could only say *peccavi*. It would be a great improvement if papers could be printed and put in the hands of members at the meetings. Reference had been made to the fact that his experiments had depended on the evolution of carbonic acid, that carbonic acid being collected over water; and it had been suggested that he might have used a layer of oil over the water to prevent absorption. Well, he had tried an experiment that way with petroleum, and he had found that with an inch layer of petroleum over the water the absorption of gas was two or three times greater than when water only was used.

Mr. NEWLANDS asked whether the petroleum itself had absorbed the gas, and, if so, whether the author had tried vegetable oils.

Mr. JAGO replied that the petroleum had absorbed the CO_2, and at more than twice the rate of absorption by water. He had not tried vegetable oils. One of his reasons for making his experiments in the manner he had described was, that the apparatus was one which bakers could use themselves. A very large series of experiments were made, and all those of each series simultaneously and under the same conditions, so that whatever errors might occur would affect all equally. He had determined the relative quantity of alcohol in a few instances, but not systematically. He had not made any estimations with the direct object of ascertaining whether gases other than carbon dioxide were produced. That subject had been treated recently by M. Girard in the *Comptes Rendus* (101, 601—603), who found that the gas consisted mainly of carbon dioxide, mixed with the air originally contained in the flour. He had employed the yeast which was at present most commonly used by bakers—viz., compressed distillers' yeast. What was known as "patent yeast" often contained a large variety of ferments; brewers' yeast was much purer. But this compressed distillers' yeast was almost absolutely pure, and seldom contained any organism other than a saccharomyces, to which Pasteur had referred as "new high yeast," which, in his opinion, was the best for producing fermentation in dough. Brewers' yeast would ferment a pure saccharine liquid more rapidly than compressed distillers' yeast; but the latter would evolve gas at many times the rate of the former in a stiff dough.

Mr. HERON observed that what he had wished to draw attention to by his previous remarks was not so much the mere presence of foreign germs, as the fact that various yeasts were known to contain various species of organisms. There were different species of the *saccharomyces*, each one of which exercised a distinct specific function during fermentation. That was known to be the case in the fermentation of brewers' worts. It was, probably, also the case in the fermentation of dough, and, if so, one might expect that each particular class of ferment would produce its own peculiar effect on the flavour of the bread in which it was employed.

Mr. JAGO replied that he was now engaged in comparing the different kinds of ferments, and had a considerable mass of work done, which was, however, not sufficiently digested to be laid before the public. He was working on the whole of the varieties known commercially, and had already found several to produce distinctive and characteristic effects. He hoped in his present work to go a step further in the same direction, to isolate from each well-marked yeast the organism which characterised its specific action.

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Meeting held March 7, 1887.

THE PRESIDENT IN THE CHAIR.

M. HERMITE'S PROCESS OF ELECTROLYTIC BLEACHING.

BY C. F. CROSS AND E. J. BEVAN.

THE conditions under which bleaching powder has now for many years been produced are threatened with serious disturbance by the introduction of the ammonia-soda process. As a near relative of the now discredited Leblanc process, it will need to establish itself upon a new basis, a position independent of the particular complementary function which it has hitherto fulfilled. If it is assumed that bleaching powder, in its present form, is indispensable to chemical industry, its manufacture from lime and chlorine must be continued, and there will be a readjustment only in regard to the source of the hydrochloric acid, and the cost of production. But if, on the other hand, it can be shown that we have an altogether different source of supply of bleaching compound, similar, if not identical in nature and action, a new attack is opened, necessitating for its repulse a re-vindication, and on the ground of intrinsic superiority on whatever view we may take of the actual composition of bleaching powder—and from the later researches of O'Shea (*Chem. Soc.* 1883, 410), we may regard the formula proposed by Odling—viz., $Ca\genfrac{}{}{0pt}{}{OCl}{Cl}$ as sufficiently confirmed—the solution which it yields contains the hypochlorite $Ca(OCl)_2$, as the effective bleaching agent; and the reaction of this with the organic compounds, the consequent modification of which constitutes the actual bleaching operation, is one of simple oxidation. We may perhaps qualify this statement by the admission of certain cases in which chlorination or oxychlorination has been ascertained to take place, the products being chloroform or chlorinated derivatives of even higher molecular weight, but the fact is generally admitted that bleaching by means of the hypochlorites is, or may be, controlled, so as to be one of simple oxidation. The chlorine in bleaching powder we may regard, therefore, to borrow a term from electricians, as an *accumulator* of oxygen. From this point of view it is of interest to compare it with two other bleaching agents, very similar in their action, this action more obviously in either case depending upon a simple oxidation of the colouring matters which are removed or dislodged—viz., potassium permanganate and hydrogen peroxide, in the degree of concentration practically available.

The percentage ratio of active oxygen in these compounds is:—

Bleaching powder…………	$33 \underset{18}{\times} 71$	= 7·5
*Potassium permanganate	$\frac{O_3}{K_2Mn_2O_8}$	= 15·7
Hydrogen peroxide ………	(10 vols. 0)	= 1·4

Taking these substances at their selling prices of to-day, the advantages of bleaching powder in point of economy are sufficiently manifest. There are other advantages in regard to convenience and sim-

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* The limit of deoxidation being taken as the dioxide.

plicity of application, but it is unnecessary to dwell in detail upon this superiority over all other generally known oxidising compounds. We have rather to contrast it in regard to results with compounds which have as yet been little studied; these are the products of electrolysis of solutions of the chlorides of the alkali and alkaline earth metals, more especially the latter. Viewing the matter *à priori* and generally, the first contrast which strikes us—assuming that by means of such electrolysis we can prepare a solution of similar nature and properties, containing—*i.e.*, a hypochlorite as the effective bleaching agent—is in the mode in which chemical energy is impressed, in the two cases.

Elementary chlorine and lime represent high potentials, of which some considerable fraction is dissipated in arriving at a *soluble* bleaching compound. The measure of the loss is the calcium chloride formed simultaneously with the hypochlorite in the solution. In the electrolytic process, on the other hand, we commence at the bottom of the scale of energy, as regards the material sphere of action, and, as we have reason to conclude, the energy practically of the current between the electrodes is impressed into the molecule rearrangement which is determined. The loss of energy sustained in the evolution of hydrogen is not a necessary one, at least in principle, for the gas can be collected and burned. Allowing this loss, however, it is, even if complete, considerably less than that represented by $CaCl_2$. But we shall find, in the results of measurements of oxidising efficiency in terms of the current, evidence of a retention of a portion of the hydrogen, and therefore of its energy, under the condition of the complicated hydrolysis which takes place. On this general forecast, which we now sum up, the electrolytic process offers a more economic disposal of energy in the production of effective combinations. It may be urged that our present method of preparing bleaching powder, and from this a bleaching solution, here contrasted with the electrolytic process, is capable of improvement, or even may come to be replaced by a process having for its basis the same chlorides, which shall be raised by purely chemical means to the necessary potential. Such a process, the theoretical complement of the Solvay alkali method, is no doubt an object of search to those engaged in its development, and we will not attempt to prejudge the probability of its success. The standard of to-day is bleaching powder as prepared by the well-known process, and to this all our comparisons must be referred.

In our comparison of the two systems on the ground of relative expenditure of energy in preparing the bleaching compounds, we have assumed that the products of electrolysis are likewise the corresponding hypochlorites. But, as we shall presently find, this is not the case. The electrolysis is, as already stated, of a complicated nature.

The heat of formation of magnesium chloride, which of all the chlorides has been found to give the best results, lies sufficiently near to that of water—

$$^{*}\ H_2O = 68{,}360 \qquad MgO.2(HCl) = 26{,}440 + 44{,}000 = 70{,}440$$

as to bring both within the range of the primary decomposing action of the current. The possible complications thus introduced, together with those of secondary decomposition and rearrangements, under the condition of a continuous influx of energy, render it impossible to predict the molecular equilibrium finally to be attained.

The electrolysis of water is, in itself, a complicated phenomenon, as the experiments and interpretations of De La Rive, Traube, and Jamezek sufficiently show (*Jahn. Elektrolyse*, p. 155). There is evidence of the decomposition of water into H and OH rather than into $H_2.O$. The presence of the halogens is known to affect very considerably the evolution of hydrogen; the halogen hydracids are formed at the cathode, and at once brought within the sphere of the electrolysis. Further, we know that the relations of the ions to the electrodes are in no sense invariable: on the contrary, they are entirely dependent upon the conditions of the electrolysis. In the special case we are considering it is conceivable that the chlorine at the anode will determine the translation of oxygen to the cathode. Again, the endothermic reactions $H_2O\ O = -23{\cdot}070$, $Cl_2.O = -18{,}040$ are so similar, in point of consumption of energy, that their simultaneous occurrence is highly probable.

These are a few of the causes of the extensive complications with which this electrolysis is attended.

What we may call the primary interpretation of an electrolysis, according to Faraday's law, presupposes a complete separation of the ions. When this does not occur, and where, by electrochemical substitution, the anode and cathode are brought into relationships peculiar to a peculiar balance of the products of analysis, the law requires a modified interpretation. We shall revert subsequently to this point, as affecting the particular case under consideration.

This decision is intended to prepare the way for two important experimental results, which have been so repeatedly verified, that we give them as inherently associated with this electrolysis. (*a*) The *bleaching* efficiency of the electrolysed solution is considerably in excess of that of a solution of calcium hypochlorite of the same *oxidising* efficiency, measured—*i.e.*, in terms of the usual standard—an alkaline solution of arsenious acid. (*b*) The oxidising efficiency—*i.e.*, free or active oxygen—thus measured and expressed in terms of the current, is in excess of that calculated on the basis of the electrolytic law, as directly interpreted.

It is necessary to give a short account of the probable causes underlying such important factors of the economy of the system. (*a*) In regard to the first, it is only necessary to state that the investigation of the electrolysed solution shows the presence of bleaching compounds of very high tension. Thus, on cooling to 0°, and shaking with ether at this temperature, even when the solution is, or is made, strongly basic, the latter exhausts a considerable proportion of the bleaching compounds, which evaporate for the most part spontaneously with the ether. The investigation of the composition of the bleaching solution is a complicated matter, and the results when complete will be dealt with in a future communication. For the present it is sufficient to state that, in addition to the hypochlorite, other compounds of high oxidising activity are present—viz., hydrogen peroxide, and probably a higher oxide of chlorine. The necessary result of this difference of composition is a difference in bleaching action: whether to the advantage of the electrolysed solution or otherwise we now proceed to consider.

Anticipating the statement of the results of experiments as to the comparative bleaching efficiency of the two solutions—ordinary bleaching powder and electrolysed magnesium chloride—at equal oxidising strength, the superiority of the latter has been incontestably proved, the relative bleaching efficiency having been found in many cases 1 : 2. Keeping, for the present, to *à priori* view of the matter, have we any theoretical ground for regarding such a

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* Neglecting considerations due to changes of state.

result as improbable? The bleaching of vegetable fibres is, or is the result of an oxidation, and from the similarity of the substance decolourised by the oxidation to the mass of the fibre substance, which is, to use the ordinary expression, bleached, it may be concluded that the oxidation is not limited simply to the decolourising of adventitious constituents, but is extended to the whole fibre substance. This is, moreover, abundantly proved by experiment. Such an action differential in character implies, in itself, a variable consumption of oxygen. But the study of the particular characteristics of the fibre constituents increase still further the probability of such variation. The oxidation of aldehydic molecules, already in a complex condition of condensation, is attended by water exchanges, which may be, in the one or other direction—*i.e.*, of hydrolysis or condensation. Time, in this view, is an important factor; rapidity of attack will favour the former, and *vice versâ*. Further, it is evident that the greater or less activity or tension of the oxygen in bleaching compounds would determine corresponding variations in the mode of attack, and the bleaching, with its attendant changes, would be similarly influenced, both in direction, and, as we may reasonably infer, in consumption of oxygen. Our experience of bleaching in the Mather-Thompson continuous range has abundantly proved the importance of rapidity in the first attack, and that this rapidity is characteristic of compounds of high oxygen tension. A long series of experiments with the electrolysed solution, also containing such compounds, have been attended uniformly with the two results (1) rapidity of action, and (2) small consumption of bleaching oxygen, comparatively with bleaching powder solution, and we are driven to conclude that these two results are essentially correlated.

The former result we are able to demonstrate by experiment here; for the latter, not conveniently admitting of demonstration to an audience, we have the evidence of a large number of determinations, in which the various vegetable fibrous substances known to commerce have been treated. Of these we shall cite typical experiments—we defer the consideration of these until we have considered more closely the quantitative aspect of the electrolysis, and the special features mentioned under (B).

For the measure of the current the usual units are, of course, adopted, and for the chemical effect we take the aggregate measure of oxidising effect, as determined by titration with arsenious acid, and expressed for convenience of comparison with bleaching powder in terms of the active or available chlorine. The solution, which it has been found most advantageous to use, contains 2·5 per cent. of $MgCl_2$, anhydrous. A tank, such as is used in installations of the Hermite system on the large scale, was filled with 845 litres of the above solution at the ordinary temperature.

A mean current of 200 ampères was passed for 12 hours; the titrations of the liquid and instrument readings were performed every 15 minutes.

The mean yield of the available chlorine per ampère hour, and the accumulation or quantity per litre, are given below, the experiment being considered divided into four successive periods of 3 hours each:

	Cl. per Ampère Hour.
1 period	1·80grms.
* 2 „	1·12 „
3 „	1·56 „
4 „	1·40 „

The equivalent calculated according to the electrolytic law is $1·05 \cdot 10^{-5} \times 60 \times 60 \times 35·5 = 1·34$grms.

The explanation of this apparent divergence from the theoretical number follows from what he gave before. The theoretical electrochemical equivalents we take to be the quantities separated at the one or other electrode in electrolyses which are ascertained to be simple, and which are worked by a sharp separation of the ions; in other cases, such as the present, where the work of both electrodes, so to speak, appears in the aggregate result, which is arbitrarily measured as an aggregate, and in terms of a particular effect, as the measurement is not in accordance with the law, so the result is in no sense a divergence from the law. Taking the mean number 1·47 available chlorine per ampère hour thus accounted for, we will express it in terms of mechanical work expended to produce it—5 "Watts" being equal to 1·47Cl (the em.f. being taken at 5 volts); the production of 100kilos. Cl will consume 344,000 Watts. Taking 600 Watts at the dynamo pulley as representing h.p. effective—and this equivalent has been supplied to us by our friend Prof. Pictet, as the result of a very large number of careful determinations—we see that to produce 100kilos. chlorine per hour we require the motive power represented by 570h.p. This we may call the fundamental industrial equation—the expression of mechanical work in terms of the chemical effect which it produces.

The equation, however, is not yet in its final terms, for, as already indicated, the term "available chlorine" and all that it implies, is a purely arbitrary one, and we have yet to examine into the relative bleaching efficiency of the electrolysed and bleaching powder solution, at equal oxidising strengths on the arsenite standard.

Assuming for the moment that they are equal, the bleaching powder equivalent is 300kilos. = 6cwt. per hour, with a plant representing 570h.p.

Further, we have taken the power at the dynamo pulley; consequently we have to take into account, in a complete statement of relative cost, the special apparatus necessary for the electrolysis. This we shall defer until we have dealt with the previous question.

We may mention that the above measurements were made in conjunction with Professor Pictet, who has recently devoted some days to the minute study of the process as applicable with his system of preparing wood pulp by digestion with aqueous sulphurous acid. He fully confirms the results obtained by us in our first investigation, which we undertook at the request of M. Hermite, the inventor, and Messrs Paterson and Cooper, the joint proprietors of the process and patents upon which it is based. M. Hermite, or rather his system, having been subjected to certain damaging, but ill-founded, criticisms in an English technical journal, he thought it expedient to ask us for an independent judgment on the necessary basis of actual measurement. Our results are given in two reports which, although private communications, are printed, and are available to any who may wish to go more into detail than it is possible or advisable to do in this paper. Further, the measurements were made on the laboratory scale, our model tanks containing only some 12 litres of solution, and, as we said, concluding our report speaking of the defects of the apparatus and their influence on the results, "these defects, which are chiefly those of arrangement of apparatus, are already obviated in the apparatus designed for working on the large scale, and we look with confidence to an ample verification of our estimate when the apparatus comes to be worked on the manufacturing scale."

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* Milk of lime added to basic reaction; yield consequently diminished.

In other words, it was obvious that the mean number which we then obtained for yield of "available chlorine"—viz., 1·25grms. per ampère hour, was a minimum. The superior conditions under which the current is disposed, the arrangement of the electrodes, the circulation of the liquid, and, what is more important, the altogether different balance of products determined by the large mass of solution—these modifications have very considerably raised the ratio of oxidising efficiency to the current.

The results obtained with calcium chloride, to which we will devote a few words in concluding this part of our subject, are not so favourable as with the magnesium compound. It is not surprising that a complicated electrolysis, attended by a sensitive balance of products, should be affected by a change of base. The thermochemical constants for the calcium salts are different, and the atomic weight of the metal is nearly double. The investigation of the difference in the electrolysis is an elaborate problem; at the same time, the differentiation consequent upon the alteration of the basis is a considerable facilitation of the work in the scientific sense, and whatever the industrial outcome, upon which we reserve our opinion, the interest and importance of the problems are intrinsically great.

The comparison will also be required to be made on the large scale, for we have seen how the volume or more of the solution electrolysed affects the final equilibrium. Fully alive as are the proprietors, and as we need scarcely say the inventor, to the close union of science and industry, the laboratory which they have constructed for the purposes of these investigations promises to contribute in the future considerably to both. Sufficient unto the day are the results thereof—in fact, there is no occasion to anticipate, and therefore pass on from this discussion of the electrolysis to that of its application to bleaching purposes.

In all the usual modes of employing bleaching powder, the basis is that of exhausting, as far as possible, the active constituents of the bleaching solution, the exhausted solution being then ejected. It is probable, on the grounds previously discussed, that if the strength of the solution were prevented from falling by the addition of hypochlorite *pari passu* with its consumption, the actual consumption would be less as the time required certainly would be. The difficulties and waste attending such a system, however, would probably outweigh the advantages, and so we can adopt the present empirical method as representing the economic mean attained by crude practices. An important feature of M. Hermite's system is that the maintenance of a certain minimum of bleaching strength is perfectly under control.

The principle of the method is the circulation of the bleaching liquid, from the electrolytic tank, of course of special construction, through the bleaching tank, which may be any of the forms ordinarily used. By means of the current, therefore, a continuous supply of the bleaching compounds can be kept up, and the bleaching rendered more economical in regard to consumption of "chlorine" as well as much more rapid. In our comparative estimate of bleaching efficiency we propose to leave the time factor out of consideration, basing our comparison only on the relative consumption of chlorine.

Of all the numerous bleaching operations in the domain of vegetable fibres, the greatest consumption of bleaching powder is found in the treatment of linen yarns (20—40 per cent.) and paper pulp (10—25 per cent.); of the latter the maximum consumption takes place in the bleaching of straw, esparto, and bisulphite wood pulp.

In both departments we have made a large number of comparative determinations, of which we will cite typical results:—

Flax yarn.—(*a*) Three-quarter bleach on *boiled yarn*:

Two *dips* with intermediate scald in soda ash:

Weight of Yarn.	Electrolytic Cl. consumed.	Chlorine as Bleaching Powder.
330grms.	1 dip .. 12·3 2 " .. 2·3 Total 14·6	29·2

The electrolytic chlorine, therefore, has double the efficiency of the chlorine of bleaching powder.

(*b*) Three-quarter bleach from *green yarn*, two dips with intermediate scald in soda:—

Weights of Yarn.	Electrolytic Cl. consumed.
372grms.	13·75+7·45=21·2

This result could not be attained with bleaching powder similarly employed; a further treatment, consisting of a scald and dip being necessary.

Multiplying the 21·2 of Cl by 3, we get what we may consider as the equivalent weight of bleaching powder—*i.e.*, 20 per cent. on the weight of the yarn. To produce the same result with actual bleaching powder, the consumption was 38 per cent. The result, therefore, is as in the preceding.

We may sum up our experimental results in this province as follows:—On the electrolytic system the consumption of chlorine is one-half that on the ordinary system; owing to the greater efficiency of the bleaching, we are able, in certain grades of bleaching, to suppress one or more of the alkaline treatments, in which case the loss of weight sustained by the yarn is less; in all other respects the results on the two systems are very similar.

Paper Pulp.—The various classes of pulps enumerated above, requiring for a full bleach from 18—25 per cent. of bleaching powder, calculated in the weight of the product, have been bleached in the electrolytic system under a great variety of conditions, and in a strict comparison of the two systems. The consumption of electrolytic chlorine we have always found to fall within the limits of 3—5 per cent., or multiplied by 3, to obtain the assumed equivalence of bleaching powder, 9 to 15 per cent.

We do not propose to enter into further details in regard to these comparisons. We approached the matter ourselves with a reasonable amount of scepticism and sufficient experience of the ordinary systems of bleaching to prevent our falling into any considerable error in the investigation. We give these conclusions as our confirmation of Mr. Hermite's figures; and, as he is fully disposed to give to others, as he has to us, the facilities for verifying by experiment all the quantities upon which his system, as an industrial one, is based, we have the less need to occupy space with details of measurements.

We revert now to what we called the fundamental equation of economy. Instead of taking an equal value for chlorine in the two forms, we will take the ratio 3 : 5 as the mean of our various determinations, for the efficiency of the chlorine of bleaching powder, to that of the electrolysed solution. Therefore, the mechanical work represented by 570h.p. will produce the equivalent of 10cwt. of bleaching powder per hour, or, expressed in a more convenient form, a 50h.p. engine will give 1 ton per day of 24 hours. Taking the cost of 1h.p. (steam) at £9 per annum, and calculating the output on the basis of 300 working days, the cost for power is £1 10s. per ton of the hypothetical product. In cases where water power is available, the costs, of course, will be considerably less. We have taken, for convenience, what may be considered a fair average cost of mechanical effect, leaving special cases to be specially dealt with. We now have to consider the cost of the special apparatus, dynamo, tank, electrodes, and leads. For a current of 1000 ampère at 5 volts., the unit installation as we may permit—this amounts to £350; each such unit giving us the equivalent of $\frac{1}{6}$ ton of bleaching powder—1000 (current) × 1·40 (yield per A.H.) × 5 (eqt. bleach powder) × 24 = 168,000grms. in the 24 hours—we should require 6 such units to use up the work of the 50h.p. machine. Taking 15 per cent. on the capital sum for interest and depreciation, it amounts to £1 per ton of hypothetical bleaching powder.*

The only other important item of cost is the salt, magnesium chloride. The waste of this can be arrived at on the basis that a drained pulp will retain as a maximum twice its weight of water, or in this case a 2½ per cent. solution of $MgCl_2$. The waste will be, therefore, 5 per cent. on the weight of the pulp bleached, which is 1 per cent. on the hypothetical bleaching powder—in any case a very small amount in money value.

We are dealing with money values, not from the merely commercial point of view—*i.e.*, as a question of advantage to this or that manufacturer, but from the point of view from which we started—viz., the probable future of bleaching powder; and having worked our way round to this question, we leave it as it is always most satisfactory to do, unanswered.

We do not anticipate any panic amongst bleaching-powder manufacturers, nor do we venture to propose that another of the "noxious trades" should henceforth be regarded as doomed. We only ask for the indulgent consideration of results which appear to us to have an important bearing on the chemical industry of this country.

In conclusion, we should like to express our obligation to the inventor, M. Hermite, and those who are associated with him, for the opportunity afforded to us of laying this matter, full as it is of scientific interest, before the Society.

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Meeting held March 7, 1887.

THE PRESIDENT IN THE CHAIR.

"CASTNER'S SODIUM PROCESS."

BY JAMES MACTEAR, F.C.S., F.I.C.

Having been for some months professionally engaged in connection with the development of the Castner sodium process, I am enabled, through the kind permission of Mr. Castner, to present to this Society the details of his process for producing the metals, sodium and potassium, together with a few facts concerning their uses and the cost of manufacture.

The process, heretofore exclusively used for the production of these two metals, is so well known, that anything more than a brief reference to it is hardly necessary in this paper.

By the older process, carbonate of soda, charcoal, and lime, in the proportion of 30, 13, and 7, are made into the finest and most intimate mixture, and then calcined at a red heat to render the mixture more compact, which also expels a considerable amount of carbonic oxide. This calcined mixture is then introduced into wrought iron cylinders of small diameter, and heated to a temperature of about 1400° C., whereby the alkaline metal is reduced and distilled from the cylinder, through a small tube provided for the gases and vapours, into the receptacle known as the condenser. Through a variety of causes, not more than 40 per cent. of the metal contained in the charge is obtained, and in the manufacture of potassium very much less. The tear and wear on the metal cylinders is enormous, and forms a large proportion of the cost of manufacture. To carry out this process and arrive even at these results require:—1st, the most careful grinding and mixing of ingredients; 2nd, the addition of lime to prevent fusion; 3rd, an excess of carbon to ensure contact between the particles of soda and carbon in the refractory charge; 4th, previous calcination to make the charge less bulky; 5th, wrought iron must be used in constructing the cylinders, being the only metal which it is practicable to use that will stand the high temperature; 6th, cylinders must be used of small diameter, so as to allow the heat to penetrate to the centre of the refractory charge; 7th, the exit tubes from the cylinders to the condensers require the most careful attention to keep them open, owing to the formation of the black compound, formed by the action of carbonic oxide upon the vapour of the alkaline metal, which combination takes place at about the condensing point of the metallic vapour. This is one of the most serious obstacles to be met with in the course of manufacturing sodium or potassium, not only causing a large loss of metal, but interfering generally with the operation. In the making of potassium the formation of this compound, which is exceedingly explosive, and which is produced even more readily than when making sodium, is the chief reason that this metal costs almost ten times as much as the same quantity of sodium.

As near as I can ascertain at present, sodium costs about 4s. per pound to produce, the following being the chief items:—

Wear and tear to furnaces, cylinders, etc.	2s.
Materials owing to loss and waste	1s.
Labour	8d.
Fuel	4d.

Since Mr. Castner's paper upon his process, which was read before the Franklin Institute of Philadelphia, October 12, 1886, several slight changes in the mode of carrying on the process have been made. These have been brought about by the experience gained from the actual working of the process upon a commercially large scale.

The reactions by which sodium and potassium are produced are somewhat difficult to describe, as they vary somewhat according to the mixture of materials and temperature employed in the reduction. The mixtures which it is now preferred to use, are represented by the reactions:—

$$(1.)\ 6NaHO + FeC_2 = 2Na_2CO_3 + 6H + Fe + 2Na;$$

$$(2.)\ 6KHO + FeC_2 = 2K_2CO_3 + 6H + Fe + 2K.$$

In place of using an actual chemical compound of iron and carbon, as expressed by the above reaction, a substitute or equivalent is prepared as follows:—To a given quantity of melted pitch is added a definite proportion of iron in a fine state of division. This mixture is cooled, broken up into lumps, and coked in large crucibles, giving a metallic coke consisting of carbon and iron, the proportions of each depending upon the relative quantities of pitch and iron used. This metallic coke, after being finely ground, provides a substance having the iron and carbon in a like proportion to an iron carbide, and from which neither the iron nor carbon can be separated by mechanical means. The fine iron is conveniently prepared by passing carbonic oxide and hydrogen in a heated state, as obtained from an

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* In those countries where the position of bleaching powder is different, the economic basis of comparison will be different. In the majority of cases the result would be found to be even more favourable to the electrolytic system.

ordinary gas producer, over a mass of oxide of iron, commercially known as "purple ore," heated to a temperature of about 500° C.

In producing sodium, preferably of the highest obtainable strength, caustic soda is mixed with a weighed quantity of the so-called "carbide," sufficient to furnish the proper amount of carbon to carry out the reaction indicated above. The crucibles in which this mixture is treated are made of cast steel, and are capable of containing a charge of 15lb. of caustic soda, together with the proper proportion of the carbide.

After charging a crucible with the above mixture, it is placed in a small furnace, where it is kept at a low heat for about 30 minutes, during which time the mass fuses, boils violently, and a large part of the hydrogen is expelled by the combined action of the iron and carbon; the carbide, owing to its gravity, remaining in suspension throughout the fused soda. At the end of the time stated, the contents of the crucible have subsided to a quiet fusion. The crucible is then lifted by a pair of tongs on wheels, and placed upon the platform of the elevating gear, as shown in the drawing, and raised to its position in the chamber of the main distilling furnace. The cover, which remains stationary in the furnace, has convex edges, while the crucible has a groove round the edge, into which the cover fits. A little powdered lime is placed in the crucible groove just before it is raised, so that when the edges of the cover and crucible come together, they form a tight joint, and, at the same time, allow the crucible to be lowered easily from the chamber when the operation is finished, to give place to another containing a fresh charge. From the cover projects a slanting tube (as shown) connected with the condenser. The condenser is provided with a small opening at the further end, to allow the escape of hydrogen, and has also a rod fixed (as shown), by means of which any obstruction which may form in the tube, during distillation, may be removed. After raising a crucible into its place in the furnace, the hydrogen, escaping from the condenser, is lighted, and serves to show, by the size of the flame, how the operation is progressing in the crucible, the sodium actually distilling soon after the crucible is in its place. The temperature of the reduction and distillation has been found to be about 823° C. The gas coming off during the first part of the distillation has been analysed, and found to consist of pure hydrogen. An analysis of a sample of the gas, taken when the operation was almost completed, gave, as a result, hydrogen 95 per cent, carbonic oxide 5 per cent. It has been found advisable to use a little more carbide than the reaction absolutely requires, and this accounts for the presence of the small quantity of carbonic oxide in the escaping gas, the free carbon acting upon the carbonate formed by the reaction, thus giving off carbonic oxide, and leaving a very small percentage of the residue in the form of peroxide of sodium. This small amount of carbonic oxide rarely combines with any of the sodium in the tube; and so the metal obtained in the condensers is pure, and the tubes never become choked with the black compound. In the preparation of potassium a little less carbide is used than the reaction requires; thus, no carbonic oxide is given off, and all danger attached to the making of potassium is removed. After the reduction and distillation, the crucible is lowered from the furnace, and the contents poured out, leaving the crucible ready to be re-charged. The average analysis of the residues show their composition to be as follows:—

Carbonate of soda	77	per cent.
Peroxide of sodium	2	,,
Carbon	2	,,
Iron	19	,,

The average weight of these residues from operating upon charges of 15lb. caustic soda, and 5¼lb. of carbide, is 16lb. These residues are treated either to produce pure crystallised carbonate of soda or caustic soda, and the iron is recovered and used again with pitch in the formation of carbide. From this residue, weighing 16lb., is obtained 13lb. of anhydrous carbonate of soda, equivalent to 9·4lb. caustic soda, of 76 per cent.

Operating upon charges above mentioned, the yield has been—

Sodium ....actual	2·50lb.	Theory..	2·85lb.
Sodic carbonate .. ,,	13·00lb.	,,	..13·25lb.

The average time of distillation in the large furnace has been 1 hour and 30 minutes, and as the furnace is arranged for 3 crucibles, 45lb. of caustic soda are treated every 90 minutes, producing 7½lb. of sodium and 39lb. of carbonate of soda. The furnace is capable of treating 720lb. of caustic soda daily, giving a yield, in 24 hours, of 120lb. of sodium and 624lb. of anhydrous carbonate of soda. The furnace is heated by gas, which is supplied by a Wilson gas producer, consuming 1cwt. of fuel per hour. The small furnace in which the crucibles are first heated requires about ½cwt. per hour. The following estimate of cost, etc., is given from the actual running of the furnace working with the above charges for 24 hours.

	£	s.	d.
720lb. of caustic soda at £11 per ton	3	10	10
150lb. carbide at ½d. per lb.	0	6	4
Labour	1	0	0
Fuel	0	17	0
Re-converting 624lb. of carbonate into caustic, at a cost of about £5 per ton on the caustic produced	1	0	0
Total	6	14	2
Deducting value of 475lb. of caustic recovered	2	6	8
Cost of 120lb. of sodium	4	7	6
Cost per pound	0	0	8¾

Regarding the item of cost for damage to the crucibles by the heat, this question has been very carefully gone into. Some of the crucibles have been used upwards of 50 times, and from their condition at the present time, there is no doubt that they can continue to be used at least 150 times more before they become unfit for further use. In considering 200 operations to be the life of a crucible, the item of damage or wear and tear amounts to less than 1d. per pound on the sodium produced; and, if we take the furnace wear and tear at the same rate of 1d. per pound, we shall see that the wear and tear of plant is only 1/12th of that incurred in the ordinary process. *It is upon these facts that Mr. Castner bases his claim to be able to produce sodium by his process upon the large scale, at a cost of less than 1s. per pound.* The advantages of this process will be apparent to any one at all familiar with the manufacture of these metals as conducted heretofore. The first and most important end gained is their cheap production, and this is owing chiefly to the low heat at which the metals are produced, the quickness of the operation, non clogging of the conveying tubes, and a very small waste of materials. The process, furthermore, admits of being carried on upon a very large scale; in fact, it is intended ultimately to increase the size of the crucibles, so as to make the charges consist of 50lb. of caustic soda. Crucibles of cast iron have been found quite suitable; and it is intended, in future, to use crucibles made of this material in place of the more expensive steel.

As regards potassium, it has hitherto been regarded very much as a chemical curiosity, and sells for about 60s. per pound. By this method the cost of the manufacturing operations is no more than for sodium, the higher cost of the caustic potash being the chief element of increased expense. The uses of these alkali metals are at present limited, owing to their high cost alone. Sodium is used somewhat largely in manufacturing aluminium, magnesium, silicon, etc., and in the formation of amalgams, while potassium is only used in small quantities as a chemical magnet. It will hardly be considered out of place in concluding this paper, relating to the manufacture of sodium and potassium, to mention some few facts connected with aluminium. This metal depends at present upon sodium for its production, and, consequently, any process successfully producing *cheap* sodium, in reality allows of the manufacture of *cheap* aluminium. Notwithstanding all the efforts that have been made by various chemists and metallurgists for the past thirty years in endeavouring to invent some process for producing aluminium, whereby that most interesting and valuable metal could be cheaply produced by a better process than that of Deville, absolutely nothing has been accomplished that would even lead one to hope that some time in the future his process would be superseded. By employing Deville's process, and using sodium as heretofore manufactured, the aluminium costs between 30s. and 40s. per pound. Owing to this high price alone, the consumption is limited, and therefore the manufacturer is obliged to ask, in selling the metal, a relatively high price, in order to obtain anything like a fair profit upon the invested capital. The present selling price of aluminium varies between 50s. and 60s. per pound: although every few months there appears in some newspaper the information that some parties (*unknown*) have contracted with other parties (*unknown*) for a large quantity of aluminium, at prices varying between 10s. and 30s. per pound. It is needless to say that upon inquiry the contracting parties cannot be found. Aluminium, if placed upon the market at 20s. per pound, could undoubtedly be sold in large quantities, the demand rapidly increasing as the metal gained in favour, which, owing to its varied valuable properties, it would do to a certainty. It is allowed by all those familiar with the different items of cost in carrying out Deville's process, that, could sodium be obtained for 1s. per pound, aluminium could be made below a cost of 15s. per pound.

I think it is not, therefore, too much to claim for the "Castner process" of manufacturing sodium and potassium—now that it has been demonstrated commercially capable of producing sodium at 1s. per pound—that it is the greatest advance in the direction of producing aluminium at a cheap rate which has been made since Deville first demonstrated the possibility of producing that metal on a commercial scale.

It has long been known that the distillation of the metal sodium is rendered more easy by the use of a proportion of potash in the mixture. It is also known that a series of alloys of potassium and sodium can be produced, several of which are liquid, having much the same appearance as mercury when under naphtha. These alloys are very curious, one of them remaining liquid at 0° C., while another is lighter in its specific gravity than naphtha, upon which it floats. Specimens of several of these alloys are upon the table, and are open to your inspection.

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AN IMPROVED SYSTEM OF ELEVATING, SPECIALLY APPLICABLE TO ACIDS.

BY JAMES MACTEAR, F.C.S., F.I.C.

The problem of pumping or raising corrosive liquids is one which has given rise to various ingenious contrivances; but, in practice, these have been reduced to a system of raising with compressed air, in which the liquid to be raised is run into a reservoir, and then, by means of air, compressed to a sufficient degree, forced through a pipe to the height required, where it is delivered into a cistern, such an arrangement of delivery pipe being used as will prevent the splashing about of the liquid by the escaping air. It is unnecessary to describe this arrangement more in detail, it being so well known to all practical men. This apparatus is, however, unfortunately, not well suited for the elevation of hydrochloric acid, as the vessels and pipes must be constructed of a material to stand the action of this acid, which is by no means an easy thing to do. Pumps, constructed of such materials as glass, earthenware, guttapercha, ebonite, etc., and of various systems, have been tried; but these have never had much success, being expensive to erect and keep in order.

The apparatus which I purpose describing to you is one which is especially applicable to the raising of acids, and has been introduced by Messrs. Kuhlmann & Co. in France, where it has met with a large measure of success. It is called by them an "Emulseur," from the fact that in its action an emulsion of air, with the liquid to be raised, is formed.

If, for example, we take a syphon of this form and invert it, we find that liquid placed in the syphon will stand at the level of the shorter limb, any addition made to the level of the longer limb of the syphon will simply cause an overflow at the shorter limb: but if we lead a small tube into the longer limb, and allow a thin stream of air to bubble into the liquid, we shall find that the level of the liquid in the longer limb will rise to a very considerable height, the air of the liquid forming an emulsion, or intimate mixture of the liquid and bubbles of air, the mean density of which is considerably less than the liquid.

If we now allow a supply of liquid to flow continually into the short limb of the syphon, whilst at the same time we continue the injection of the air, there will be a continuous current of the liquid emulsion ascending the long limb, which may be drawn off at the highest level to which it attains by a proper arrangement. The new system of apparatus is based upon this principle, and is very simple, can be easily erected, and works with very little supervision, as once the apparatus is started it continues to work continuously until the supply of air and acid is suspended.

Let us take, for instance, the case of a Glover tower, which has to be supplied from a chamber erected in the usual way upon columns, say 20 feet from the ground. All that is required is that the supply pipe from the chamber should be brought down to or near the ground, then turned upwards, and be continued to the top of the Glover tower, so as to deliver into the cistern. A short distance above the bend at the ground level, the air pipe is introduced, and a small stream of air allowed to rise in the pipe. With the constant feed of acid and of air, the delivery at the top of the tower is constant, and requires no supervision whatever.

The drawing No. 1 shows this form of arrangement, and represents an apparatus capable of raising 800kilos. of sulphuric acid per hour to a height of 45 to 60 feet, the expenditure of air required being about equal to 5 litres of air per kilo.; the amount of air required is a little more than with an ordinary "montjus" or "acid egg," but the cost of repairs to the cocks, etc., of the latter apparatus far more than counterbalances the extra cost of air, whilst there is a very large saving in the cost of labour for attendance on the apparatus, no cocks having to be turned on and off, as is the case with the montjus.

In some cases, where compressed air is not available, the apparatus is worked by means of an exhauster such as the "Korting" steam jet, which is so well known. This form of apparatus is very easily and cheaply erected, and especially suitable where the liquid to be raised is to be taken at the ground level.

This arrangement is applied to the raising of muriatic acid. A vacuum is erected by a steam jet in the series of vessels, and the acid is thus sucked up to a certain level; a small air tap at the bottom being opened allows of the necessary quantity of air entering, the effect being to deliver a constant stream of the acid into a reservoir. So soon as this is full enough, which is shown by a glass indicator let into the pipes, the aspiration is stopped for the moment, and the liquid run out of the reservoir. The run-off tap of this vessel is again closed, and the aspiration again started, and so on. The results obtained with this apparatus are exceedingly satisfactory.

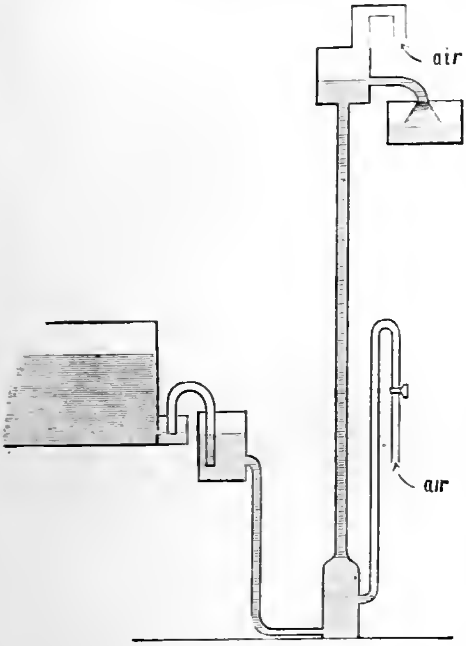

FIG. 1.

With acid of 32° Tw., an ordinary injector creating a vacuum, will only be able to raise it to the height of 18 or 19 feet, where it will oscillate; but, when the air-cock is opened to the proper extent, the emulsion formed can be raised to 35 to 40 feet. If the receiver contains, say, about 150 litres, it can be filled in from 7 to 10 minutes. The aspirator is then stopped and the receiver run off, when the apparatus is again turned on and the process continued. By a slightly more complicated arrangement, with two reservoirs or receivers, the process can be made practically continuous; but, with the one in question, which I have just described, from 600 to 800 litres per hour can be raised without difficulty.

Various slight modifications in the construction are made to suit special circumstances, but the general principle is the same in all cases.

The third form of this apparatus is applied to the ordinary montjus, and is applicable to cases where the pressure of the air is not sufficiently strong to elevate to the height required. In this case a pipe communicates between the air supply and the rising main in such a way that in addition to the pressure of the air upon the surface of the liquid in the montjus, a small proportion of the air is allowed to escape into the rising main, forming an emulsion reducing the density of the liquid, and enabling it to be carried up 2 or 3 times the height due to the actual pressure of the air itself.

ERRATUM.—In Mr. Wingham's paper (this Journal, February number, page 76), as regards the numbering of the woodcuts Figs. 1 and 2, read that numbering in reverse order.

Liverpool Section.

Chairman: Prof. J. Campbell Brown.

Vice-Chairman: Dr. F. Hurter.

Committee:

J. Affleck.
E. G. Ballard.
Ernest Bibby.
H. Brunner.
J. C. Gamble.
D. Herman.
J. W. Kynaston.
E. K. Muspratt.
Jas. Simpson.
A. Norman Tate.
A. Watt.

Local Sec. and Treasurer: W. P. Thompson, 6, Lord Street Liverpool.

Meetings will be held at University College Laboratory, Brownlow Street, on April 6 (Annual Meeting) and May 4, and the following papers have been promised:—

Mr. C. Longuet Higgins, "On the Manufacture of Potassium Chlorate by means of Magnesia."

Mr. J. W. Macdonald, "On the Manufacture of Arrowroot in St. Vincent, West Indies; its Uses and Adulterants."

May 4.—Discussion on Mr. Westmoreland's paper "On the Estimation of Sulphur in Pyrites."

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

A Meeting was held in the Chemical Theatre of the University College, Brownlow Street, on Wednesday evening, March 2, 1887.

PROFESSOR CAMPBELL BROWN IN THE CHAIR.

THE CHAIRMAN called attention to some specimens of quinones. These were formerly curiosities, but some of them are now used in the manufacture of dyes. Some are still curiosities; they are now, however, acquiring new applications.

Mr. W. P. THOMPSON (secretary), laid on the table a blasting plug. It consisted in a wedge or wedges, and a wooden plug with planes complementary to the wedge. In the wedge-shaped grooves thus formed at one or both ends the wedges were inserted and the whole placed in the blast hole; a little tamping was then thrown in and lightly tamped. The explosion drove the wedge or wedges into the block, splitting it, and wedging it tight in the hole. This apparatus was very cheap, and was found to give a better result than ordinary tamping, was safer, and saved time and labour. It was the invention of a Mr. Francis, mining engineer, and had been largely used with water cartridges and others.

The CHAIRMAN then called on Mr. Driffield to read his paper.

SUGGESTIONS ON BOILER MANAGEMENT.

BY VERO C. DRIFFIELD.

Steam may be regarded as the mainspring of chemical industry. There is hardly an operation connected with chemical manufacture which is not dependent upon steam. Anything, therefore, which relates to economy and safety in the use of steam must have an interest for the chemical manufacturer, and, with this in view, I have been prevailed upon to bring before you to-night a few practical suggestions which, I think, tend in the direction I have named.

I can hardly hope to lay before you anything very new or very original, but what I have to say is the outcome of practical experience with boilers for some years past. My remarks will, therefore, be essentially practical, and I shall have very little to say of theoretical considerations.

I do not propose to call your attention to any special design of boiler, nor am I going to enter into constructive details generally, but my remarks will apply to boilers which are already in use, and which I assume will, in the great majority of cases, be boilers of the ordinary Lancashire or Cornish type. My object is to point out certain parts of the boiler which I have found peculiarly liable to suffer from wear and tear, certain matters which tend to the waste of fuel, and others which render the boiler liable to become a source of danger. At the same time I hope to point out precautions and remedies which, in my own practice, I have found to prolong the life of the boiler, to save fuel, and to avert danger.

One of the greatest difficulties the steam user has to contend with is incrustation, or the deposition within the boiler of solid matter which has been dissolved or suspended in the feed water. This incrustation causes enormous loss of fuel by preventing transmission of heat to the water, and it is liable to lead to overheating of the boiler plates.

This solid matter contained in the feed water generally consists mainly of the carbonates of lime and magnesia, and of sulphate of lime. These carbonates of lime and magnesia are held in solution by an excess of carbonic acid, which is driven off when the water is heated, and these salts are then precipitated. They are, however, precipitated not as a hard incrustation, but in a light, powdery form, and they may, in themselves, be regarded as the least objectionable substances introduced into the boiler. The carbonates of lime and magnesia, however, become objectionable if three conditions are not fulfilled. These conditions are, first, that the flues are allowed to cool well down before the boiler is blown off, otherwise, when the water is removed, the heat from the flues will bake these precipitates into a hard scale which is difficult to deal with, whereas in the flowery state they admit of easy removal. Secondly, that tallow be not used for lubricating engine cylinders if the exhaust steam from the cylinders be used directly to heat the feed water, as tallow combines with the precipitated lime and magnesia, and forms with them a soapy mass which is more liable to lead to danger than is a hard but brittle scale. Thirdly, that any sulphate of lime there may be present in the feed water be decomposed, otherwise the hard incrustation, formed by the precipitation of this salt, will incorporate itself with the lime and magnesia, and so prevent the easy removal of the latter salts.

With respect to the magnesia, this salt is found in the scale and mud of the boiler, not as carbonate but as hydrate, as is shown by the analyses I have here, there being no carbonate of magnesia at all in the scale, and very little indeed in the mud. The magnesia is, however, precipitated, in the first instance, as carbonate, and is only converted into hydrate after prolonged exposure to the temperature within the boiler. This fact seems to have escaped the attention of Mr. Macadam, who read a paper on "Boiler Incrustations," which appeared in our Journal, vol. ii. page 12, and who throughout puts down his magnesia as carbonate. This hydrate of magnesia bakes into a hard scale much more readily than does the carbonate of lime if the flues are not well cooled down before the boiler is blown off.

The presence of sulphate of lime in the feed water is a much more serious matter than is that of the carbonates I have named, as sulphate of lime deposits itself, as is well known, in the form of a hard scale, which tenaciously adheres to the plates and is very difficult to remove. Another salt, which is also very objectionable in the feed water, is chloride of magnesium. This salt rapidly decomposes as the temperature of this water is raised, and sets free hydrochloric acid. I need hardly say what a source of mischief, and indeed danger to a boiler, the presence of free hydrochloric acid must be.

Quite recently my attention was called to serious internal corrosions which were taking place in a group of our boilers. For some time I attributed this to having fed the boilers partly with some hot distilled water which I thought it a pity to waste. Distilled water, we all know, has a highly corrosive action upon wrought iron. I discontinued the use of the distilled water, but the corrosive action still went on. I now had an analysis made of the water used for feeding the boilers, and found that it contained an abnormally large quantity of chlorine. Evidently something had gone wrong at the well, and this eventually proved to be the case; the well bottom had broken in, and we were pumping surface water which was clearly in communication with the river. The well was repaired and the trouble was at an end. When my attention was called to the water it contained 29·8 grains of chlorine to the gallon; but after the well was repaired the quantity rapidly declined to 2·2 grains, the normal amount. The water also contained considerably more magnesia than it formerly did, so that we may reasonably infer that the corrosions which were taking place in the boilers were due to hydrochloric acid arising from the decomposition of chloride of magnesium.

Now there are few things which have received more attention than have means to prevent or to render innocuous the presence of these substances in water used for feeding steam boilers. The patents taken out, and the nostrums of one sort or another proposed for this purpose, are simply legion. The great object of an anti-incrustator is to prevent, as far as possible, the precipitation, in the form of a hard scale, of the solid impurities contained in the feed-water and to neutralise any free acid which may be present, or which may be formed by the decomposition of the salts. Whatever substance will best accomplish this, without being otherwise injurious, is the best anti-incrustator to use. Of course, such a process as Dr. Clark's for purifying the feed-water before it enters the boiler at all, is, theoretically, the best to adopt; but it necessitates so much care and accuracy in carrying it out, and requires so much space for settlers and filters, that it is seldom adopted at all. The only plan open to us, therefore, is to deal with the solid impurities as best we may within the boiler itself. I shall show you presently, however, that the feed water may be purified to a considerable extent, before it reaches the boiler at all, in its passage through a feed-water heater.

So far as I can ascertain, nothing has ever been proposed which is practically better adapted for preventing incrustation than the introduction into the feed-water of carbonate of soda. Carbonate of soda has, of course, no influence upon the carbonates of lime and magnesia; but, as I have said, these salts are comparatively harmless in themselves, and easy to deal with. It is upon the sulphate of lime and the chloride of magnesium that the action of carbonate of soda is so beneficial. The action of carbonate of soda upon these salts is, of course, to decompose them, preventing, in the case of sulphate of lime, the formation of hard scale; and, in the case of chloride of magnesium, the production of free hydrochloric acid.

Now, as to the introduction of carbonate of soda into the boiler, the practice of some is to put it in in large quantities before the boiler is set to work again after being washed out. If this is done the soda is probably entirely removed by the blow-off cock long before the boiler comes to be washed out again; and, from the large quantity of soda put into the boiler to commence with, priming is very liable to ensue. I much prefer to inject the soda dissolved in the feed-water in regular daily amounts. When we consider presently the question of a feed-water heater, I will show you how I deal with the soda. The best salt of soda, I think, for the purpose is the carbonate; caustic soda is open to the objection that it has a serious action upon the brass fittings of the boiler. As to the best form of carbonate of soda to adopt as an anti-incrustator, I would recommend, as being more convenient for use, that which is most readily soluble, and which contains the greatest amount of alkali in a given weight. Of course, the freer it is from impurities the better. As to the quantity, this will, of course, vary with the salts dissolved in the water which have to be dealt with; but my own practice is to inject daily into the boiler an amount of alkali sufficient to decompose the sulphate of lime which analysis shows to be present in the feed-water. Of course if chloride of magnesium is present, there must be, in addition, sufficient alkali to decompose this salt also.

	Feed-water. Grains per gal.	Heater Mud. Lb. per cub. ft.	Boiler Mud. Lb. per cub. ft.	Boiler Scale. Per cent.
$CaSO_4$	2·14	—	—	0·51
$CaCO_3$	19·68	93·7	62·5	39·35
$MgCO_3$	4·23	5·8	1·7	none
MgH_2O_2	none	none	32·7	44·92
Na_2CO_3	none	0·5	3 1	3·01
SiO_2 (sand)	1·92	—	—	10·70
Al_2O_3 and Fe_2O_3	0·46	—	—	1·21
NaCl	9·16	—	—	none
Total Solids	37·59	100·0	100·0	99·70
Total Solids direct	37·40	—	—	—
MgO on 100 CaO	16·8	5·3	70·0	138·5

I must ask you to refer for a moment to the table of analyses before you. The feed-water, of which this table gives the analysis, is yielded from a well on the works, and is that with which most of our boilers are fed. It contains, as you see, 37·40 grains of solid matter in the gallon. Of this, 19·68 grains, or the bulk, is carbonate of lime. Fortunately there are only 2·14 grains of sulphate of lime, which is a very moderate quantity, and no chloride of magnesium at all. We have, therefore, only to deal with the sulphate of lime, and it is easy to calculate what quantity of carbonate of soda this sulphate of lime will require to decompose it. Supposing a boiler evaporates 35 cubic feet of water an hour, this would mean a deposit in the boiler, in 24 hours, of 1·6lb. of sulphate of lime, and this requires for its decomposition 1·25lb. of pure carbonate of soda. We have, therefore, only to inject into the boiler an amount of carbonate of soda sufficient to decompose any sulphate of lime and chloride of magnesium there may be present; and if, on a strip of neutral litmus paper, the water in the boiler has a distinctly alkaline reaction, we may be sure that we are doing all that can be done chemically. The water for testing may conveniently be taken from one of the water gauges.

With respect to the analysis of the hard scale which was taken from a boiler fed with this water, the first point which strikes one is the satisfactory way in which the addition of carbonate of soda to the feed-water has done its work. You see it has almost entirely decomposed the sulphate of lime, there being only 0·51 per cent. of this substance present in a scale which has probably been many months in the course of formation. This analysis shows that the chief constituent of the scale is hydrate of magnesia, and the only way to check the conversion of this substance into a hard scale is, as I pointed out before, to prevent its being baked upon the plates after the water is blown out of the boiler. The analysis of the boiler mud shows that a considerable amount of hydrate of magnesia exists in a powdery form.

To render the analysis of the scale more complete and valuable I append separately the acids and the basis comprising it:—

CO_2	17·48
SiO_2	10·70
SO_3	0·30
Cl	0·07
MgO	31·01
CaO	22·25
Na_2O	1·75
Fe_2O_3 and Al_2O_3	1·21
Water	11·99
	99·70

As to accessory measures for preventing incrustation, I would further impress the importance of allowing the boiler to stand for as long as possible after the fires are drawn before it is blown off. It is perfectly obvious that if the boiler is blown empty while the flues are still hot, the plates will become hotter than they were before, and, ignoring any injurious straining of the boiler itself, the precipitated lime and magnesia will bake hard. If, on the other hand, the flues are allowed to cool well down before the boiler is blown off, the powdery condition of these precipitates will not be interfered with, and they can then be easily removed. In the next place it is a good plan to blow about an inch of water out of the boiler at least twice a day; this removes a considerable amount of the precipitated salts, and, at the same time, insures the blow-off tap being kept in working order. If this tap is never used, excepting when the boiler is entirely blown empty, it will then very probably be found to be blocked with scale, and cannot be used at all. This leads to pricking the tap, or loosening the plug, which are dangerous operations, and renders blowing-off in an emergency often out of the question. Then, as to washing out, I think it is a doubtful economy to allow a boiler to work too long before it is thoroughly cleaned. My own practice is to wash a boiler out every four weeks, which, for one working day and night, is seldom enough. This, however, largely depends upon the nature of the feed-water used. It is also desirable to adopt a form of feed-water heater which will, as far as possible, collect within itself the solid impurities of the water, so that a great proportion of them never reach the boiler at all. Of this I shall have more to say when speaking presently of water heaters.

In spite of these precautions, the formation of hard incrustation will sometimes gain ground, when it will well repay to resort to scaling, which should, of course, be carefully done, so as to prevent injury to the boiler plates. I have upwards of forty boilers in my charge, but it is very rarely indeed that I have any occasion to resort to scaling. I have seen it stated that an incrustation $\frac{1}{16}$th of an inch in thickness is equivalent to a loss in fuel of 20 per cent., and that the loss in fuel increases very much more rapidly than does a proportionate increase in the thickness of the scale. In addition to those disadvantages to which I have already called your attention, I must add the fact that the presence of incrustation in a boiler always renders inspection difficult and generally unsatisfactory.

water. By allowing the steam, however, to mix directly with the water, almost the entire heat is absorbed, and the heater necessary for the purpose is a much simpler and less costly apparatus than when the steam is caused to circulate through pipes. The only point to be attended to in using open steam is that tallow must not be used for lubricating the engine cylinders, as, if tallow finds its way into the boilers, it becomes, as I said before, a source of mischief and danger. This it does by combining with the precipitated carbonates, and forming with them a soapy yielding coating on the flues, exceedingly likely to lead to overheating of the plates, and also by decomposing and producing fatty acids which are highly injurious to the boiler. Tallow may, however, be very advantageously substituted by one of the many mineral lubricants now to be had, for not only are these lubricants harmless in the boiler, but, unlike tallow, do not injure the cylinders. It is only by using these mineral lubricants that the insurance companies are at all likely to tolerate the form of heater which I am advocating.

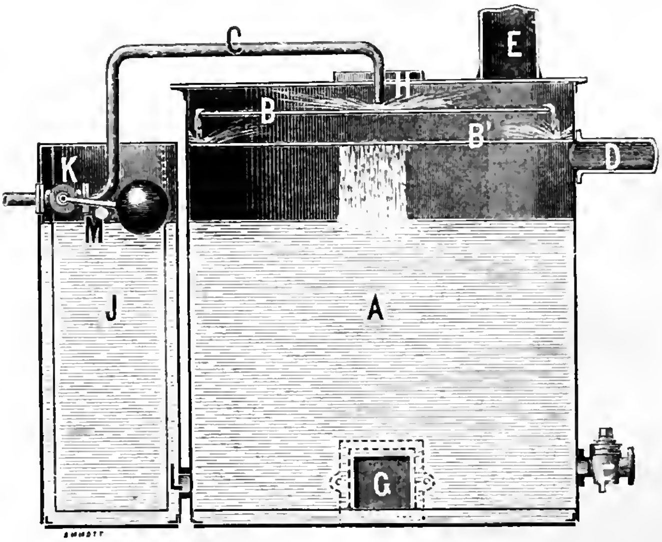

FIG. 1.

I will now ask your attention to drawing No. 1. This drawing represents a form of feed-water heater which I have had in satisfactory use for many years past.

From most chemical works a large amount of waste heat passes away in the form of exhaust steam, and this heater is designed to utilise this exhaust steam. In a chemical works, unlike a cotton mill, the power is generally supplied from a number of small engines scattered over a large area, and the boilers are, instead of being placed in one continuous range, divided into a number of groups. The plan I advocate is to provide a heater for each group of boilers, and then to apportion to each heater a share of the exhausts which lie nearest to it.

There are two forms of heaters adapted to utilise waste steam—that in which the steam is caused to circulate through pipes placed in the water to be heated, and that in which the steam is allowed to enter directly into contact with the water itself. Now the objection to heating water with closed steam is that the heat from the steam has first to pass through the pipes before it can get to the water, and the pipes very soon become so thickly coated with scale as to almost entirely prevent transmission of heat to the water.

A represents a cylindrical vessel which may be conveniently and economically made of a portion of an old boiler shell. At the top of this vessel are two circular shelves B and B^1. B, the upper shelf, is not quite so large in diameter as the vessel itself, and so allows an annular space between its edge and the inside of the vessel. B^1, the lower shelf, fits closely at its edge to the tank, but is provided with a circular hole in the centre. C represents the pipe through which the cold water is supplied to the heater. This pipe is reduced in area at the extremity which enters the heater, so that the water is injected at a considerable pressure. The water impinging against the upper plate B is broken up into a fine spray, more or less filling the space above the shelf. The water finds its way through the annular space down on to the under plate B^1, and from thence through the circular hole into the body of the heater. The exhaust steam enters through the pipe D, and is compelled to take the same course as the water, though in the contrary direction, before it can find its way out at the chimney E. As many exhausts as the capacity of the heater will admit may, of course, be placed round the vessel on the same horizontal line as the one shown. By the time the steam has passed through this apparatus it is almost, if not entirely, condensed, and the amount emitted by the chimney is very small indeed

The hot water is drawn off at the tap F, which may with advantage be fixed higher up the side of the vessel than it is shown in the drawing, in order to allow more room for the settlement of the precipitated salts. G is a manhole, which is used for cleaning out the heater, an operation which it is desirable to carry out once a week, for one great advantage of this heater is that a large amount of the solid matter contained in the feed-water is precipitated within it, and so prevented from ever reaching the boiler at all. On the bottom of the heater I always find a plentiful deposit in the form of mud.

In order to show you what an amount of service these heaters render in purifying the feed-water before it enters the boiler, I may tell you that an analysis of the water on leaving the heater showed that it contained only 17·5 grains of solid matter to the gallon, while the water supplied to the heater itself contained, as we have seen, 37·4 grains. You see, therefore, that the heater has deprived the water of more than half the solid matter which it originally contained. The solid matter retained by the heater is chiefly carbonate of lime, as you will see from the analysis of the mud taken from the heater that it only contains 5·3 parts of magnesia for every 100 parts of lime, while the feed-water originally contained 16·8 parts of magnesia for 100 of lime.

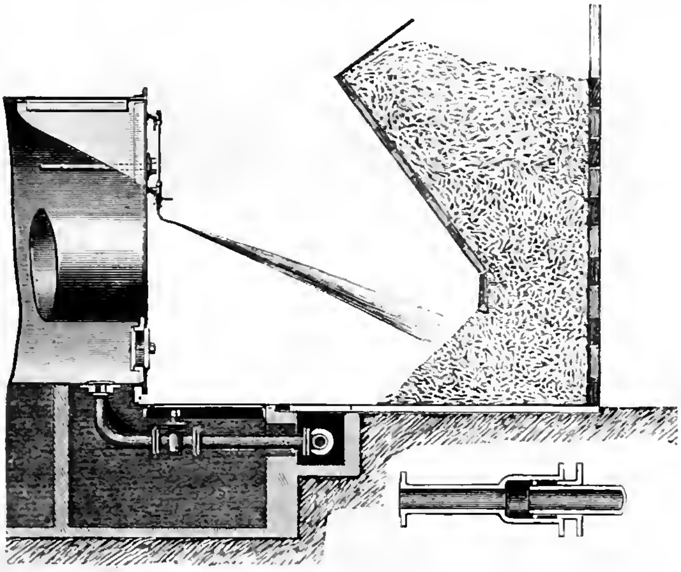

FIG. 2.

On the top of the vessel, where the water pipe enters, is a circular hole H, which is covered with two semi-circular plates, which are easily removable. It is through this hole that the daily quantity of soda is introduced, when it is, of course, soon washed down into the body of the heater, and from thence finds its way into the boilers. The object of the tank J at the side is simply to maintain a constant water level in the heater, and to render the whole apparatus automatic. This is attained by means of the ball valve K, which would not, of course, work in the heater itself, because, in the first place, of the agitation of the water, and secondly, because the balls of these valves working in hot water soon become coated with incrustation, when they lose their buoyancy, and are so rendered useless. The water in the tank J, which communicates with the heater by the branch L, is, of course, comparatively cool and quiescent. The hole M is simply an overflow, which comes into play if the ball valve should stick, or fail from any cause. A pipe from this overflow may advantageously be conducted to the vicinity of the firemen, so as to call their attention should anything go wrong.

Apart altogether from the saving effected by heating the water with waste heat, whether derived from the flues or from exhaust steam, it must not be forgotten that it has an important tendency to prolong the life of the boiler itself. A boiler which is fed with cold water is subjected to irregular straining, which will inevitably render it more liable to leakage and ultimately to injury.

In my experience, that part of a boiler which is most liable to suffer from wear and tear is the bottom of the front end plate, and the bottom of the first plate of the shell, together with the angle-iron which connects these plates. There is so much damp about here, arising from the difficulty of keeping the connection between the boiler and the blow-off pipes perfectly tight; from dripping and discharge from the water gauges; and from slaking cinders upon the foot-plate; that, without great attention, corrosion is sure to set in sooner or later.

If you will refer to drawing No. 2, I will advise the adoption of several precautions which, if carried out, will do a great deal to preserve this part of the boiler from injury. First of all, have a good, substantial cast-iron foot-plate, consisting of a frame with a large plate let into it, which plate can be taken up so as to give access to the hearth-pit. In the large plate let there be a hole just over the blow-off tap, which hole is also fitted with a plate, making the entire surface of the foot-plate uniform, and have it chequered. Let this foot-plate be fixed fully 3 inches below the level of the front end angle-iron, so that any damp cinders which may lodge beneath the angle-iron are easily removable. Avoid wrought-iron foot-plates; they warp, and allow cinders to get down, and injure the blow-off pipes and taps, and the firemen are liable to slip upon them. Just behind the angle-iron have a cast-iron feeder in two pieces, put in one from either side, and resting upon the foot-plate. Let the brickwork, too, at the front end of the boiler be kept well behind the angle-iron, so that any leakage from the front joint may be easily discovered and checked. Insist upon the hot cinders and clinkers being brought forward from contact with the boiler front before they are slaked, and do not allow the water to be thrown upon the front of the boiler. Better still, have the hot cinders and clinkers removed in iron barrows and slaked elsewhere, but in either case let them be removed as soon as possible, otherwise, apart from the probability of their injuring the boiler, firing will be carried on over them, and fuel will fall among them and be wasted.

With respect to leakage from the joint connecting the boiler to the blow-off pipes, the best way of preventing this is to take care that there is plenty of freedom and elasticity in the blow-off pipes themselves. Do not allow the pipes to be buried in the ground, but let them lie in a channel, as shown on the drawing, supported on bars of iron built in. Let the channel be simply covered over with the flooring flags, so as to be easily accessible. Where there is a range of boilers, put, at intervals, into the line of blow-off pipes connecting them an expansion joint. These expansion joints may be quite cheaply constructed, as shown on the drawing, and I find they are sufficiently good for this purpose, without going to the expense of boring and turning at all. If these pipes are treated as I suggest, and are perfectly free to move under the influence of varying temperature, the difficulty of keeping the joint beneath the boiler tight will disappear. If the pipes are fast in the ground, on the other hand, this joint will be a continual source of trouble, and the pipes themselves will give way at their joints, if they do not, at times, actually break.

I consider the blow-off joint the most important one about a boiler, as, apart from the injury it will cause if it leaks, should the joint-ring blow out altogether, it is very probably almost impossible to get at the fires to draw them; and so serious injury may be caused to the internal flues, and the fireman will possibly be scalded.

Every six months, or whenever the boiler flues are cleaned, I would advise that the under-side of the first shell-plate of the boiler and the front-end angle-iron be well painted with red oxide paint the whole width of the bottom flue, extending inwards up to the cross wall. This assists wonderfully in preserving this part of the boiler from injury by damp.

As to the blow-off tap itself, the first desideratum is that it should be tight. This is best secured by adopting a good asbestos-packed tap, and then taking care that the plug is not removed when the boiler is washed out. If the plug is removed, small particles of scale are liable to get between it and the shell, when the tap will soon become leaky. If the tap is opened twice a-day, as I suggested, it will not be at all liable to choke up with deposit, and will therefore afford no excuse for removing the plug. A blow-off tap should also be one of the straight-way type; the passage through it should be in a straight line, and not angular.

With respect to the water gauges, it is a mistake to adopt cheap and lightly constructed ones. They should also be tight, otherwise they will drip on the foot-plate and keep the front end of the boiler damp. The next point is that they should have ample sized passages through them, otherwise they are liable to choke up and mislead. There should never be less than two sets of water gauges on one boiler. Many steam users bring the waste pipes from these gauges down on to the foot-plates, just where we have already seen dampness is particularly objectionable; others discharge the water from these gauges into the internal flues, which is also to be deprecated; others, again, discharge into a drain for the purpose. But, in any case, these plans necessitate pipes of small bore to carry away the water from the gauge taps, and these pipes are constantly stopping up with deposit, and are always a source of trouble. The plan I have found best is to attach to the bottom gauge taps a few inches of small iron gas-piping, bent so as to direct the water on to the slack in front of the boilers. This prevents the water doing any mischief to the boiler front, is cleanly, and gives no trouble from the pipes stopping up. If the taps are tight, which good asbestos-packed taps will be, nothing beyond these short bent pieces of piping are requisite; but if the gauge taps leak at all, they will probably require supplementing with ordinary gas taps screwed on to the ends of the bent pipes.

If the points to which I have directed your notice are properly attended to, you ought to secure almost entire immunity from the deleterious action of damp and cinders upon this most vulnerable part of the boiler, and upon the blow-off pipes beneath.

There is one other part of the boiler which is peculiarly liable to suffer from wear and tear. I refer to grooving, which is liable to arise in the two end plates immediately around the angle irons which connect them to the internal flues. This mischief is, in the first instance, due to mechanical forces produced by the expansion and contraction of the boiler under the influence of varying temperature, and is induced by too great rigidity and want of elasticity. If this grooving is found to be taking place, examine the gusset-stays at once, and if they are fastened to the end plates nearer than nine inches from the angle irons of the flues, release them by removing the bottom rivets until this distance can be secured. Look, also, to the horizontal stays; these should not be too taut, but should be capable of vibrating three inches when smartly pulled in the centre. Any stays there may be in the boiler for supporting these rods are better removed.

Before we leave this drawing, I should like to call your attention to one or two other points. With respect to the mud-hole in the boiler front, it is customary to make the joint with an indiarubber ring twelve or thirteen inches in diameter. These rings are expensive, and if no precaution is taken the ring will be torn when the joint is broken, and a new one will be required every time the boiler is washed out. If, however, the side of the ring which comes into contact with the mounting on the boiler be painted with a mixture of blacklead and tallow, the ring will adhere to the mud-hole cover, but will readily leave the mounting; and it may, by this simple attention, be used over and over again.

On the other side of the drawing you see a bin for the purpose of holding the slack. This is an arrangement I most strongly recommend as having great advantages over the rough and ready method of discharging the fuel on to the floor of the boiler-house. In the first place, this bin saves fuel, as it keeps it from under foot, and prevents its admixture with the cinders and clinkers. The bin also saves room, as it is obvious that the fronts of the boilers may be placed nearer the outside of the building than if room has to be left on the floor for the slack. In the next place the bin prevents slack-dust from entering the building, a nuisance which is particularly great if the boilers are in proximity to any chemical produce which it is an object to keep white. Lastly, this bin equalises the quality of the fuel. If the slack is discharged on to the floor of the house, it will be found that the fine stuff will always accumulate at the back, while the good rough slack will roll down to the front and be used up first, leaving the fine to be dealt with alone afterwards. With this bin, however, a fair admixture of the coarse and the fine slack is secured throughout.

There are two directions in which the hot gases may be caused to travel through the flues of a boiler. In both cases they, of course, first of all pass through the internal flues; but after this the difference arises. One plan is to cause them to pass next through the side flues, and lastly under the bottom of the boiler. The other plan is the reverse of this, and after passing through the internal flues the hot gases are caused to pass under the bottom of the boiler, and lastly through the side flues. The latter is, I think, the better plan, for the following reasons:—First, the coolest water is at the bottom of the boiler, and as it is a great object (in order to prevent straining of the boiler) to preserve an equable temperature within it, I prefer to apply the hottest gases to the coldest part. Secondly, the value of horizontal heating surface is very much greater than that of vertical; therefore, by applying the hottest gases to the underside of the boiler, the heat is more thoroughly absorbed than it would be by the vertical plates in the side flues. Now, a main reason why the course I advocate is often not adopted, is in consequence of the difficulty of making the flue divisions at the back end of the boiler sufficiently tight to prevent the hot gases escaping to the chimney without passing through the external flues at all. The setting at the back end is decidedly more easily made tight if the plan I deprecate is adopted.

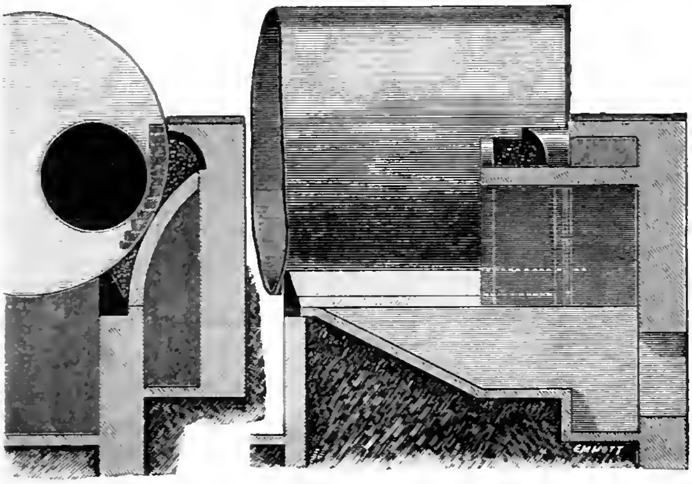

Fig. 3.

I think I can show you, however, that the plan I advocate for the course of the hot gases is quite compatible with tightness, and I shall ask you to refer to drawing No. 3. Please remember that, after the gases have left the internal flues, we want them to pass along the bottom flue back to the front end, then through the side flues, and out to the chimney. At the back end of the boiler it is therefore necessary to build partitions to prevent the gases passing to the chimney before they have traversed the bottom and side flues. These partitions usually consist of stepped brick midfeathers built into the back end wall, and brought up against the back end of the boiler, as indicated on the drawing. Now, these midfeathers are excessively unstable things, and time after time, when examining boilers, I have found them to have more or less given way, and the hot gases to be escaping straight to the chimney, without doing any work in the bottom and side flues at all. Apart from the instability of these walls, it is difficult to keep them so closely in contact with the boiler end as to prevent, in any case, some leakage, on account of the expansion and contraction of the boiler itself. Anxious to retain this particular course for the circulation of the gases, and at the same time anxious to avoid these losses, I adopted the plan of making good the flues at the back end of the boiler which is shown on the drawing.

Instead of building a stepped wall against the end of the boiler, I build an arch into the end and side walls, and allow it to enter about two feet into the side flue, just clearing the boiler. The space between the boiler and the arch is filled with dry sand, which is prevented from running out at the sides by pieces of brick shaped to fit. The boiler is now free to move over these arches without producing any crevices which can lead to leakage and loss, and the arches themselves are thoroughly stable structures. I have found this plan a complete preventive of loss, as it compels the hot gases to traverse the entire length of the flues, and at the same time to take that course which I believe to be most desirable.

While speaking of flues, I should like to impress upon you the desirability of making the side flues more roomy than they are frequently constructed. If every designer of a boiler setting were made to crawl up a hot side flue, he would agree with what I say. Some people think that six inches wide in the narrowest place is sufficient, but in the interest of efficient examination, and of the inspectors themselves, I would say never make this width less than nine inches.

When one boiler in a range is laid off, it is found that, unless the gland of the junction valve be well and freshly packed, the water which condenses in the steam main connected with the idle boiler, will be forced out through the gland of the valve, by the steam pressure in the other boilers. This water is a great nuisance on the top of the boiler, but, what is worse, it finds its way into the flues, and keeps the covering tiles and the seating blocks damp, and very probably gives rise to corrosion. Now, of course, this may be met by having a separate drainpipe attached to the lowest point of each rising main, and slightly opening a tap on the outlet end every time a boiler is laid off. Taps, however, are liable to leak when they are not wanted to, and this arrangement also requires attention in opening and closing the tap at the right time.

Drawing No. 4, however, shows you how the difficulty may be overcome perfectly automatically. The drawing shows two junction valves fixed upon boilers: the right-hand boiler is supposed to be working, and the left-hand idle. Above is the steam main to which the rising mains from the junction valves are connected. The right-hand junction valve is open, allowing the passage of steam from the boiler, and the left-hand valve is closed. The rising main from the closed junction valve will, of course, gradually collect condensed water, which, if nothing is done to prevent it, will be forced through the gland of the valve, but if the rising main of the idle boiler be connected with the rising main of one which is working, by means of an inch pipe, as shown, the water which collects will be forced back into the working boiler through its open junction valve. This takes place because the pressure of the steam, and the slight plus pressure due to the head of the water itself on the one side, will overcome the steam pressure alone on the other.

The junction valves are purposely not shown on this drawing in the positions they usually occupy, in order to indicate the arrangement more clearly. On this drawing only two boilers are shown connected, but if there are a number of boilers in the range, the drain pipes may, with advantage, be continuous, and connect them all. You will observe that the drain-pipe is bent in plan between every two boilers; this is done to allow for expansion and contraction. The pipe should be constructed of copper, because of the action of condensed water upon wrought iron. I adopted this arrangement with considerable misgiving, as I feared that the pipes would be liable to stop up with deposit carried over by the steam, but this is not the case, and the system works admirably.

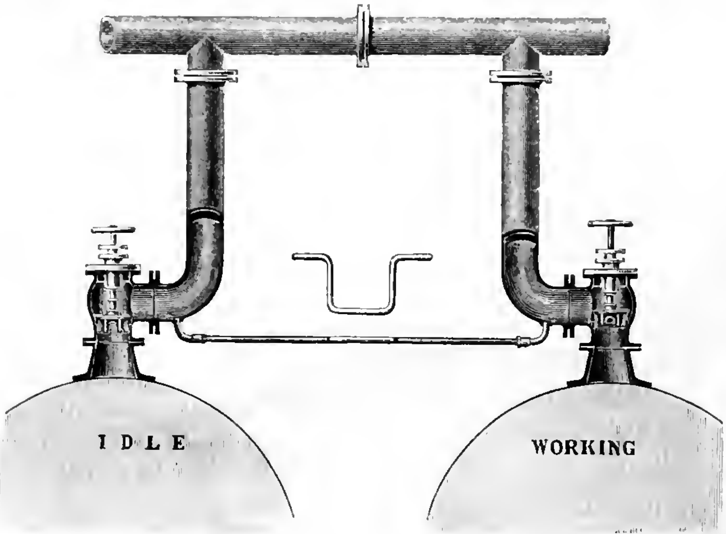

Fig. 4.

I have often been asked whether I consider the introduction of cross-tubes into the main flues of a boiler, an advantage. I am myself opposed to their adoption in all ordinary cases. At first sight it would appear as if cross-tubes must increase the heating surface, and consequently be beneficial; but it must not be forgotten that while the tubes do present more surface, it is *vertical* surface, and it is only obtained at the sacrifice of the horizontal surface which lies immediately behind them. For the tubes, as it were, cast a shadow, and deflect the hot gases from the upper part of the main flue, just where they would otherwise be most efficient. I have not made any actual experiments to support my opinion, but so far as I can judge, from general observation, I feel no doubt about the matter.

These cross-tubes render inspection much more painful and difficult, as anyone who has ever threaded his body through the maze of cross-tubes in a "Galloway" boiler will quite understand. These tubes, again, act as dust catchers, and a flue containing them will much sooner become choked with flue dust than will a flue which has no cross-tubes in it. It is obviously desirable to prevent the accumulation of soot and dust in the flues as far as possible. The only advantages which I think can be claimed for cross-tubes are that they strengthen the flues, and tend to promote circulation. If, however, the flues are constructed with the "Adamson" or "Bowling" seam, I don't think anything further is requisite to strengthen them, and if the boiler is fed with hot water, and the hot gases are caused to circulate as I have recommended, I don't think anything is needed to improve the circulation. In the rare cases of boilers fired with waste heat, when the heat passes through the internal flues only, these cross-tubes do certainly act beneficially in promoting circulation.

I shall probably be expected to say something regarding safety valves and fusible plugs. They are most important details of the boiler, and I believe that proper attention to them will do more to remove any liability to danger than anything else. There should always be two safety valves on each boiler, one of the ordinary deadweight type, and the other constructed to blow off when the steam pressure becomes excessive, or when the water level falls too low. To insure these valves never sticking, it is a good thing to have them lifted or moved upon their faces regularly once a week. Lever or spring safety valves, or any that admit of being tampered with, are dangerous, but it is seldom an object to a fireman in a chemical works to maintain an excessive pressure—the difficulty is generally to get the desired pressure kept up. Regarding fusible plugs, I would only say that to be efficient they must be kept clean, and they should be thoroughly cleaned on both sides every time a boiler is laid off. Every year the plug should be discarded and replaced with a new one whether it shows signs of leakage or not.

With respect to the supervision of boilers in a chemical works, I think the best plan is to appoint as foremen two steady and tried men, one for the day, and the other for the night shift. Of course this implies that there are sufficient boilers to warrant such an arrangement. These foremen should thoroughly understand the details of a boiler, and may with advantage be selected from among the fitters. It may then be part of their duty, when at work during the night, to attend to any minor fitting requirements that may be needed in the works generally. This will often save calling in the assistance of the regular fitters. These foremen may also be made the heads of any fire brigade organisation, because, as a matter of course, either one or the other, or, at any rate, a competent substitute, is always on the spot, and as their work necessitates their constant patrol, more or less, of the whole works, they become in fact general watchmen. The regular duty of the foremen is to see that steam is kept up, that firing is properly carried out, and that the evolution of black smoke is, as far as possible, prevented; to examine the boilers, and to see that any necessary repairs are executed. They see also that routine work, such as putting the soda into the heaters, is regularly attended to. Where the number of boilers is large, it is well to employ a fitter, whose duty it is to prepare the boilers for work again after being washed out, or before and after flue cleaning. This duty may, however, devolve upon the foremen, if the number of boilers does not warrant the employment of a fitter in addition, but there are so many little repairs needed in connection with the boilers and the pumps, that any spare time a fitter may have, may be usefully filled up.

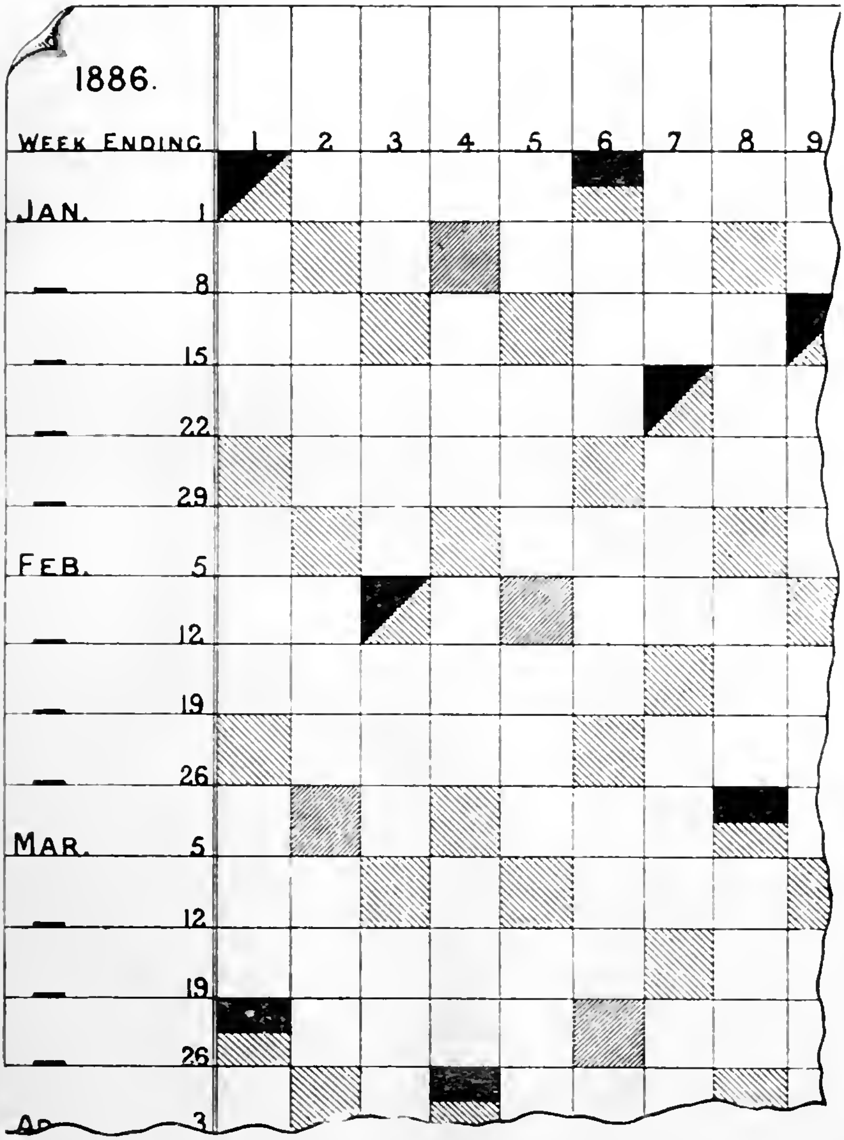

FIG. 5.

I find it an excellent plan to pay the foremen a small annual bonus upon each boiler, the amount being based upon the nature of the report received from the insurance company. This is a decided stimulus to their watchfulness and care, and goes a long way to prevent laxity in the execution of routine duties. It is always a difficult matter to secure regular attention to details which are of a routine character, and anything which tends to prevent rules falling into abeyance is an advantage.

A daily boiler report book should be kept by the foremen, and it should be their first duty on coming in to work to inspect the boilers and take their report. There is, therefore, a record taken every 12 hours, showing which boilers are working or idle, and the height of the water and the pressure of steam in each boiler individually. Remarks are also made in case any of the fittings are discovered to be inefficient, and in the book is entered when the boilers are washed out, the flues cleaned, and repairs executed, and by whom the boiler was examined. Each report is signed by the foreman making it; and, in case of any subsequent inquiry, records how matters stood when it was made. This book should be daily submitted to the head of the department to whom the foremen are answerable, and in whose hands the ultimate responsibility rests.

In addition to this record kept by the foremen, I find it necessary to keep myself two other books. In one of these I enter abstracts of the insurance company's reports, showing at a glance their remarks respecting the condition of the boilers, and their recommendations, if any, regarding them. This book is always consulted when the next opportunity arises for putting such recommendations into practice. The second book I keep is merely a record showing when the boilers are washed out, when the flues are cleaned, and when the annual inspection takes place. This ensures these operations being carried out at their proper time, and in their proper order. In order to show you how I record these matters so as most graphically to strike the eye, I refer you to diagram No. 5. This represents the corner of a page of this book, and gives you the record of eight boilers for a period of thirteen weeks. The blue squares indicate that the boiler has simply been washed out; the squares with the horizontal black band that it has been washed out, and that the internal flues have been cleaned; and the squares divided diagonally indicate that, in addition to washing out, the whole of the flues, both internal and external, have been thoroughly cleaned; the red squares indicate the same as the last-named, excepting that, in this case, the boiler has been thoroughly examined by the insurance company's inspector. You will observe from this diagram that it is my practice to wash a boiler out every four weeks; every three months the internal flues are cleaned, and every six months the whole of the flues are swept out. The inspection, of course, takes place upon one of the latter occasions. I find this method of recording these operations very satisfactory, as it is so easy to see at a glance when washing out, etc., becomes due. This book is of such a size that one opening represents a year's working. Every week end this record is consulted, and a list is made of those boilers which require attention in the ensuing week.

I have referred several times to boiler insurance companies, and I think I may say here that I consider them invaluable and indispensable agencies in successful boiler management. This is especially the case in works where there are comparatively few boilers, and where, consequently, the organisation is perhaps not as perfect as it might be. But, in any case, if the boilers are placed in the hands of a competent insurance company, it secures, at any rate, one thorough examination of each boiler in the year. No casual examination can ever be as satisfactory as one undertaken by a thoroughly trained inspector, who daily makes investigations of boilers, and who will often be led to suspect mischief from trifling indications, which would altogether escape the notice of one less experienced. Of course, I assume that the company selected is one which will do its work honourably, and will have the steam users' interests at heart. Fortunately, the steam users' interests are in reality identical with those of the shareholder—namely, to conduce to safety in the working of boilers.

We have now reached the end of those suggestions on boiler management which I intended to lay before you to-night. My paper has by no means exhausted the subject, and it has covered ground which is no doubt familiar to most of you; but I shall be very glad if, out of what I have said, you are able to glean a suggestion or two which may prove of any practical value. If the subjects I have spoken upon are familiar in themselves, their importance is, I believe, often insufficiently appreciated. I hope, however, that in matters of detail some novelty of treatment may be found. As far as I know, for example, the feed-water heater to which I called your attention is unlike anything of the kind in general use, and, on the other hand, my remarks on incrustation certainly contain nothing new. I have only tried to lay this subject before you in as concise a form as possible; and I wish here to acknowledge my indebtedness to my friend, Dr. Hurter, for the valuable assistance he has, from time to time, rendered, by making for me analyses, some of which I have placed before you to-night. Any value my remarks on incrustation may have is largely due to the interest he has taken in this subject. I also wish to express my thanks to Messrs. Gaskell, Deacon & Co., for kindly permitting me to place at the disposal of this Society the outcome of experience I have gained in the supervision of their boilers. I have called your attention to some points which are of a very trifling nature, but I believe that the constant exercise of watchfulness and care in matters of detail, trifling in themselves, will, after all, be found among the best suggestions on boiler management.

DISCUSSION.

Dr. J. **Campbell Brown** (Chairman) said that the large attendance showed the interest which had been taken by the members in the subject, which was more or less important to every manufacturer. He thought the way in which it had been treated, and the valuable suggestions which had been made, ought to call forth a good discussion. Besides the more chemical points, he was particularly struck by the reference made to cross tubes in boiler flues, and he hoped that some of the members would be able to give the results of practical experience with cross tubes. As Mr. Driffield said that he had not put his theories into practical test, perhaps it would not be too much to suggest that it would be of great advantage, not only to the members of the Society, but to the manufacturing community, if practical experiments were made to support or contradict the *a priori* theory which he (Mr. Driffield) had put before them. *Prima facie*, there was undoubtedly a great deal to be said for it.

Mr. **Gibson** said he would like to ask Mr. Driffield two or three questions. 1. Did he get his boilers absolutely clean? 2. Did he get them absolutely without corrosion? and, 3. What was the price of carbonate of soda? He was not in the chemical trade, but was exceedingly interested in the subject, and would like to have Mr. Driffield's replies.

Mr. **Brunner** said he wished to ask Mr. Driffield, and perhaps Dr. Hurter, for some further explanation with regard to the analysis. He noticed, for instance, in the analysis given of the boiler mud there was 3·1 carbonate of soda, and in the boiler scale 3·01 carbonate of soda. He would ask whether that did not point to the probability of an unnecessarily large quantity of carbonate of soda being used in the precipitation of impurities. He thought perhaps it was due to the formation of the insoluble compound of carbonate of soda and carbonate of lime, with which they were acquainted. With regard to the boiler scale analysis he noticed hydrate magnesia 44·9 and silica 10·7. Were they to understand that the magnesia existed there as hydrate, and the silica as free silica? It seemed to him, under the circumstances in which they existed in the boiler, very probable that the silica and magnesia would combine, and that that possible combination may have had a good deal to do with the formation of scale. It was rather a peculiarity that the boiler mud contained no silica. He would also like to ask Mr. Driffield a practical question, whether, if worked with as much care as Mr. Driffield evidently bestowed on the boilers under his charge, he could give any idea what the increased life of a boiler would be, compared with a boiler working under ordinary, somewhat careless, conditions as to attention? Also with regard to the amount of fuel consumed, how many pounds of water did he evaporate per pound of fuel in his carefully managed boilers, and what would be the amount of water evaporated in boilers which were not so well attended to? It seemed to him that those were points upon which every steam user would like to be informed, as upon these points depended whether or not it was advisable and whether it paid to spend a considerable amount of money in carefully attending to boiler management. He had no doubt himself that it did pay.

Mr. Wm. Ingham (Assistant Engineer, National Boiler Insurance Co.) said he would like to make a few observations on the very excellent paper. Mr. Driffield had admirably expressed the views held by most engineers, but there were certain points upon which they had little or no information. With regard to cross tubes, he had known many experiments made in which the cross tubes proved of no advantage. They advised cross tubes principally in cases where the flues were only strengthened by hoops, and in order to promote circulation. Many boilers were only fed by cold water, but the products of combustion were carried up the sides before passing under the bottom, and in such cases they generally found the ring seating of the shell to leak, whereas when the cross tubes were used they promoted the circulation, and there was not the same difference in temperature between the lower and the upper parts of the boiler. That and the additional strength given to the flues were the only advantages of cross tubes. With regard to prevention of incrustation, for a number of years most of the boiler engineers had recommended the use of soda ash; that was perhaps the most economical form of using carbonate of soda. He thought Mr. Driffield was not quite correct in his views about caustic soda. They had found that caustic soda had caused leakage in the brass fittings. Caustic soda was very efficacious with some kinds of water, and had a distinct advantage over the caustic lime used in Clark's process. The caustic lime threw down the carbonate. The caustic soda, however, absorbed the carbonic acid and formed carbonate of soda, which was available for decomposing any sulphate of lime present, converting it into carbonate of lime, and afterwards precipitating it. He thought, also, that Mr. Driffield was scarcely right in his view about the use of grease and tallow. It was not these that formed a scale, but rather they so thickened the water as to make a sort of accumulation, and this thickening of the water prevented a sufficient transmission of heat from the plates to the water. With reference to the waste of heating power through scale, it was a fact that probably nine-tenths of the evaporation was done in the furnace, and very little was done in the bottom parts of the boiler, where the scale accumulates. The scale itself was not really so disadvantageous as was generally supposed. It was, however, desirable that the scale should be removed, because many of the disadvantages, such as straining the seams at the bottom of the boiler, around the furnace angle irons, and other parts where the scale accumulated, were caused by it. The water that Mr. Driffield had given them an analysis of was what they termed "land water." They generally advised, before any of the thousand-and-one nostrums before the public were used, that an analysis of the water should be made. People generally sent their scale to be analysed, which was useless. When they had a sample of the water they knew exactly what to do. With regard to mud cocks, he understood that Mr. Driffield recommended the use of an indiarubber ring. This was scarcely desirable, as he had known of two or three explosions resulting from the use of an indiarubber ring. He knew many firms who simply used a short length of lead piping, pressed out flat, and he knew of lead joints of this nature lasting for many years. With regard to lubricants, they thought that mineral oils might with advantage be used, but not animal or vegetable oils.

Mr. Carey said he must congratulate Mr. Driffield upon his successful summary of a practical experience in the management of boilers. He would also like to ask one or two questions. He concluded, when Mr. Driffield spoke about the quantity of carbonate of soda to be put in a boiler, he specially referred to a boiler evaporating about 35 cubic feet per hour, and working continuously through the 24 hours. Mr. Driffield, also, in referring to his very useful method of preventing the leakage of valves connecting the steam main to the boilers, spoke of a copper pipe one inch in diameter, and said that he had found that it did not fill up with sediment. He would like to ask what length of time he had had those copper pipes? With regard to cross tubes, he would ask Mr. Driffield whether he had found a difference of temperature in chimney gases, leaving a boiler with cross tubes and without? or could give a rough estimate of the comparative efficiency of the two boilers? He thought Mr. Driffield had been unnecessarily modest when he said that he had introduced nothing new on the subject of incrustation, as the points that he had shown about magnesia salts were new and of great practical utility.

Mr. J. W. Macdonald asked how long a boiler would work without sealing in the way recommended by Mr. Driffield, and what thickness of scale would be formed in the time? Also, if he could tell them the proportion there was between the cold feed water and that produced by the condensation of the exhaust steam, so as to find out the reduction of solids in the cold water? He thought a good deal of the apparent reduction (from 37 to 17 grains per gallon) was really due to the dilution produced by the condensed water formed from the exhaust steam.

Dr. Hurter wished to answer Mr. Brunner's remarks as regards the analyses. Mr. Driffield had chosen to give the results of the analysis of the boiler mud in the diagram as percentages. The mud was taken out of the boiler as a thick fluid, and the results were returned as pounds per cubic foot, and would be so expressed in the journal. The analysis of the mud was not complete, and was undertaken simply to confirm the peculiarity found in the scale—viz., that the magnesia was present as hydrate, and not in combination with any acid. The 10 per cent. of silica present in the scale was really chiefly sand. The analysis of the scale puzzled him at first. He had given it to his assistant, who had found it to add up to about 110. He was, therefore, obliged to make it himself, but as long as he calculated the magnesia as carbonate the results were unsatisfactory. In Mr. Macadam's paper there were somewhere about 50 different analyses of boiler incrustations, all adding up to nearly 100, in every one of which the magnesia was stated as carbonate. His (Dr. Hurter's) own investigation proved to him, beyond doubt, that the magnesia was to a great extent in the mud, and wholly in the scale as magnesia hydrate. To him this was news, but, on searching, he found that Professor Voelcker had discovered this fact as long ago as 1867, and that many careful analysts, Dr. Fischer among others, had noticed the same fact. It was a very curious fact, because he had not succeeded in expelling CO_2 from either magnesite or freshly precipitated magnesia carbonate, at the temperature of a boiler in a current of steam. The carbonate of soda, mentioned in the boiler mud, was not in the precipitate, but in solution, and was the excess of soda which had accumulated for a long time in the boiler. It was necessary to ascertain this in order to find what amount of carbonic acid corresponded to the various bases, and whether the magnesia was free as hydrate, or combined as carbonate.

Mr. A. Norman Tate congratulated the Society on having Mr. Driffield there to read his very excellent paper, one which they might take as a type of the papers required by the Society. He was very glad to hear Mr. Driffield mention the difficulties that followed the use of tallow. He had made numerous examinations, connected with boiler-corrosion, of waters from many parts of the world, especially in cases of corrosion of marine boilers: most of these were traceable to the use of tallow introduced into the feed water. He fully agreed with Mr. Driffield that the tallow itself caused much of the mischief, especially that which was sold for lubricating purposes and which was the vilest rubbish ever sold under the name of "tallow." There was no doubt that tallow did combine with magnesia in the boiler, and caused a coating and a considerable amount of corrosion. With regard to the remarks that had been made as to the use of mineral lubricants, it was a curious fact that if tallow were used at the same time with a mineral lubricating oil, the result was often detrimental to both boilers and fittings, although mineral lubricants of themselves might be innocuous. With reference to magnesia, some time ago he had occasion to examine some water in connection with the breakdown of some half-dozen boilers. They had broken down very rapidly. A change of feed water had taken place. The boilers had been worked for from three to four years without difficulty, with the exception of a large amount of scale. That scale, of course, was considered detrimental: the water was therefore changed, and then, after some three or four weeks only, the boilers gave way. In that water over 13 grains per gallon of chloride of magnesium was found, and he had not the slightest doubt himself that it was owing to the decomposition of the chloride of magnesium that corrosion took place. They were greatly indebted to Mr. Driffield for calling their attention to the matter. It was undoubtedly very important that there should not be any chloride of magnesium in feed water. Some remarks had been made with reference to the use of carbonate of soda and caustic soda. It occurred to him that if caustic soda were used after scale had been formed, leakage would most certainly result, because caustic soda so cleared off the scale that faults were made apparent which before were not perceivable. When caustic soda had been used at the starting of a boiler, his experience had been that it had much the same effect as ordinary soda ash.

Mr. W. P. Thompson said that Mr. Driffield had recommended that the return flue should go under the boiler first, before going along the sides. About thirteen years ago he had been asked by a millowner in Derbyshire to examine his boilers. He said that every time they were quiet—say at dinner time—after the first few strokes of the engine the pressure unaccountably and suddenly rose 20lb. or 30lb. He (Mr. Thompson) had examined these boilers, and found that the reason of the sudden change was simply that the centre flues being rather short, and the side flues receiving the hot gases from them being extended above the water line, the upper parts of the side flues got nearly red hot, and the water, previously quiescent, being agitated by the withdrawal of steam, dashed against them and burst into steam quicker than the engine could get rid of it. By altering the flues this was remedied. He thought it frequently happened that flues were built too high, in which case during stoppages of the use of steam they were apt to get over-heated, in which case explosions might ensue through sudden rise of pressure and the weakening of the plates through overheating, especially when the water was low. Bringing the products of combustion under the boiler before allowing them to traverse the side flues, prevented this danger occurring.

Mr. A Watt said, with reference to tallow, that he had had a deposit given to him which consisted of little balls which were composed of tallow and magnetic oxide of iron, which were quite attracted by the magnet.

Mr. Macdonald had once examined a dark mud that had been deposited on the furnace tubes of two boilers, and which seemed to have such great non-conducting properties that the tubes got overheated and soft, so that the internal pressure bulged out the tubes close down to the fires. This mud contained a good deal of magnesia hydrate and carbon, in addition to the lime sulphate, which in this instance did not form a scale. On discontinuing the water which contained the organic matter, the ordinary hard scale formed, and the boilers gave no more trouble. The magnesia was formed from the decomposition of magnesia salts contained in the Thames water, softened by the Porter-Clark process before using in the boilers. The carbon was produced by the decomposition of the organic matter after the long-continued high temperature.

Dr. J. Campbell Brown, before calling on Mr. Driffield to reply to the various speakers, said he was very pleased at the interesting discussion which had ensued, especially from a practical point of view, and he hoped that Mr. Driffield would be induced to follow up the matter, and read another paper next year.

Mr. V. C. Driffield, in replying, said that Dr. Brown had suggested that he should make experiments as to the value of cross tubes. He had often thought of doing this, and would endeavour to carry it out, and would afterwards be glad to place the result before the Society. He felt, however, so sure that his views on the subject were correct, that if he was about to order a new boiler he would certainly order it without cross tubes. Replying to Mr. Carey, he said he had not ascertained whether there was a difference in the temperature of the waste gases on leaving boilers with and without cross tubes, but he did not anticipate that there would be any material difference. He had been asked whether he succeeded in keeping his boilers clean. He flattered himself that he did. Of course they had not the appearance of brand new boilers, but he considered what deposit there was, very trifling. He agreed with what the engineer who spoke (Mr. Ingham) had said—namely, that by far the greater part of the work done in a boiler is done in the furnaces, and upon the furnace plates he practically never found any scale at all. Incrustation takes place most readily where the water is quietest, and hence any deposit there is, is found upon the shell plates towards the back end of the boiler. Even here he did not find it of any very material thickness. Mr. Brunner had asked whether, after all his trouble, the life of the boiler was materially lengthened. He could not say, as he had never had a boiler worn out yet. All he could say was that he believed a boiler was supposed to have done its duty if it worked for 20 years; that they had boilers which had exceeded that age, and that he hoped to get a good many more years of work out of them yet. As to evaporation, he had not come prepared to enter into that subject, but he might say that it amounted to from 6 to 7lb. of water per lb. of fuel. This was, however, a matter which depended upon so many conditions, such as quality of fuel and draught. He thought that the engineer present (Mr. Ingham), who had found fault with his indiarubber ring for the mud-hole joint, must have misunderstood him. He knew perfectly well that, in the case of a mud-hole mounting fixed outside the boiler, where the pressure within would tend to break the joint, an indiarubber ring might be objectionable; but if they would refer to his drawing, they would find that the mud-hole mounting there shown was inside the boiler, and, as it was a spigot joint, the ring could not possibly be blown out. Indeed, the greater the pressure in the boiler the tighter the joint became, and no injury could arise even if the bolts became loose. Mr. Carey asked if the quantity of soda suggested applied to an evaporation of 35 cubic feet of water per hour. It did; but, of course, if the boilers did not evaporate so much, the quantity would be reduced. As to the method of coupling the junction valves with the copper drain pipes, he could give it a three years' character, and he thought that was long enough to prove pretty positively that it was satisfactory. A remark had been made about the condensation of exhaust steam in the water heater which was to the point. This he felt he had overlooked. He could not say, without inquiry into the matter, what proportion of the water supplied by the heater was due to condensation, but it was part and parcel of the benefit of the heater that, whether by condensation or otherwise, it did reduce the solid matter contained in the feed water.

The Chairman said probably the Society would remember that last month it was arranged that questions should be sent out to Dr. Archbold regarding his paper on "Starch Manufactures." This had been done, and they had his reply, which was as follows:—

DR. ARCHBOLD'S REPLY TO THE DISCUSSION ON HIS PAPER ON "STARCH" (Read at the February Meeting of the Liverpool Section).

	1st.	2nd.	3rd.
Starch	98·5	92·88	20·33
Gluten Cellulose	—	2·38	1·25
Ash	0·3	0·60*	3·65*
H_2O	1·2	1·11	1·77
	100·0	100·00	100·00

What is meant by the three grades of starch obtained from the three separate runnings will be clearly understood from the above analyses, which represent average analyses of these starches as taken from the kiln. In the first running there is a large body of starch separated from the albumenoids, &c., and the latter being heavier and denser, quickly subside, leaving the upper stratum of nearly pure starch, which is run off with greater facility, and free from the impurities. The second and third grades, on the same treatment as second and third runnings, contain much of the above perfectly separated starch, mixed with that less perfectly separated, the globules of starch having more or less particles of albumenoids and cellulose adhering to them, the resulting starches being more or less coloured, while the first is perfectly snow white. These grades generally come under the designation of "manufacturers' starches," and are used principally by paper makers, dyers, &c., and in commerce usually contain 18 to 20 per cent. of water. The ash, as will be seen, is high; however, that is generally due to free alkali. Regarding the formula of starch, I should like to dwell at great length. However, in this reply, I must be brief, as time prevents me going further into detail. Dr. F. Salomon made numerous experiments on potato starch, which have been corroborated by myself on corn starch, which go to prove that its empirical formula is $C_6H_{10}O_5$, or some multiple of it $(C_6H_{10}O_5)_2$. Starting with the elementary composition of starch and the formation of dextrose according to the equation $C_6H_{10}O_5 + H_2O = C_6H_{12}O_6$; that is, 100 parts anhydrous starch = 111·11 parts of anhydrous dextrose. Therefore, in the complete saccharification of starch (= to 100grms. anhydrous starch) the yield was found to be (from an average of over 100 such experiments, and the sugar estimated by Allihon's method) equal to 111·11grms. dextrose, by sp. gr. 111·11grms. dextrose, and by optical method 111·11grms. dextrose; thus confirming the formula of $C_6H_{10}O_5$.

Manchester Section.

Chairman: Sir H. E. Roscoe, M.P.

Vice-Chairman: I. Levinstein.

Committee:

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R. F. Carpenter.
C. Estcourt.
H. Grimshaw.
Peter Hart.
Dr. Gerland.
C. Schorlemmer.
Dr. Schunck.
Dr. Watson.
Wm. Thomson.
L. Siebold.
Dr. Hewitt.

Local Secretary:
J. Carter-Bell, Bankfield, The Cliff, Higher Broughton, Manchester.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

ON THE DIGESTIVE FERMENTS.

BY F. BADEN BENGER, F.C.S.

At the request of several members of the Committee of this Section of the Society of Chemical Industry, I have undertaken to read a short paper on the digestive ferments, and to give some illustrations of the action of these ferments on articles of food. I at first hesitated very much to pose before you in the position of one who presumably has something new to say—when I have so little—but I was reminded that this particular branch of physiological chemistry is probably rather outside the field of observation of most members of the Section, although many of the experiments I have to show you are in reality performed daily by each one in his most private laboratory—his stomach. These are the considerations which led me to attempt the task of interesting you for a very few minutes this evening.

The study of these digestive processes has naturally attracted the attention of many eminent men. In this country one of the most recent, and certainly the most distinguished investigator, has been Sir Wm. Roberts, M.D., F.R.S., of this city, and to his researches I am indebted for much that I have to bring before you.

Digestive ferments is the name given to certain principles secreted at different points in the alimentary canal, their office being to transmute the food we eat into products capable of being assimilated, and so used in the building up of our tissues, or in supplying the necessary fuel required to maintain the continuous working of our several functions. Speaking generally, these ferments have the power of increasing the solubility and diffusibility of food—for instance, starch is converted into sugar (maltose), and albumen into peptone. The changes brought about are not, chemically speaking, complicated, though the physical condition of the substance acted on is often entirely altered. The actual ferments themselves have never been absolutely isolated. It is known, however, that they are albuminoid, or are invariably associated with albuminoid matter: they are soluble or unorganised, as distinguished from the organised and insoluble ferments, such as yeast. They are precipitated from watery solution by alcohol, but even prolonged contact with this fluid does not injure them. When the alcohol is removed, their solubility and activity are found to be unimpaired. They are destroyed by many chemical reagents, and when in solution they are coagulated and rendered permanently insoluble and inactive by a temperature of about 75° C. They have no power of self-multiplication or growth of any kind, as is the case in the class of so-called organised ferments, but their action is quite distinct from what we understand by chemical, in the ordinary sense of the word. I shall presently have the opportunity of illustrating my meaning by an experiment. A special interest attaches to these principles from the fact that they play so important a part in our individual organisms. Their origin is shrouded in mystery, they are formed under the influence of vitality, and seem indeed to be a remnant of unexpended vital force.

The importance of preparations of these ferments in modern civilised life is considerable; some of them are largely used in medicine, and others are employed in the manufacture of peptonised or partially digested foods.

The first of the secretions with which our food is brought in contact in the process of digestion is the saliva. One of the purposes served by saliva is to lubricate the morsels of food, and so facilitate their being swallowed, and this probably is the extent of its service with regard to meat, and many other articles of diet; but saliva contains a very important ferment—ptyalin. This body may be precipitated in an impure condition by adding filtered saliva to strong alcohol. Its action on cooked or gelatinised starch is similar to that of malt diastase, converting it into dextrine and sugar. Starchy foods, of course, form a very considerable part of the diet of man. The importance of ptyalin can, therefore, be well understood, especially when it is known that starch is not acted on by the juices of the stomach, and that it is not until it reaches the duodenum that farinaceous food is again brought under the influence of a starch digesting ferment. It is essential that the starch should be cooked, as raw or unbroken starch granules are scarcely acted on at all by the saliva of man, though the lower animals are capable of digesting it. I have here a small quantity of ptyalin, and if I add a little to this test tube full of warm starch mucilage, you will observe that a change will shortly take place. The change is much more rapid if saliva is used, as the ptyalin is then in solution, and a few seconds will be required to bring the ptyalin to the same condition. The first step in the digestion of starch is the formation of soluble starch; a bright transparent solution is obtained which still gives the blue reaction with iodine; then dextrines are produced, yielding brown and yellow reactions with the same reagent; and finally sugar, yielding no colouration with iodine. This digestion of starch by ptyalin can take place only in alkaline, neutral, or faintly acid media. The juices of the stomach during digestion are acid, but it seems probable that masses of bread and other farinaceous food, saturated with saliva, would continue for a time to be acted on by the ptyalin after they reach that organ, as they could hardly be immediately permeated by the gastric juice.

We now come to the digestive ferments of the stomach. These are pepsin and a curdling ferment, the active principle of the well-known rennet used in the manufacture of cheese. Pepsin is the agent by which albuminous matter or proteids, such as meat, eggs, etc., are converted into soluble peptones in the stomach, and thus fitted for absorption. Though not absolutely inert in neutral media, it is practically so. The normal acidity of the gastric juice is equal to about 0·2 per cent. of HCl., and though it is probable that during the digestion of meat, etc., other acids are set free from salts contained in the food, hydrochloric acid is found to be the one secreted with pepsin in the gastric juice. Water containing 1 per cent. of strong hydrochloric acid is a suitable medium for experiments with pepsin.

Pepsin, like all the digestive ferments, is soluble in water or glycerin. From an aqueous extract of the mucous membrane of the stomachs of animals, it may be precipitated in various ways—perhaps it would be more correct to say that precipitates may be obtained in which the presence of pepsin can be demonstrated by its digestive power. But actual pepsin has never been isolated, and attempts to purify the precipitate are very apt to lead to great diminution in its activity. The mucous membrane does not always yield an active extract. The pepsin is sometimes incompletely formed. It may exist as what is called pro-pepsin or pepsin-precursor, and time, aided by atmospheric influences, may be necessary in order to develop the perfect ferment.

The Pharmacopœia process for preparing pepsin is the somewhat rough-and-ready one of scraping the cleansed mucous surface of the stomach of the pig with a blunt knife; the matter thus removed is dried at a temperature not exceeding 120° F., and powdered. Carefully prepared, this is a fairly active product; but the best that can be said of it is that it contains the proteolytic ferment of the stomach mixed with much undesirable animal matter, extremely liable to decomposition. I once asked a candidate at an examination of the Pharmaceutical Society how to make Pharmacopœia pepsin, and he told me it was done by scraping the outside of a sheep after the removal of the skin. I have examined some specimens of pepsin which may have been prepared by this method.

Some commercial pepsins are prepared by precipitating aqueous extracts of the mucous membrane of the pig or sheep, the precipitate is commonly mixed with starch powder or sugar of milk. Fluid preparations are, however, now much used; but by whatsoever process pepsin is prepared, the only test of its quality that can be applied is the measure of its digestive power. The mode of applying this test, adopted in the last edition of the "British Pharmacopœia," is one proposed by myself in a paper read before the British Pharmaceutical Conference, at its York meeting in 1881. The official direction is as follows:—"Two grains of it with an ounce of distilled water, to which 5 minims of hydrochloric acid have been added, form a mixture in which at least 100 grains of hard-boiled white of egg, pressed through wire gauze of 36 meshes to the linear inch, and made of No. 32 brass or copper wire, will dissolve on their being well mixed, digested, and well stirred together for 30 minutes at a temperature of 130° F."

In previous editions the white of egg used was ordered to be in thin shavings, the temperature 98° F., and the time "about four hours." The test was tedious, the condition of the egg not precisely indicated, and the element of time more or less variable according to the meaning attached to the word "about."

My original paper contains some details of manipulation necessarily omitted from the brief Pharmacopœia directions. In practice I find that the white of egg having been pressed through the wire gauze and weighed, is best lightly rubbed in a glass mortar with the acidulated water: this separates the vermiform particles, which cannot be satisfactorily accomplished by mere stirring; this is, of course, most important, as the amount of albumen dissolved, other things being equal, will depend on the amount of surface presented to the action of the ferment. The mixture is then poured into a large test tube and floated in a beaker of water. Half-a-dozen such tubes, numbered, and each containing 100 grains of hard-boiled white of egg and 1oz. of acidulated water, can thus be floated in the same water-bath, and the same number of examples of pepsin or preparations of pepsin can then be tested under absolutely identical conditions. This latter point is most important in comparative experiments, for it must be remembered that the digestive power of pepsin is greatly influenced by many circumstances, the degree of subdivision of the egg, the temperature of the mixture, the volume of the solvent, and the frequency with which the mixture is stirred. Having floated the charged test tubes in the beaker, as shown on the table, and provided each tube with a small glass stirrer so that pepsin may not be transferred from one tube to another, the heat of the spirit lamp or Bunsen's burner is applied until the temperature of the whole has reached 130° F. There is no practical difficulty whatever in this, and any slight variation of temperature effects all the tubes alike, so that the value of the test for comparative experiments is not influenced by slight variations.

The samples of pepsin or its preparations having been previously weighed or measured, are now added to the tubes and the temperature maintained as nearly constant as possible, care being taken that it does not rise above 130° F. The contents of the tubes should be stirred at regular intervals, say every five minutes, and in half-an-hour the albumen should have dissolved. The glass water-bath is more convenient than the ordinary water-oven or incubator, as it enables the operator to see the progress of the experiment, and in practice it is often easy to select the best sample of pepsin in a few minutes.

It will, of course, be noticed that the temperature employed in this artificial stomach is much higher than that of the body. It was adopted because it was found that about 130° F. is that of the maximum activity of pepsin, and experiments had shown that specimens of pepsin which were most active at the higher temperature, were invariably the most active at the temperature of the body (98° F.), whilst the adoption of the higher temperature enabled the operation of testing to be accomplished in half-an-hour instead of occupying four hours, as in the previous edition of the Pharmacopœia.

Some may perhaps be asking themselves the question, How can a dose of pepsin which requires 20 or 30 minutes to digest 100 grains of egg at 130° F., have any appreciable effect on a meal when taken as a digestive?

In answering this, we must not forget the fact that whilst in our laboratory experiments the products of digestion remain in the digesting apparatus to gradually retard, and finally stop, the action of the ferment, in the stomach these products are constantly removed as digestion goes on. It must not be supposed that 100 grains of egg albumen is all that 2 grains of B. P. pepsin, or the minimum dose of a fluid preparation, will digest in half-an-hour under other conditions and with other surroundings. The following experiment (described by me in *The Lancet* of 3rd April, 1886) will demonstrate the contrary. I took ten times the Pharmacopœia quantity of egg and acidulated water—that is, 1000 grains of egg and 10 fluid ounces of water; these were placed in a beaker; 100 grains of egg and 1oz. of acidulated water were put in a test tube and stood in the beaker, and the whole heated to 130° F. A teaspoonful, the minimum dose of an active fluid preparation of pepsin, was then added to both beaker and test tube, the temperature maintained constant, and the contents of both stirred occasionally. When the egg in the test tube had all dissolved, which in this experiment occupied 25 minutes, the contents of the beaker were thrown into a fine muslin filter and drained; the undissolved egg weighed 220 grains. Here, then, a small dose of pepsin had dissolved 780 grains of egg in 10 ounces of fluid, whilst a similar dose had dissolved 100 grains in 1 ounce of fluid. Another attempt was made to approach more nearly to the conditions under which pepsin acts in the stomach. The egg, acidulated water, and pepsin were placed in a parchment dialyser and floated on a bowl of acidulated water. In this case it was found, also, that enormously more egg was dissolved in the dialyser where the products of digestion could diffuse away, than in a test tube containing a similar mixture.

Each of the two beakers on the table contained, this afternoon, 1000 grains of hard-boiled white of egg and 10 ounces of acidulated water. To one I added a teaspoonful of an active solution of pepsin, and maintained it at a temperature of 130° F. for half-an-hour—you will observe that the white of egg has disappeared, and it now exists as peptone, or peptones, for there are several—in solution, and the presence of this peptone can be easily demonstrated by a colour test. When a solution of peptone is rendered strongly alkaline with potash, and a few drops of Fehling's copper test are added, a beautiful rose colour is produced. I will apply this test to a portion in a test tube.

The second ferment contained in the gastric juice is that known as the curdling ferment, and is familiar to all of us as the active agent in rennet. Its sole property, as far as is known, is to curdle milk, to cause a separation of the casein, though it is probable that it serves some other purpose. If it were found only in the stomachs of milk-consuming animals, we might rest on the supposition that it is merely a milk curdler, but Sir Wm. Roberts has obtained it from the digestive organs of the fowl, and I have myself extracted it from the stomach of the cod-fish. Now, neither of these creatures can possibly require the services of a milk curdler. The curdling power of gastric juice was long considered to be due to pepsin, but it is now known to be caused by the presence of a distinct ferment. If the mucous membrane of the stomach of the calf be macerated in a saturated solution of common salt, an extract is obtained practically destitute of proteolytic power, but extremely active as a curdler. If I add a few drops of this solution to a beaker of warm milk (about 100° F. is the best temperature), and stir them together, we shall see that in a few minutes the milk will solidify in a characteristic manner—a solid jelly-like mass being produced. If this be now broken up with a glass rod, the casein, or curd, will shortly contract, and form lumps floating in the whey. Much of the fat of the milk is entangled with the caseïn in these masses, and the whey is chiefly a solution of the lactose, or sugar of milk, and the salts.

The ferments of the pancreas or sweetbread have not, until recently, attracted much attention, and the remarkable digestive power of the pancreatic juice was scarcely suspected. Three of these ferments are known to exist: an amylolytic or starch-digesting one, resembling ptyalin in its power of converting starch into sugar, a proteolytic or proteid digesting one called trypsin, and another curdling ferment. The ferments of the pancreas, like those of the stomach, have not yet been absolutely isolated; they may be extracted from the minced pancreas by similar solvents, water, or glycerin—and here, again, the same difficulty is experienced as in extracting the ferments from the mucous membrane of the stomach. The gland may contain no completely formed ferments. They may exist as zymogen, or mother of ferments, and our solutions may prove inactive until the perfect ferment is developed.

I am not aware of a process by which they can be entirely separated from each other. I have obtained by fractional precipitation from aqueous solutions with strong alcohol, precipitates possessing respectively very much more of the diastasic and of the tryptic ferment, but have never completely separated them. Like the peptic ferments, they are very easily destroyed, and the utmost care is necessary in their preparation.

I have here a solution of these pancreatic ferments, and will first give you an illustration of its starch-digesting or diastasic power. This beaker is filled with warm thick starch mucilage. If I add a little of the solution and mix it with the starch paste by stirring, you will notice a rapid change in the contents of the beaker—they quickly become thin and transparent. I can now pour them from one beaker to another like water. If we now apply the well-known iodine test for starch to a portion, we shall still get the blue colouration—the starch has for the most part been merely converted into the soluble modification, but the digestive process is going on, and in a short time we should get the brown, and then the yellow, reaction of the dextrines; but to save time I will add a little more of the pancreatic solution — now iodine no longer produces a blue reaction — the starch no longer exists as starch, but as dextrine A few more drops are added, and now no colour is produced by the addition of iodine; the starch has been transmuted into sugar (maltose). The rapidity of this transmutation depends upon the proportion of ferment to starch. It is easy to produce the change almost instantaneously. If I half fill this test tube with the pancreatic solution, warm it slightly, and add a drop or two of the starch mucilage, I cannot apply the iodine test in time to catch a molecule of the starch unconverted. This illustrates the peculiar action of the ferments, to which I referred early in my paper. This change from starch to sugar can be produced almost as rapidly as the neutralisation of an acid by an alkali; but, on the other hand, if the proportion of ferment to starch be small, many hours may be required to effect the transformation; or, if still smaller, the ferment may exhaust its energy before the whole of its work is accomplished. Sir William Roberts, in his Lumleian Lectures, gave a very graphic illustration of this action. "There is," said he, "something in this, strikingly suggestive or reminiscent of the action of living organisms. To illustrate my meaning, let us compare the particles of the ferment to a band of living workmen, whose function it is to scatter little heaps of stones. If the heaps are few, and the workmen many, all the heaps will be scattered at once, and the energy of the workmen will remain sensibly unimpaired; but if the heaps are millions, and the workmen hundreds, and if the workmen are doomed to labour on until they fall exhausted at their task, the scattering of the heaps will go on for a comparatively long time, and the process of exhaustion will be a gradual one."

We will now turn to the proteolytic or proteid-digesting ferment of the pancreas, trypsin. It will be remembered that the proteolytic ferment of the stomach, pepsin, is practically inactive in neutral solutions, and is destroyed by alkalis. Trypsin, on the other hand, is active in neutral and alkaline solutions, and inactive in more than feebly acid media. An alkalinity equal to about 1 per cent. of bicarbonate of soda, seems the most favourable, however, to its full action. Its digestive power is exercised less rapidly on coagulated white of egg or fibrin than is that of pepsin. The casein of milk, however, is much more rapidly digested by the pancreatic than by the peptic ferment, and therefore affords us a convenient means of illustrating its action.

I have here two beakers filled with slightly-diluted milk. To one has been added a teaspoonful of the same solution of the pancreatic ferments used to demonstrate the action of the amylolytic or diastasic ferment, and the mixture has been kept at a temperature of about 55° C. for half-an-hour. There is very little alteration in the appearance of the milk. It is a little yellower; but a few tests will show that the casein has disappeared, and peptone has taken its place. I will pour some of the milk from each beaker into these test glasses, and add a little dilute acetic acid. In the peptonised or digested milk no precipitate is produced, but in the other the casein is, of course, precipitated. If we take two other test glasses of the peptonised and unpeptonised milk, and apply the test for peptone used just now, solution of caustic potash and a few drops of Fehling's copper test, we get the rose-red colouration instantly in the peptonised milk, but none in the other.

During the transformation of casein into peptone, an intermediate body called meta-casein is first formed. This is distinguished from ordinary casein by its property of coagulating on boiling. Ordinary milk can, of course, be boiled without change, but if we boil milk which has been submitted—for a few minutes only—to the action of a small proportion of the pancreatic ferment, and which is thereby partially peptonised, an abundant curdy precipitate is formed. This, however, can be entirely prevented by previously rendering the milk slightly alkaline; about 1 grain of bicarbonate of soda to the ounce of milk is sufficient to prevent the precipitation of meta-caseïn on boiling. That this does not prevent its formation can be shown by neutralising a portion of alkaline milk at the proper period of digestion, and immediately boiling it, when the meta-caseïn will be thrown down as before.

We may illustrate the wonderfully rapid action of trypsin somewhat in the same way that we did the amylolytic ferment of the pancreas. I mix in this test tube a little pancreatic solution, water, and milk; it is even unnecessary to warm them. If, now, I apply the peptone test, the rose-coloured reaction is produced; some of the casein has already been converted into peptone.

By adding a solution of the pancreatic ferments to a large excess of strong alcohol, a white precipitate is formed, possessing both the amylolytic and proteolytic power of the original solution. I have some of this precipitate in my hand. It has been dried at a low temperature, and its activity is very remarkable. If I take a small fraction of a grain of it on the point of my penknife, and stir it into this beaker of warm starch mucilage, you will observe in a few seconds that a change is going on; the mucilage has become thin and clear, the starch is rapidly undergoing transformation into dextrine and sugar. Its action on milk, too, is similar to that of the pancreatic solution, from which it is precipitated. The pancreas contains yet another ferment, one capable of coagulating milk in a very similar manner to the curdling ferment of the stomach or rennet, but differing from it in this respect:—Rennet will coagulate neutral or very feebly alkaline milk, but alkalinity produced by a grain of bicarbonate of soda to the ounce of milk is sufficient to prevent it. The curdling ferment of the pancreas, however, is unimpaired by an alkalinity three or four times as great, so that the two ferments cannot be identical. It is singular that, until comparatively recent times, the only function attributed to the pancreatic juice was the digestion of fats, and yet to-day it is the one that is questioned. It is one I have never obtained satisfactory evidence of, and am, therefore, unable to demonstrate to you.

In testing preparations of the pancreatic ferments we have again to rely, as in the case of pepsin, on the measurement of the work they are capable of performing. In an elaborate paper read before the Royal Society, London, Sir Wm. Roberts describes a method of accomplishing this. In the case of the amylolytic ferment, it is based on "the quantity of starch mucilage of known strength, which can be transformed by a unit measure of solution of the ferment to the point at which it ceases to give a colour reaction with iodine in a unit of time, and at a fixed temperature." The proteolytic ferment is estimated in a similar manner, except that milk is used instead of starch mucilage, and the indication or end-reaction of the experiment is the precipitation of meta-casein on boiling a portion of the milk.

A knowledge of the temperature at which the maximum activity of these ferments occurs is important in their practical application to the production of peptonised or partially peptonised or digested foods. The activity of the diastasic or amylolytic ferment commences a little above the freezing point, and rises gradually with the temperature until 30° C. is attained; it then remains stationary until 45° C., and then gradually falls with the further rise of temperature, until at 65° C. it ceases to act.

The activity of the tryptic ferment rises gradually with the temperature until 60° C. is reached, and then rapidly falls until at about 75° C. it becomes inert.

Peptonised or partially peptonised milk, and other articles of diet, are very largely used at the present time in rearing infants, and by invalids unable to digest ordinary food.

Fully peptonised milk has a slightly bitter taste, which is unobjectionable to many, and which may be covered by the addition of a little coffee. It is, however, seldom necessary to fully peptonise articles of food, and partially peptonised milk scarcely differs in appearance or taste from ordinary milk; nevertheless it has been very considerably modified. Its undigested caseïn cannot be curdled by the acid juices of the stomach into tough compact indigestible masses, but forms on the addition of acid light flakes, which are much more easy of digestion.

In preparing this partially-digested milk, the following points should be borne in mind: 1st, The milk should be diluted with a fourth, or, better, with a third of its bulk of water. This entirely prevents the action of the curdling ferment of the pancreatic solution. 2nd, The temperature of the milk should be from 50° C. to 60° C., at which the tryptic ferment attains its maximum activity; and 3rd, That if the milk be not consumed by the infant or invalid as soon as it is sufficiently peptonised, it must be rendered slightly alkaline by the addition of about one grain of bicarbonate of soda to the ounce, and boiled up to put an end to the action of the ferment, the addition of soda being then necessary to prevent the precipitation of meta-casein. It is preferable, when convenient, to use the partially-peptonised milk unboiled with the ferment still active. Many other articles of food are peptonised in a similar manner—soups, beef tea, farinaceous gruels, etc.

We must content ourselves on this occasion with the mere mention of the remaining ferments concerned in the digestion of our food. Bile is said to assist in the emulsifying of fats, and the intestines secrete a ferment which changes cane sugar into invert sugar. Such, gentlemen, is the very hurried sketch of the principal digestive ferments which the limited time at our disposal this evening permits, and I feel that my apologies are due to you for having attempted to traverse so wide a field.

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A DISCHARGE FOR MANGANESE BRONZE IN CALICO PRINTING.

BY JOHN RILEY.

The manganese bronze of the calico printer is an oxide of manganese. It is obtained on cotton cloth by passing the cloth through a moderately strong solution of a salt of manganese, precipitating the monoxide by means of caustic soda, and converting this monoxide into a higher oxide by means of oxidising agents, such as bichrome and bleaching liquor.

The style was first introduced by the late Mr. John Mercer, in the year 1823.

The discharging agent in use at the present time is stannous chloride. When a solution of this compound is printed upon manganese bronze and steamed, a double decomposition takes place; oxide of tin is fixed upon the cloth, and the chloride of manganese which is formed is washed away by a passage through water.

The number of colours which can be associated with stannous chloride is limited, and some of those which are used are not altogether satisfactory as regards fastness against light and soap.

In my endeavour to discover a discharging agent which could be used in conjunction with more permanent colours, I found that the sulphocyanates (commonly called sulphocyanides) had a considerable reducing action upon the manganese bronze. I first observed this property in December, 1883.

I was rather surprised when reading quite recently the "Life of John Mercer," published a few months ago, to find that Mercer had observed and applied this property of the sulphocyanides. The following is an extract from the biography referred to:—

"One of his (Mercer's) applications of the sulphocyanide (mixed with a little sulphuric acid) was for discharging manganese bronze without injuring blue, or interfering with subsequent dyeing with madder, logwood, etc."

At the time referred to, the pieces, after printing, were hung for a day or two to give the reducing agent time to act; steaming was not applied in the production of this style until within a comparatively recent period.

I cannot say whether or not this information was ever made public prior to the publication of this book; if it has been, I have never come across it.

I was desirous to find out a discharge that could be used along with pigment colours, which are fixed by means of albumen. The mixture of sulphocyanide of potassium and sulphuric acid as used by Mercer will not do for such colours.

I discovered a mixture that can be employed perfectly well with albumen, and which discharges the bronze completely when steamed for one hour in Smith's continuous steaming machine. I had hopes that this discharge would prove of considerable practical value, but up to the present time those hopes have not been fulfilled. To obtain a good discharge it is necessary to add 1⅛lb. ammonium sulphocyanide and 3lb. of ammonium chloride per gallon of colour. These salts are hygroscopic and under the influence of the steam, the discharging materials swell beyond the legitimate limits of the object printed. If a pigment colour, such as vermilion or ultramarine blue, is used along with the discharge mixture, a white bondage is visible round the red or blue object. In printworks phraseology it would be described as "bleeding." This is a very serious fault, and until it is remedied the discharge will be of little practical use.

Steaming in the box at 1lb. pressure gives a neater mark, but the discharge is not so perfect. Insoluble sulphocyanide of lead and ammonium chloride give a better result, but the bleeding is not entirely done away with.

Potassium sulphocyanide does not discharge quite so well as the ammonium sulphocyanide.

Ammonium sulphate may be substituted for ammonium chloride without any appreciable difference. There is no weakening of the fibre by this method of discharging the bronze.

I cannot give a satisfactory explanation of the chemical changes which occur in the discharge under consideration. I presume that the sulphur of the sulphocyanide is converted by the peroxide of manganese into sulphate of manganese, but the functions of the ammonium chloride I cannot explain.

The ammonium sulphocyanide itself discharges to some extent: in fact, I believe that a very strong solution of this compound would completely discharge the bronze.

Ammonium chloride discharges only to a slight extent, but it assists the ammonium sulphocyanide very materially.

Birmingham and Midland Section.

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Notices of papers and communications for the meetings to be sent to the Local Secretary.

DISCUSSION ON DR. G. H. MORRIS'S PAPER.

Dr. Tilden said he had great pleasure in expressing his gratification at what they had had an opportunity of listening to. It might not, perhaps, be known to the meeting that Dr. Morris has paid a visit to Copenhagen, and has there studied the process in Dr. Hansen's laboratory. Whilst one felt how exceedingly wide the subject is, he took it that most chemists are beginning to understand that they will have to make themselves acquainted with the conditions of growth and development of micro-organisms and the chemical changes they bring about. They had only to recall a number of quite familiar transformations, such as nitrification, which at one time were supposed to be purely physical or chemical, but which are now known to be effected through the agency of minute forms of life. Dr. Morris had referred throughout solely to the process by which the organisms are isolated one from another, and he had referred exclusively to the changes which the organisms themselves undergo; but, of course, there was another part of the question, which he supposed would not be neglected. And he would be glad to learn from Dr. Morris whether any systematic work is going on as to the action of yeast or other organisms on chemically pure materials? They were a long way off knowing exactly what are the constituents of a wort, but if they knew the effect of yeast on solutions of pure sugars they should have made an important step forward; and he would like to know whether systematic experiments were likely to be undertaken on a large scale? as this was surely a subject which ought to occupy the attention of all practical men.

Mr. Collins said he understood Dr. Morris to say that several of the yeast cells have different powers of attenuation. He would be glad to know if this was the same for the yeast used in this country, and whether the different powers of attenuation were caused by the yeast acting in a different manner?

Dr. Morris: With regard to the question asked by Mr. Collins, he might say that so far as the experiments had been carried, the differences of attenuation given by different cultivated yeasts were as marked as those with the pure Carlebery yeasts. With reference to Professor Tilden's remarks, experiments had recently been made by Bourquelot on the action of yeast upon certain carbo-hydrates, and with what was known as "German yeast." Had the experiments been carried on with pure yeast they would have thrown considerable light upon the action of the yeast upon carbo-hydrates. It was, however, shown that the rate of fermentation depended upon and was proportional to the rate of diffusion of the carbo-hydrates through the cell-wall. With regard to the action of yeast upon pure solutions he could only say that he had given a brief summary of what had been done, and he had no doubt that before long they should have the whole of the subject of the fermentation of the various carbo-hydrates by pure yeast thoroughly examined. Of course, in a thing of that kind it was not the work of a day; it required a very lengthened series of experiments, and he was afraid it would be some considerable time before they were able to say what the action of pure yeast upon the various constituents of malt-wort was, but when they were able to do so it would doubtless throw a very great light upon the question of fermentation.

Glasgow and Scottish Section.

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Vice-chairman: Prof. Mills.
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R. Pullar.
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A. Whitelaw.

Hon. Treasurer:
J. J. Coleman, Ardarroch, Bearsden, near Glasgow.

Local Secretary:
G. G. Henderson, Chemical Laboratory,
University of Glasgow.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

The Fifth Meeting of the Fourth Session of this Section was held in the Rooms, 207, Bath Street, Glasgow, on Tuesday, March 1, 1887.

MR. J. NEILSON CUTHBERTSON IN THE CHAIR.

INDICATORS IN VOLUMETRIC ANALYSIS.

BY R. T. THOMSON.

About four years ago I began a comparative study of the characteristics and behaviour of litmus, methyl orange, phenacetolin, and phenolphthalein as indicators in volumetric analysis, and in four subsequent papers these observations were extended to rosolic acid and lacmoid. In the following paper I propose to bring the same tests to bear on turmeric, cochineal, dimethylamidoazobenzene, and Congo red, and in a general way to institute a comparison between these indicators and those which were formerly examined. Before proceeding, it will be well to make a remark regarding the end-point of the reaction, or shortly end-reaction, which occurs in titration. I have rejected indicators in cases where the end-reaction was doubtful or obscure, so that the change in colour was not reasonably sharp, but was gradually developed. It is right to make this point clear, as other observers seem to be satisfied with end-reactions which, in my judgment, ought not to be relied on. In certain circumstances we may be compelled to content ourselves with approximate results, but we must not flatter ourselves that anything like desirable accuracy has been attained.

Turmeric.

Little information can be gathered with regard to turmeric paper, beyond its delicacy as a test for free alkalis and alkaline earths, especially hydrate of barium, and its special application to the detection of boric acid. The yellow turmeric paper employed in the following experiments was prepared according to the directions in Sutton's "Volumetric Analysis." Besides this, a red-brown paper was made by adding sufficient dilute caustic soda to the alcoholic turmeric solution, and passing slips of filtering paper through it. This paper, when dried, is of a light reddish-brown tint, but when wetted with pure water this is intensified to a dark red-brown colour. When partly inserted in a very dilute solution of an acid, the portion immersed becomes bright yellow, while immediately above this a moistened dark red-brown band is formed, and the upper dry portion retains its original colour. This phenomenon only occurs in the titration of a comparatively large proportion of an acid, when the latter is nearly all neutralised, and thus serves to indicate the near approach of the end-reaction. When neutral or alkaline, the colour of the immersed portion of the paper is simply intensified in the manner already described. This intensification is quite as decided as a transformation of tint would be.

Passing over any details with regard to the hydrates of the alkali and alkaline earth metals, the first substance to present itself for consideration is—

(1) *Ammonia.*—Several experiments brought out the fact that only about 97 per cent. of the ammonia present could be determined with turmeric paper as indicator, and further, that the end-reaction was an extremely indefinite one. In this respect turmeric agrees with phenolphthalein, and, like it, is absolutely useless in the determination of ammonia, or for any estimation in which that compound, or salts derived from it, is present.

(2) *Carbonates and Sulphide of Alkalis.*—On titrating carbonate of sodium with sulphuric acid, taking care that no loss of carbonic acid occurred, the change in colour of the yellow turmeric paper became gradually less marked, until when about 51 per cent. of the soda had been converted into sulphate, and the other half had formed bicarbonate of sodium, the solution showed a tendency to turn the red-brown paper yellow. The point at which the latter compound is produced cannot, however, be arrived at with anything like precision, even when small quantities of the salt are operated upon. In the latter circumstances phenolphthalein gives a fairly good end-reaction at the same stage of the titration, and in this shows its superiority to turmeric. In normal sulphides half the base is determined, but the same remarks apply to the behaviour of turmeric with these compounds as with the carbonates.

(3) *Thiosulphate, Sulphite, and Phosphates of the Alkalis.*—The first-named of these compounds is neutral to turmeric, as it is to all the other indicators I have examined. The normal sulphites of potassium and sodium (Na_2SO_3), and the mono-acid phosphates of these metals (Na_2HPO_4), are nearly neutral, or more correctly, slightly alkaline. In this respect turmeric resembles phenolphthalein, but the latter gives a sharp end-reaction, while with the former the neutral point is so ill-defined as to be valueless.

(4) *Silicate and Borate of the Alkalis.*—In ordinary silicate of sodium ($Na_2Si_4O_9$) about 90 per cent., and in borax ($Na_2B_4O_7$), about 50 per cent. of the total soda can be determined with sulphuric acid when turmeric paper is employed as indicator. The end-reactions are eminently unsatisfactory, as is also the case if phenolphthalein be substituted for turmeric.

So far, turmeric shows little utility as an indicator, but we have still to glance at its chief claim to favourable consideration, which rests on its delicate indication in the determination of organic acids with caustic soda or potash.

(5) *Determination of Citric Acid.*—Four years ago I showed that phenolphthalein was the only perfect indicator for this purpose, and that even litmus and rosolic acid, leaving aside their objectionable end-reactions, were rendered unfit for use owing to the fact that they show a distinct and measurable alkalinity in normal citrate of sodium. Since then turmeric solution has been proposed by F. Watts, especially for dark coloured solutions. His method is to spread it in thin films on a white plate, and to transfer a drop of the titrated liquid upon one of these films, in order to find the point at which the end-reaction is reached. I am convinced, however, that the red-brown paper I have described is both more sensitive and serviceable than the solution used in this way. In several experiments made with 25cc. of $\frac{n}{5}$ citric acid, exactly 25cc. of $\frac{n}{5}$ caustic soda were consumed in each case, and the red-brown paper ceased to acquire a yellow tint at exactly the same point as phenolphthalein showed a faint alkaline reaction.

In the determination of acetic, tartaric, oxalic, lactic and succinic acids, turmeric paper is equal in precision to phenolphthalein, and can be used in very dark-coloured solutions, where the latter could only be employed after large dilution.

Owing to a distinct alkalinity of normal soaps and an unsatisfactory end-reaction, turmeric paper cannot be substituted for phenolphthalein, even in the few cases where it might be useful in the estimation of free fatty acids or the saponification equivalent of oils.

An excellent feature in red-brown turmeric paper, and a quality which it possesses in common with phenolphthalein, is its power of detecting small but determinable proportions of acid in strong alcohol. Particular care must be exercised in judging the neutral point, especially on the near approach of the end-reaction, as the colouring matter is partially dissolved. Even the most delicate litmus paper cannot accomplish this occasionally useful result; and fails to detect, for example, 0·03 per cent. of acetic acid in a 90 per cent. spirit, unless the alcohol be expelled from the paper after immersion. I formerly showed that the inability of lacmoid paper, to indicate the presence of comparatively large proportions of acids, was much more striking than that of litmus.

On the whole, turmeric, though not so widely applicable as phenolphthalein, is worthy of consideration as a useful adjunct to the latter indicator. It provides us with a paper which is more reliable than litmus in the titration of solutions containing citric, acetic and succinic acids.

In both phenolphthalein and turmeric, and especially as regards the former, the chief weakness lies in their peculiar susceptibility to the disturbing influence of the normal salts of ammonium. In consequence of this, the sphere of their application is considerably contracted. An indicator possessing the general properties of phenolphthalein, but not exhibiting this imperfection, is still a desideratum.

Cochineal.

In the determination of pure alkalis and alkaline carbonates and sulphides, cochineal solution gives accurate results and a fairly good end-reaction, although affected somewhat by free carbonic and hydrosulphuric acids. In normal sulphites half of the base can be estimated with standard acid, as has been already shown by Giles and Shearer. Of the phosphates, the di-acid one (NaH_2PO_4) is indicated as neutral, and in this and the case of the sulphites is seen the dissimilar characters of cochineal and phenolphthalein or turmeric. The former agrees with methyl-orange and lacmoid paper, in giving the same results with the substances mentioned, but yields in delicacy of end-reaction to the two latter indicators. In other respects, also, cochineal resembles methyl-orange and lacmoid, inasmuch as it is entirely useless in presence of organic acids.

The radical defect of cochineal when employed in alkalimetry is occasioned by the damaging influence of the presence of even small proportions of alumina or iron, which cause the pink colour, though modified to some extent, persistently to remain even after the addition of excess of acid.

In spite of its fine colour, the application of cochineal must necessarily be very limited, and when methyl-orange and lacmoid can be so easily obtained and possess such conspicuous advantages over it, this indicator must be included in the list of those which may be fairly described as unnecessary.

Dimethylamidoazobenzene.

This compound was proposed by Fischer and Philipp as a substitute for methyl-orange, and was stated by them to be superior to the latter in delicacy. Its natural colour and that produced by the addition of an acid are similar to methyl-orange, but it requires to be kept in alcoholic solution. The dimethylamidoazobenzene I employed was prepared by Prof. Lunge, to whom I am indebted for a specimen which I received more than a year ago, accompanied with a request to communicate my opinion of its merits. I found that it acted precisely like methyl-orange, in being unaffected by free carbonic, hydrosulphuric and boric acids; in indicating the same neutral point in the titration of various salts with acid, such as the sulphites and phosphates; and in being valueless as an indicator for organic acids. In common with methyl-orange, dimethylamidoazobenzene is unable to detect acidity in presence of nitrous acid or a nitrite, a peculiarity which, among all the indicators I have yet examined, belongs only to those two. It must be acknowledged, as has already been advocated by Lunge, that the end-reaction obtained with methyl-orange is not inferior, but if anything superior, to that of Fischer and Philipp's indicator. In its own department, methyl-orange remains unrivalled as a solution indicator; and its best substitute, when darkness of colour or other circumstances renders this necessary, is lacmoid paper.

Congo-Red.

This compound is soluble in water with production of a solution of blood-red colour, which is changed to blue by the addition of acids. Red paper can be prepared by passing slips of filtering paper through the solution, and drying. Owing to the blue compound being nearly insoluble in water, the blue paper cannot be made by simply adding acid to the red solution, but must be obtained by immersing the dried red paper in dilute acid. Congo-red has been of late highly eulogised as a very delicate test for free acids, and since completing my experiments, I have noticed that it has been directly recommended as an indicator in alkalimetry, with special application to the titration of aniline.

The same ground was gone over as with turmeric and the other indicators, but I do not propose to go into great detail, as the results were discouraging. It was found that in titrating a cold solution of the carbonate or sulphide of an alkali metal with acid, the liberated carbonic or hydrosulphuric acid somewhat affected the colour, slightly purpling the red. In a boiling solution a considerable excess of acid did not effect any decided change in colour. Even in a cold solution containing 2grms. of hydrate of sodium in 100cc. of water, where traces only of carbonate were present, the effect of a drop in excess of normal sulphuric acid was simply to render the bright red of a dirty brownish-red colour, which is a very undesirable end-reaction. On further addition the solution became purple, and the full blue colour did not appear after the addition of 1cc. of the acid in excess, an effect which was produced by 0·2cc. in pure water coloured with the same amount of Congo-red. This injurious effect was traced to the normal sulphate of sodium formed, and the same phenomenon was observed when normal acid was dropped into pure solutions of the sulphates, chlorides and nitrates of sodium, potassium and ammonium.

The Congo-red paper was found to be of little value, as a considerable excess of free acid was very slow in its action, and the change to blue was not at all decisive. The blue paper indicates more sharply, but shows a tendency to redden even when there is a trace of acid present with the normal alkaline salt, and the exact point at which neutrality was reached was thus rendered doubtful. Congo-red behaves like methyl-orange and lacmoid paper in showing bisulphites, diacid phosphates and bichromates to be practically neutral, and being altogether useless for organic acids. But at its best it lacks the sharpness characteristic of methyl-orange and lacmoid paper, and the only conclusion which can be arrived at is that Congo-red must be excluded from the list of generally useful indicators.

I have already noticed the fact that Congo-red has been much recommended as a very delicate indicator for free acids. A vague statement like this is of little use, as the possession of the property described is the primary claim of any substance to be regarded as an indicator. The information really required is a comparison of its power with that of other indicators. I formerly gave results, showing the amount of acid or alkali required to completely transform the colour of definite quantities of these substances. For each test I used 100cc. of pure water and 0·5cc. of the indicator solution, the strength of which was so arranged that each gave, as nearly as could be judged by the different tints, the same intensity of colour. The quantity of pure dry Congo-red was 0·5grm. per litre, and 0·5cc. of this solution required fully 1cc. of decinormal acid to change the colour entirely. To effect the same result litmus and methyl-orange required 0·5cc., and for lacmoid, reddened phenolphthalein and cochineal, only 0·1cc. of the acid were required. Instead of being one of the most delicate tests for acids these experiments exhibit Congo-red as the lowest in the scale as regards sensitiveness. Carrying inquiry further, it was found that in a mixture of 12 parts normal acetate of sodium and one part of glacial acetic acid, free acid could not be detected at all with Congo-red. This last fact reduces to an absurdity the unqualified statement we have been considering, and clearly proves that the ability of any indicator to detect free acid is wholly dependent on circumstances.

Congo-red has been recommended by Messrs. Williams and Watson Smith (*Jour. Soc. Chem. Ind.* v. 72—75) as a good indicator for the detection of free acid in alum; but I have not been so fortunate as to be satisfied with its capabilities in this respect. For the experiments, 1, 2, and 3 per cent. solutions of the finest Turkey-red alum, five times recrystallised, and a Congo-red solution, containing 0·5grm. of the dry substance per litre, were prepared. On testing 100cc. of these alum solutions, it was observed that the first two drops of the indicator solution added did not produce much colouration, and that 0·15cc. was the smallest practicable amount that could be employed. The colour thus developed showed distinctly purple when compared with the same amount of Congo-red in pure water. Now, this result disagrees with the opinions expressed by Messrs. Williams and Watson Smith, who agree in saying that pure alum gives no reaction with Congo-red, if the latter be dilute enough. However, going a step further, it was found that with the 1 per cent. solution of alum, an addition of 0·2cc. of $\frac{N}{5}$ sulphuric acid produced only an almost imperceptible darkening of the purple, and that a large excess of acid failed to bring out the expected full blue colour. The tints of the 2 and 3 per cent. solutions of alum were even more difficult to judge. In the face of these results, which are quite in keeping with those already described, I think we must accept the conclusion without the least hesitation, that congo red is incapable of detecting with anything approaching to a certainty 0·2 per cent., or even of giving a trustworthy indication of the presence of 0·5 per cent. of free sulphuric acid in alum. I have not yet had opportunity to examine this subject further than to observe that methyl-orange is superior to Congo-red, and that lacmoid is useless.

Classification of Indicators.

The definite difference shown by various indicators, and the similar results afforded by others, point to the conclusion that it might be possible to classify them according to their general characteristics. In the determination of pure hydrate of sodium, potassium, calcium, and barium, with standard hydrochloric and other strong mineral acids, all indicators act alike; but it is in the titration of a weak acid with a strong base that diversity of behaviour makes itself apparent. Take, for example, the neutralisation of sulphurous acid with caustic soda. Methyl-orange shows the acid sulphite ($NaHSO_3$) to be neutral, while phenolphthalein remains unaffected until the normal sulphite (Na_2SO_3) is produced. The end-reaction with litmus paper lies between these extremes, although nearer to the phenolphthalein result, but it is not sharply defined like the other two. These essential differences are also observed in the neutralisation of the normal carbonates, sulphides, phosphates, arsenates, and other salts, as well as the organic acids. Basing our classification on these and similar facts, we find that indicators naturally divide themselves into three groups, of which the typical and most valuable members are repectively methyl-orange, phenolphthalein, and litmus. The following table includes the ten indicators I have experimented upon, arranged according to the plan just explained:—

Methyl-orange Group.	Phenolphthalein Group.	Litmus Group.
Methyl-orange	Phenolphthalein	Litmus
Lacmoid	Turmeric	Rosolic Acid
Dimethylamidoazobenzene	—	Phenacetolin
Cochineal	—	—
Congo Red	—	—

The members of the methyl-orange group may be described as those which are most susceptible to the action of alkalis; phenolphthalein, and turmeric, as those on which acids have the predominating influence; while the litmus group may be said to oscillate to some extent between these extremes, but more closely approximating to the second than to the first series. These distinctions must not be confounded with the delicacy of end-reaction, which is a totally different matter. When this arrangement of indicators is considered, it will appear that a solution might at the same time be alkaline, acid, and neutral, according to the indicator employed. An apt illustration of this fact may be remarked in saliva, which is on an average neutral to litmus paper, although it may be slightly acid or alkaline in certain circumstances, but is always strongly alkaline to lacmoid or Congo-red, and acid to turmeric paper. Fresh milk is another apposite example of a naturally occurring liquid which acts like saliva in the instances referred to.

The rules of classification here adopted are, like all general rules, liable to exceptions. Besides what may be called the anticipated similarity of behaviour of indicators belonging to different groups, as in these cases already alluded to, certain circumstances may arise in which this likeness unexpectedly manifests itself. This is well brought out by rosolic acid giving a sharp end-reaction in the titration of sulphurous acid with caustic alkali, and at the same time indicating normal sulphite as the neutral compound. In this exceptional case rosolic acid belongs strictly to the phenolphthalein group, while litmus and phenacetolin adhere to the general rule.

Purity of Indicators.

Reference has been occasionally made in chemical journals to the inefficiency of impure indicators, and methods suggested by which to test the purity of certain of these substances. It may be laid down as a fixed rule that litmus and turmeric should never be prepared by simply dissolving the commercial articles in water or alcohol, but should be previously purified according to the directions in Sutton's "Volumetric Analysis." With regard to methyl-orange, phenolphthalein, lacmoid, etc., it serves little purpose to determine whether they are of absolute chemical purity. All that is necessary is to observe whether their behaviour conforms to the descriptions given in this and former papers, and which have been confirmed by Lunge, Sutton, and other observers. It would thus appear that the most rational method of testing indicators is to apply them in several crucial tests, such as the titration of carbonate, sulphide, sulphite, phosphate, and borate of sodium, and acetic and citric acids. Not only must the delicacy or otherwise of the end-reaction be attended to, but also the percentage of alkali or acid obtained in these compounds. In all tests the temperature of the titrated solution should be taken into account, as, for example, the sulphite and mono-acid phosphate of sodium or potassium show more alkalinity to phenolphthalein in hot than in cold solutions, and in the latter case only is the end-reaction definite.

SELECT INDICATORS.

Although it is desirable to be acquainted with the properties of many indicators, yet it is useful to make a judicious choice of those which cannot be dispensed with in volumetric analysis. Of the ten indicators which we have been considering, the three representative ones are of primary importance. So far as the results of my experiments show, all the good and serviceable qualities required of indicators are held in comparatively greater perfection by methyl-orange, phenolphthalein, and litmus, than by the other seven. The only exception to this is in the neutralisation of sulphurous acid to normal sulphite of ammonium by the aid of rosolic acid, for which purpose all the remaining indicators are valueless. Litmus is the only one of those selected from which satisfactory papers can be prepared, and the advantage of having these as well as solution cannot be doubted. In nearly every particular, lacmoid paper, blue and red, is an excellent substitute for methyl-orange, and may be employed in coloured solutions, where the last-named indicator would be useless. The solution, however, is not so good, as it is slightly affected by weak acids, such as carbonic and boric, but the papers I find to be quite as effective as methyl-orange in these and similar cases. Turmeric papers, yellow and red brown, may be used in place of phenolphthalein, chiefly in the titration of weak organic acids; but there are many circumstances, as already pointed out, in which it is inadmissible. Provided with methyl-orange, phenolphthalein, and litmus, and with the addition of lacmoid and turmeric papers as valuable adjuncts, a chemist is now in a position, by simple means, to solve problems which were formerly incapable of solution.

This subject of indicators is an entirely new one, and although some interesting and useful facts have been discovered, infinitely more remains to be done in the way of developing the knowledge of those indicators already partially studied, and in the examination of others whose properties have not yet been investigated, or have only received the most superficial attention.

In the following table is given an epitome of the results obtained with indicators, and on which several processes have been based. The figures refer to the number of atoms of hydrogen displaced by the monatomic metals—sodium or potassium, when presented to the acid in the form of hydrate. From these results the composition of the salt produced will be easily inferred. When a blank is left, it is meant that the end-reaction is obscure, and not to be depended upon.

TABLE SHOWING THE BASICITY OF ACIDS WITH DIFFERENT INDICATORS, WHEN TITRATED WITH CAUSTIC POTASH OR SODA:—

ACIDS.	METHYL-ORANGE.	PHENOL-PHTHALEIN.		LITMUS.	
	Cold.	Cold.	Boiling.	Cold.	Boiling.
Sulphuric H_2SO_4	2	2	2	2	2
Hydrochloric HCl....	1	1	1	1	1
Nitric HNO_3..........	1	1	1	1	1
Thiosulphuric $H_2S_2O_3$	2	2	2	2	2
Carbonic H_2CO_3......	0	1 (dilute)	0	—	0
Sulphurous H_2SO_3 ..	1	2	—	—	—
Hydrosulphuric H_2S	0	1 (dilute)	0	—	0
Phosphoric H_3PO_4....	1	2	—	—	—
Arsenic H_3AsO_4......	1	2	—	—	—
Arsenious $HAsO_2$ ...	0	—	—	0	0
Nitrous HNO_2	indicator destroyed	1	—	1	—
Silicic H_4SiO_4	0	—	—	0	0
Boric H_3BO_3..........	0	—	—	—	—
Chromic H_2CrO_4	1	2	2	—	—
Oxalic $H_2C_2O_4$........	—	2	2	2	2
Acetic $HC_2H_3O_2$......	—	1	—	1 (nearly)	—
Butyric $HC_4H_7O_2$	—	1	—	1 (do.)	—
Succinic $H_2C_4H_4O_4$ ..	—	2	—	2 (do.	—
Lactic $HC_3H_5O_3$......	—	1	—	1	—
Tartaric $H_2C_4H_4O_6$ ..	—	2	—	2	—
Citric $H_3C_6H_5O_7$	—	3	—	—	—

Notes to Table.—(1.) The statements in the above table apply equally well to the titration of the various acids with ammonia, except in all cases where phenolphthalein is concerned, and when boiling solutions are employed. (2.) The hydrates of barium and calcium also give similar results with these acids, except in some cases where insoluble compounds are produced. Thus, carbonic acid is dibasic when titrated with barium hydrate with phenolphthalein as indicator. (3.) *Lacmoid paper* can be depended upon to act in every respect like methyl-orange, except that it is not affected by nitrous acid. (4.) *Turmeric paper* behaves like phenolphthalein with sulphuric, hydrochloric, nitric, thiosulphuric, nitrous, and the organic acids.

In the table below are brought together a few compounds whose action towards indicators could

TABLE OF COMPOUNDS NEUTRAL TO VARIOUS INDICATORS.

METHYL-ORANGE OR LACMOID PAPER.	PHENOLPHTHALEIN OR TURMERIC PAPER.	LITMUS SOLUTION OR PAPER.
Ferrous Sulphate	—	—
Ferrous Chloride	—	—
Copper Sulphate ($CuSO_4$)	—	—
Copper Chloride ($CuCl_2$)	—	—
Zinc Sulphate	—	—
Phenol	—	Phenol
Urea	Urea	Urea
Gelatin	Gelatin	Gelatin

not be deduced from the previous table. Those substances whose names are given are neutral to the indicator under which they are arranged, and those which are mentioned under methyl-orange and lacmoid, but otherwise unnoticed, are more or less acid to phenolphthalein, turmeric, and litmus.

DISCUSSION.

Mr. **Ellis** rose to ask Mr. Thomson if he had found a good indicator for boracic acid, as he had worked with several of the indicators mentioned without obtaining satisfactory results?

Dr. **Mills** ventured to suggest, as regarded the acidity of alum, the desirability of making an experiment with the addition of common salt; taking pure alum solution, and then making up similar solutions containing greater quantities of acid. He believed that common salt would cause a sharper response to the indicator.

Mr. **Stanford** thought all chemists would be indebted to Mr. Thomson for the remarkable way in which he had put the relative powers of the various indicators. There was one point, however, upon which he sought a little further information—namely, with regard to the indicator lacmoid. He gathered from Mr. Thomson's remarks that the paper and the solution differed considerably in their action, and he would like, therefore, to know more about that difference, and also how the substance was usually prepared for use in analysis.

Mr. **Thomson**, in reply, said that with regard to Mr. Ellis's question, there was no indicator, so far as he knew, that could be used in the estimation of boric acid. To methyl-orange boric acid was neutral, but after trying all the other indicators he had found none of them gave a good end-reaction or reliable results. Poirrier's blue had been said to give good results with that acid, but he had seen its value in other respects contradicted by other chemists, and was afraid that it would not be up to the mark; in the meantime there was no indicator known for that purpose. Professor Mills' idea might be a correct one, although it would require to be tested by experiment. With regard to Mr. Stanford's question about lacmoid, he was unable to tell why there should be a difference between the paper and the solution. In the case of the neutralisation of carbonate of sodium, with the solution present it was found that the liberated carbonic acid had a slight purpling effect on the blue. If the paper was inserted in such a solution the blue was sometimes faintly reddened, but when removed from the liquid was found to come back again. With mono-acid sodium phosphates, the purple came on long before the end of the reaction was reached, but the paper showed the exact point at which the diacid salt was formed. The action of the paper was slow, probably because the blue being very insoluble, adhered strongly to the fibre of the paper, and could not thus be quickly changed in colour. It had to be kept immersed for a minute or so. Only a small slip of paper was used. The method of preparing lacmoid was given by Traub and Hock as follows: 100 parts of resorcin, 5 parts sodium nitrite, and 5 parts water are heated at a temperature not exceeding 120° C. until ammonia ceased to be evolved. This mass is dissolved in water, and forms an intense blue solution. By adding hydrochloric acid the lacmoid is precipitated. It is only necessary then to collect it, wash with water, and dissolve in alcohol of about fifty per cent. strength.

THE MANUFACTURE OF GAS FROM PARAFFIN OIL, WITH A DESCRIPTION OF A SIMPLE FORM OF APPARATUS SUITABLE FOR THE DISTILLATION OF OILS INTO GAS.

BY W. IVISON MACADAM, F.I.C., F.C.S.,

Professor of Chemistry, New Veterinary College, Edinburgh.

The subject that I have the honour of laying before you this evening is one to which, from time to time, we have been called upon to give professional attention. The facts thus obtained have been added to by a series of experiments undertaken during the present session, and the results of which are now laid before the Section, in the hope that they may aid the general fund of information which will require, sooner or later, to be much extended.

Various grades of oil have been destructively distilled, the temperature being carefully regulated according to the class of oil experimented with.

The first series of trials were made with—

1. *Crude Paraffin Oil* as obtained from the shale retorts and without any further treatment. The sample had a specific gravity of 850 (water 1000); a flashing point of 92° F.; and a firing point of 106° F.

2. "*Green Oil*," which is obtained from the crude shale oil by redistilling. The sample had also had the lighter oils (naphthas) removed by fractional distillation: specific gravity, 884; flashing point, 165° F.; and firing point, 193° F.

3. "*Twice-run Oil.*"—This oil is obtained from the crude oil by distilling (the naphthas not being removed), treating with soda and vitriol, and redistilling without fractionating. The sample had a specific gravity of 802·30; a flashing point of 67° F.; and a firing point of 74° F.

4. "*Burning Oil*" obtained from the previous sample by re-treating with soda and vitriol, and distilling in fractions. The sample had a specific gravity of 805.

5. "*Crystal Oil*" obtained from the burning oil by re-treatment with strong oil of vitriol: specific gravity, 798; flashing point, 107° F.; firing point, 123° F.

6. "*Petroleum.*"—This was a sample of ordinary American oil; the specific gravity, 799; flashing point, 84° F.; firing point, 99° F.

7. *Rectified Coal Oil.*—Specific gravity, 844; flashing point, 212° F.; firing point, 230° F. This, and the preceding sample, were distilled, so as to compare the results with those obtained from the ordinary mineral oils.

8. "*No 2 Burning Oil*" obtained by breaking or "cracking" heavier oils: specific gravity, 830; flashing point, 230° F.; firing point, 250° F.

9. "*Intermediate*" *Oil.*—Specific gravity, 846; flashing point, 254° F.; firing point, 280° F.

10. "*Intermediate*" *Oil.*—Specific gravity, 868; flashing point, 203° F.; firing point, 262° F.

11. "*Intermediate*" *Oil.*—Specific gravity, 871; flashing point, 231° F.; firing point, 286° F.

(The above three samples of oil were "*unfinished.*")

12. "*Blue*" *or Lubricating Oil* from which the solid scale had been removed, the oil receiving no further treatment: specific gravity, 878; flashing point, 163° F.; firing point, 268° F.

13. "*Blue*" *Oil.*—Specific gravity, 868; flashing point, 270° F.; firing point, 335° F. This sample was specially fractionated from light oils.

14. *Light Lubricating Oil* freed from scale, treated and redistilled: specific gravity, 873; flashing point, 270° F.; firing point above 300° F.

15. *Heavy Lubricating Oils* freed from scale, treated and redistilled: specific gravity, 250; flashing and firing points above 300° F.

16. "*Gas Oil*" obtained from the acid paraffin tar by distillation: specific gravity, 828; flashing point, 119° F.; firing point, 134° F.

The crude paraffin oil and "green" oil, as well as the "blue" oils, were run in Keith's or Pintsch's apparatus, the remaining tests being made with the Alexander and Paterson apparatus, which I shall describe more fully towards the close of my communication. The averages of all the results obtained from "blue" oils in Keith's and Pintsch's apparatus are given in separate columns.

The results are stated as follows:—

1. *Specific gravity* of the oil taken at 60° F., or calculated down to that temperature, compared with water as 1000.

2. *Weight of one gallon of the oil* calculated from the specific gravity.

3. *The number of gallons of oil in one ton* by weight.

4. The temperature at which the oil *gave off inflammable vapours* — "flashing point."

5. The temperature at which the oil became *permanent inflamed* — "firing point."

6. The *amount* of gas in cubic feet obtained from *one gallon* of the oils.

7. The *proportion* of gas obtained from *one ton* of the oil.

8. The *candle power* of the gas, as determined by Bunsen's photometer. The gas was burned during the testings at the rate of 0·75 cubic foot per hour, and consumed through a No. 0000 burner specially constructed for me through the kindness of Mr. George Bray, of Leeds. The results were afterwards calculated to the value of 5 cubic feet of gas, and are stated in standard sperm candles, each consuming 120 grains of sperm per hour.

9. *Illuminating value of one cubic foot* of the gas in grains of sperm.

10. *Illuminating value* of the gas from one gallon of oil in lbs. of sperm.

11. *Illuminating value* of the gas obtained from one ton of the oil, in lbs. of sperm.

12. The proportion of *hydrocarbons* absorbed by bromine.

Summary of Results.—The results of the various tests as given in the accompanying tables show that—

1. *The Crude Oil* gave from one gallon 98¾ cubic feet of gas, which is equivalent to 26,026 cubic feet per ton of oil. The candle power was equal to 50¼ standard candles, or to 4494lb. of sperm per ton of oil. Some difficulty is experienced in working this class of oil, as it requires to be liquefied before being passed into the retort. The comparatively large proportion of carbon separated during the distillation renders it impossible to use the Alexander and Paterson apparatus, or any similar work in which the oil requires to flow through tubes. The gas is much more impure than is the case where the semi-refined or refined oils have been distilled, and it is a question whether these very crude oils will prove to be so economical as the purer varieties, and more especially the "intermediate" oils.

2. "*Green*" *Oil* gave from one gallon 102⅓ cubic feet of a gas of 53¼ candle power, and a total value in lighting power per ton equal to 4741lb. of sperm.

3. "*Twice-run Oil*" yielded 106 cubic feet of gas per gallon. The quality was equal to 70 candles, and to 7105lb. of sperm per ton. The total amount of gas obtained was 29,605 cubic feet per ton, and is the largest proportion of gas we have yet obtained from any oil.

4. "*Burning Oil*" also gives a high result, being equal to a total production of 27,484 cubic feet of a gas of 63 candle power, and of a total illuminating value of 5950lb. of sperm per ton.

5. "*Crystal Oil*" gave 29,928 cubic feet of a 54 candle gas, and a total illuminating value equal to 5538lb. of sperm per ton of oil.

6. *American* "*Petroleum.*"—This oil was most carefully tested time after time, but the quantity of gas obtained was always much below that of the ordinary "paraffins." Whilst this was the case, the illuminating value was above that of the home oils, being equal to 66 candles, or a total value per ton of oil of 5506lb. of sperm. The average quantity of gas from the ton of oil was 21,110 cubic feet. The difficulty of distillation may be due to the very different chemical composition of the American oil, and the lower temperature required to break up the paraffins which predominate in the American material as compared with the home oils, which contain an excess of the olefines.

7. *Rectified Coal Oil.*—The total amount of gas from this substance was 25,282 cubic feet per ton, and the illuminating power equal to 42½ candles. The total illuminating value was equal to 3689lb. of sperm per ton of oil.

8. *No. 2 Burning Oil* gave 27,171 feet of a 49¾ candle gas, and a total illuminating value equal to 4635lb. of sperm.

9. *Intermediate (Unfinished) Oil* of 846 gravity gave of gas 24,922 cubic feet. The illuminating power was equal to 60 candles, and the total value to 5139lb. of sperm.

10. *Intermediate (Unfinished) Oil* of 868 gravity yielded 24,383 cubic feet of a gas of 56¼ candle power. The illuminating value of the ton was equal to 4702lb. of sperm.

11. *Intermediate (Unfinished) Oil* (871 gravity) gave 24,396 cubic feet of gas. The candle power was 57½, and the total light-giving value equal to 4822lb. of sperm.

12. "*Blue*" *Oil* of 878 gravity yielded 32,492 cubic feet of gas, the power of which for illuminating purposes was equal to 54¼ candles, and to a total illuminating value of 6047lb. of sperm.

13. *868 Blue Oil* gave per ton 33,529 cubic feet of gas, the candle power of which was 54¾, and the total illuminating value 6295lb. of sperm.

14. *Light Lubricating Oil.*—This oil, when distilled, yielded 26,273 cubic feet of a gas of 61⅓ candle power, the total value being equal to 5521½lb. of sperm per ton of the oil.

15. *Heavy Lubricating Oil* yielded 23,653 cubic feet of a gas which was of 57¼ candle power, the total illuminating value per ton being equivalent to the consumption of 4643lb. of sperm candles.

16. "*Gas Oil*" from acid tar gave 25,963 cubic feet of a gas of 43⅓ candle power, and was equal in value to 3854lb. of sperm candles.

Whilst it is possible to employ all of those varieties of oil, yet it is principally those qualities *intermediate* between the burning and lubricating oils that we consider especially interesting. The somewhat large proportion of those oils which are obtained in some works, and the extremely limited demand in the market, has caused much concern to the paraffin oil companies. Various endeavours have been made to limit or altogether do away with the production of these oils, but with limited success. The manufacture of gas seems to me to be one solution of the difficulty, and the large proportion of material obtained, as well as the high candle power, is much in favour of the process. It is doubtful if the retorting of shale for the single purpose of manufacturing an oil for gas-making would prove commercially successful, as there is always a heavy loss of total illuminating value during the crude distillation, as well as in the purifying processes. As illustrating this point, a cannel coal was distilled for gas with the result that 12,208 cubic feet were obtained of 35·62 candle power. The total light-giving value was equal to 1490·91lb. of sperm. When distilled for oil the same coal gave 63·72 gallons of crude material per ton distilled, and taking the gas-making value at 100 cubic feet per gallon, we have 6372 cubic feet of gas per ton of coal. Against this, however, the candle power was raised to 50, but the total illuminating value was only equal to 1092·34lb. of sperm per ton of coal. Further, when the crude oil was rectified the following products were obtained: Naphtha, 1·44 gallons; burning intermediate oils, 22·39 gallons; lubricating oil, 14·87 gallons; and scale, 6·01 gallons per ton of shale; the total of the refined products being equal to 44·71 gallons, with an average specific gravity calculated at 836. Taking the possible gas produced at 100ft. per gallon of oil, we have a total of 4471 cubic feet of gas per ton of coal. The illuminating value of the gas would be about 55 candles, or a total illuminating value per ton of coal of 843lb. of sperm, in opposition to 1491lb. when the coal was distilled into gas direct. The objection to the above line of argument undoubtedly lies in the fact that a coal of the quality referred to would never be retorted for oil, and that the proper line would be to consider the relative values of shale and the products obtained therefrom. Here we have a new factor to take into account in the very large proportions of ash, and the consequent heavy carriage payable on useless material. I do not propose to enter into such a calculation, as I do not presume that it could be seriously thought possible to transmit shale for gas making purposes to any great distance, or that it will be to any great extent distilled for gas direct. The quantity of ash alone would, in many cases, render it impossible for a gas company to use a material which would leave so large an amount of substance—perfectly useless—to be removed from the works at considerable cost. Again, I say that it is in the use of the less valuable "intermediate" oils that the true province of gas oils will be found.

One other comparison may be given. It has been proved that when paraffin oil is consumed

PARAFFIN OIL INTO GAS.

	Crude Paraffin Oil.	Green Paraffin Oil.	Blue Paraffin Oil.		Rectified Coal Oil.	Twice-run Crude Paraffin Oil.
A.—Specific gravity of oil (water 1000) ..	850	884	878	868	841	802·39
Weight of 1 gallon of oil	8·51lb.	8·84lb.	8·78lb.	8·68lb.	8·41lb.	8·021lb.
Number of gallons of the oil in 1 ton	263·53	253·39	255·12	258·06	265·10	279·30
Flashing point..	92° F.	165° F.	163° F.	270° F.	212° F.	67° F.
Firing point	108° F.	193° F.	268° F.	335° F.	230° F.	71° F.
B.—One gallon of oil gives off gas	98·76c.ft.	102·52c.ft.	127·12c.ft.	129·93c.ft.	95·26c.ft	106c.ft.
Cubic feet of gas per ton of oil	26,026c.ft.	25,977c.ft.	32,192c.ft.	33,529c.ft.	25,282c.ft.	29,605c.ft.
C.—*Candle Power of Gas*—						
Five cubic feet are equal to	50·36cndls.	53·21	51·28	54·76	42·56	70·02
Illuminating value of 1 cubic foot in grains of sperm	1203·64grs.	1277·76grs.	1302·72grs.	1314·25grs.	1021·44grs.	1680grs.
Illuminatiog value of the gas from 1 gallon of oil in lbs. of sperm	17·052lb	18·713lb.	23·714lb.	24·391lb.	13·901lb.	25·44lb.
Illuminating value of the gas from 1 ton of oil in lbs. of sperm	4494lb.	4741lb.	6017lb.	6295lb.	3689lb.	7105lb.
D.—Heavy hydrocarbons *(absorbed by bromine)* ...	—	—	—	—	—	45·5

PARAFFIN BURNING OIL INTO GAS.

(Apparatus used, Alexander & Paterson.)

	"No. 1 Burning."	"Crystal Oil."	American Petroleum.
A.—Specific gravity of the oil	845	798·67	799·27
Weight of one gallon of the oil	8·45lb.	7·98lb.	7·99lb.
Number of gallons of the oil in one ton	271·84	280·70	280·35
Flashing point	—	107° F.	84° F.
Firing point	—	123° F.	99° F.
B.—One gallon of the oil gives of gas	100c.ft.	106·62c.ft.	86c.ft.
Cubic feet of gas per ton of oil.............. ...	27,184c.ft.	29,928c.ft.	24,110c.ft.
C.—*Candle Power of Gas*—			
Five cubic feet are equal to	63·14 candles	54	66·66
Illuminating value of one cubic foot in grains of sperm..................	1515·60 grains	1296 grains	1599 grains
Illuminating value of the gas from one gallon of oil in lbs. of sperm	21·65lb.	19·73lb.	19·64lb.
Illuminating value of the gas from one ton of oil in lbs. of sperm...	5906lb.	5538lb.	5506lb.
D.—Heavy hydrocarbons............................	36·82	28·52	37·18
Specific gravity of the gas	690	—	—

LUBRICATING PARAFFIN OIL INTO GAS.

(Apparatus used, Alexander & Paterson.)

	Light Lubricating Oil without Scale.	Heavy Lubricating Oil free from Scale.
A.—Specific gravity of oil (water 1000)	872·94	894·30
Weight of one gallon of the oil	8·73lb.	8·94lb.
Number of gallons of oil per ton	256·58	250·56
Flashing point	270° F.	above 300° F.
Firing point	above 300° F.	—
B.—One gallon of the oil gives of gas	102·4c.ft.	94·4c.ft.
Cubic feet of gas per ton of oil....................	26,273c.ft.	23,653c.ft.

	Light Lubricating Oil without Scale.	Heavy Lubricating Oil free from Scale.
C.—*Candle Power of Gas*—		
Five cubic feet are equal to	61·32 candles	57·26 candles
Illuminating value of 1 cubic foot in grains of sperm	1471grs.	1374grs.
Illuminating value of the gas from 1 gallon of oil in lbs. of sperm	21·52lb.	18·53lb.
Illuminating value of the gas from 1 ton of oil in lbs. of sperm..................	5521½lb.	4643lb.
D. — Heavy hydrocarbons (absorbed by bromine)	34 per cent.	30 per cent.

"INTERMEDIATE" PARAFFIN OIL INTO GAS.

(Apparatus used, Alexander & Paterson.)

	No. 2 Burning Oil.	"Unfinished 840."	"Unfinished 870."	"Dark 870."
A.—Specific gravity of the oil (water 1000)	830	846·21	868·68	870·89
Weight of one gallon of the oil	8·30lb.	8·462lb.	8·686lb.	8·708lb.
Number of gallons of oil per ton	270	264·71	257·86	257·21
Flashing point	230° F.	254° F.	203° F.	231° F.
Firing point	250° F.	280° F.	262° F.	286° F.
B.—One gallon of the oil gives of gas	100·68c.ft.	94·15c.ft.	94·56c.ft.	94·85c.ft.
Cubic feet of gas per ton of oil	27,171c.ft.	24,922c.ft.	24,383c.ft.	24,396c.ft.
C.—*Candle Power of Gas*—				
Five cubic feet are equal to	49·76 candles	60·15 candles	56·25 candles	57·65 candles
Illuminating value of one cubic foot in grains of sperm	1194grs.	1443·60grs.	1350grs.	1383·60grs.
Illuminating value of the gas from one gallon of oil in lbs. of sperm....	17·17lb.	19·416lb.	18·237lb.	18·748lb.
Illuminating value of the gas from one ton of oil in lbs. of sperm	4635lb.	5139lb.	4702lb.	4822lb.
D.—Heavy hydrocarbons........................	—	37·5 „	35·5%	35·9%

PARAFFIN ACID-TAR OIL INTO GAS.

(Apparatus used, Alexander & Paterson.)

A.—Specific gravity of the oil (water 1000)	828·25
Weight of one gallon of the oil	8·28lb.
Number of gallons of oil per ton	270·119
Flashing point..............................	119° F.
Firing point................................	134° F.
B.—One gallon of oil yields of gas..............	96c.ft.
Cubic feet of gas per ton	25,963c.ft.

C.—*Candle Power of Gas*—	
Five cubic feet are equal to	43·32 candles.
Illuminating value of one cubic foot in grains of sperm.............. ...	1039·68 grains.
Illuminating value of one gallon of oil in lbs. of sperm	14·25lb.
Illuminating value of one ton of oil in lbs. of sperm	3853·89lb.
D.—Heavy hydrocarbons	25·26%
Carbonic Anhydride	0·04%

PARAFFIN OIL INTO GAS.

	Average of Trials with Keith's Apparatus.	Average of Trials with Pintsch's Apparatus.
Specific gravity of the Oil....	875·89	877·91
Weight of one gallon of the oil	8·758lb.	8·779lb.
Number of gallons per ton of oil	255·76	255·15
Flashing point	289° F.	295° F.
Firing point..................	317° F.	351° F.
Gas from one gallon of oil ..	84·93c.ft.	97·03c.ft.
„ „ „ ton of oil	21,720c.ft.	24,757c.ft.
Candle power of gas	61·38 candles.	60·82 candles.

	Average of Trials with Keith's Apparatus.	Average of Trials with Pintsch's Apparatus.
Illuminating value of 1 cubic foot in grains of sperm	1473grs.	1459grs.
Illuminating value of 1 gallon in lbs. of sperm	17·876lb.	20·198lb.
Illuminating value of 1 ton in lbs. of sperm	4570lb.	5160lb.
Heavy hydrocarbons absorbed by bromine	39·05	38·20
Carbonic anhydride	0·27	0·08
Dihydric sulphide	Decided.	None.

in lamps *as oil*, there is no difficulty in obtaining from the material a light equal to 27lb. of sperm per gallon of oil. Now the total value of one gallon of oil after distillation into gas is only 21·65lb., and there is therefore a loss equal to nearly 5·5lb. of sperm per gallon of oil. Doubtless, this may be improved on, but in the meantime we are again driven to the use of the cheaper "intermediate" oils—bodies too heavy for consumption in lamps, and too thin in "body" for lubricating purposes.

In conclusion, I should desire to describe the apparatus employed to obtain the foregoing results. It is the invention of Mr. Paterson, of Messrs. Alexander & Paterson, gasfitters, of Kirkintilloch. The retort is of cast-iron, and has the oil introduced into it by means of pipes carried through the retorts from the front to near the back. During its passage through these pipes the oil becomes vapourised, and is broken up by its after-contact with the heated sides of the retort in its return passage to the outlet, which is placed in the front part of the apparatus. The gas is afterwards cooled in upright pipes, and, if necessary, may be passed through the ordinary dry purifiers, and stored for use. The permanency of the gas has been frequently tested by myself, and proved to be excellent, and quite equal to any ordinary coal-gas. One great advantage the apparatus possesses is its extreme simplicity and non-liability to get out of order. Once started, it works away, and with an occasional glance at the heating apparatus, may be continued without trouble for any desired period. My own gas-works will manufacture about 80 cubic feet of gas per hour; but, of course, the retorts may be greatly enlarged or increased in number, according to the consumption and production required.

DISCUSSION.

Dr. **Wallace** asked whether Mr. Macadam had tried ordinary crude oil from blast-furnace tar, without any kind of rectification. He had made a trial of this himself, but did not get very promising results. In the first place, it gave a pretty large amount of tar in the condenser—somewhere about one-third of the oil itself; and there was, moreover, a tendency to choke up the pipes, and also to deposit carbon in the retorts. If this oil could be used for the manufacture of gas—being the cheapest oil in the market—it would be of great consequence, because it might be used in conjunction with splint and common coals for the manufacture of gas of medium illuminating power, say 22 to 26 candles. In referring to rectified coal oil, Mr. Macadam had not particularly mentioned what kind of coal oil this was—whether from blast furnace, or made in coking ovens. The whole subject was one of great importance, and was daily becoming of greater consequence, because our fields of cannel coal, especially of better class, were being rapidly wrought out; and some gas companies and corporations had thought it necessary to look before them, and even to reduce the quality of their gas, in anticipation of the difficulty they would experience by-and-bye of obtaining supplies of first, or even second-class coal. It was, therefore, a subject fraught with commercial interest, and the Section were indebted to Mr. Macadam for the able manner in which he had brought it before them.

Mr. **Foulis** was not prepared to say much on this subject, as it was one he was just beginning to study. He would like to know, however, the advantages which this new apparatus possessed over the other forms of apparatus, such as Pintsch's. He confessed that, at first sight, he did not like these small tubes, which, under Mr. Macadam's care, might not choke up; although, in the ordinary course of gas manufacture, he was afraid this would occur. There was no doubt whatever that the interior of the retort would become, in a very short time, coated with carbon. The whole process was one of decomposition of the oil; the carbon resulting from this decomposition would be deposited in the retort, and more especially deposited on the roof of the retort. It appeared to him, therefore, that these tubes, being fixtures, would render it very difficult to cleanse the retort out. These were, of course, points on which he might be mistaken. There was a further point to which he would refer, and perhaps Mr. Macadam's attention had been directed to it—namely, whether or not there was any advantage in using, in conjunction with the oil, a jet of steam, in order to carry forward into a more permanent form some of the oils that would otherwise be condensed from the gas. There was a very simple method of gas making adopted in America, which had this advantage, that it could be applied to the ordinary retort, and it could be removed at once, if so desired. It consists of a pipe closed in the front end attached to the door, and carried back to the near end of the retort, into which another pipe is inserted, closed at the inner end. The oil is blown by a jet of steam into this inner pipe, and is there converted into vapour, and, passing from this, it comes in contact with the retort, and the oil is decomposed. The great advantage of this was that the apparatus might be removed at once, the retort cleaned out or charged with coal. With regard to the permanency of the gas, it was well known that gas, even when compressed, if allowed to remain still, did not lose a very great deal of its illuminating power; but whether this gas would stand the test of passing through pipes in cold weather without losing illuminating power, was a point on which he would be glad if Mr. Macadam would give some information.

Professor **Mills** asked how long a retort of this description could be run without being stopped for cleaning out, and, further, the cost of making the gas? The temperature required for a retort of this kind was exceedingly high, as would be seen from the formation of naphthalene. The amount of coal used for the destructive distillation of the oil was certainly very high, and it would be interesting to know the amount of coal used, for, say 30,000 feet of this gas. As regarded the composition of the gas, he was glad to hear that Mr. Macadam had promised to give some analyses of these destructive distillations. If the gas could be dissected out, and the non-luminous constituents set recorded on one side, and the luminous constituents on the other, they would then be in a position to make a better comparison with coal gas than was the case at present.

Mr. W. R. W. **Smith** said he was greatly struck some five or six years ago, in passing through Germany, to find that a commercial friend of his had all his mill lighted with gas made from oil by means of a small apparatus about twenty feet in length. He was so much astonished some time ago at the low price of oil from the blast furnace, that he procured a sample and sent it to his friend. This led to a demand for one cask, then five casks, and his friend had now laid in his winter stock of this oil, with which he lighted his mill, but of which Mr. Macadam could make very little. It was evident, therefore, that here in Glasgow they were groping after a thing which was being carried out elsewhere, and he would be glad to place at Mr. Macadam's disposal the drawings of this apparatus.

Mr. **Macadam**, replying to Dr. Wallace, said he had not as yet got satisfactory results from crude blast-furnace tar. He did not think that the "Paterson" apparatus would give good results with such oils. The figures obtained had been as yet of no practical value, and had therefore not been included in the present communication. The rectified coal oil was obtained from the regular coke ovens. Dealing with Mr. Foulis's remarks, there was no doubt that the tubes (small or big) would at first sight appear to a practical man to be a drawback to the apparatus; at the same time he had worked with it for some months without any choking of the tubes. This was probably the best answer to the question. He attempted some days ago to retort colza oil, but partly from the high viscosity and the comparatively large amount of carbon in the oil, he had not obtained good results. He pointed out, however, that this was an apparatus for "intermediate" and "burning" oils, and not for crude oil or oils of great viscosity. As a matter of fact, the apparatus had been in the hands of practical men for months, and had been found to work with perfect ease. The workmen who were in charge were not skilled or specially-trained men, but in all cases the apparatus had given satisfaction. The tubes were scarcely fixtures. In the retort which he had used for coal-testing and oil-testing indiscriminately, the tubes were attached to the door of the retort, and could be removed with the door, so that no trouble was experienced in regard to that point. The quantity of carbon deposited was not so great as might be expected, and it was very seldom that the apparatus required to be cleaned out, but when such became necessary the door and tubes were easily removed. In the larger apparatus of the same makers the door was cast in two parts. To the upper part the tubes were attached. The lower portions of the door could be removed separately, and the retort cleaned out without interfering with the tubes. If heavy oils were worked, it might be necessary to clean the retort more frequently out. With the class of oils referred to (burning and intermediate) very little cleaning would be required. Touching on the use of a jet of steam, he did not include that method of working in this paper, although he had made experiments in that direction, and desired, if permitted, to lay the results before the Section at a future meeting. The apparatus, to yield good results with steam, would require to be somewhat changed, so as to allow of a longer period of contact between the oil and steam and the sides of the retort. In regard to the question of permanency, the gas had not only been retained for long periods over water, but had also been passed through lead pipes 100 feet in length, which was a very severe test. The temperature was below freezing point, and the gas was found to be, in proportion to its illuminating value, as permanent as ordinary Edinburgh gas. The tar contained a large proportion of naphthalene, but the proportion of tar was small. He could not say that there was a large proportion of naphthalene present in the gas. During the distillation of the tar from the Alexander and Paterson apparatus he got a considerable proportion of naphthalene. He was sorry he could not, on the moment, give the cost of 30,000 feet of gas. Of course much depended on the quality of oil to be distilled. From "intermediate" oils about 24,000 cubic feet of gas could be obtained from the ton of oil. Such oils could be bought at present at about 1½d. per gallon, which was equal to about 30s. per ton. The gas was of about 60 candle power, so that, roughly speaking, the ton of oil gave gas equal in illuminating value to about 72,000 cubic feet of 20 candle gas. The retorting was certainly not so costly as with coal, for it must be kept in mind that whilst the temperature of the retort was much the same as with coals, yet a great saving must take place in the cost of labour for charging and emptying of retorts, which operations practically ceased to exist when oil was used for gas making. The actual amount of coal should also be less for a given amount of heat, as there was no ash to raise in temperature, as was the case with coals. He was at present engaged in analysing the various gases, but as these results were of little practical interest they were not included in the present communication, excepting only the amount of absorption due to bromine, which was given in the tables, and which might be averaged at from 30 to 35 per cent. of the gas. American petroleum had proved difficult to distil into permanent gas. The proportion which had been obtained from it was less than with the home oils. No doubt this was due to the difference in the chemical composition of the body, there being in the petroleum more of the true paraffin and less of the olefine group, whilst in the home oils the olefines predominated. American petroleum required a distinctly lower temperature.

No. of Revolutions.	Time.	Sperm Oil.		Caspian Oils.				Spindle Oil (partly Sperm and partly Mineral Lubricating).	
			Increase.		Increase.		Increase.		Increase.
5,000	2½ minutes.	102½	12½°	105	15	132½	72½°	92½°	32½°
10,000	5 ,,	122½	62½	125	65	155	95	107½	47½
15,000	7½ ,,	135	75	135	75	165	105	117½	57½
20,000	10 ,,	141	81	140	80	167½	107½	121	61
25,000	12½ ,,	147½	87½	142½	82½	169	109	125	65

Mr. Macadam then exhibited Bailey's oil tester, and gave a brief description of it. The apparatus, he said, was largely employed to test the relative lubricating value of oils. The apparatus was constructed in such a way as to place the oils being tested in as nearly as possible the same condition as they would be in actual work. The machine was driven at 2000 revolutions per minute, and the temperature of the bearing-block was noted at so many different revolutions. The usual number of revolutions stated in the certificate of testing were 5000, 10,000, 15,000, and 25,000, and the temperature was noted at each of those points.

The above table gives the results of tests made with the apparatus—the temperature at starting being in all cases 60° F.

All tests for viscosity and lubricating value were comparative, but this apparatus gave constant and reliable relative results. After the above tests were made, if it was desired to subject the oils to a more severe, and at the same time practical, test, then the apparatus was allowed to remain for 24 hours, after which it was re-started without being further oiled or cleaned, when a set of results were obtained from which the liability of the oil to oxidise or "gum" could be determined.

ON LABORATORY FITTINGS.

BY JOHN GIBSON, PH.D.

About four years ago Professor Crum-Brown asked me to draw up detailed plans of fittings for the new chemical laboratories of the University of Edinburgh. In accordance with this request, I visited many of the principal laboratories in this country and on the Continent. I afterwards drew up plans of fittings which were approved of, in almost every detail, by Professor Crum-Brown and by the building committee.

In the following paper I have endeavoured to describe these fittings, which have been in use for some time back, in so far as they are novel or different from those generally to be found in the principal laboratories of the United Kingdom

I wish to acknowledge in the fullest manner my indebtedness to others for much invaluable suggestion. I desire especially to thank Sir Henry Roscoe, Professor Thorpe, Professor Fittig and Professor Pebal for the advice and help which I have received either directly or indirectly from them.

In the work of fitting up the new laboratories, Mr. Allan Clark, clerk of works to the University, has given constant and most valuable assistance.

There is no more fundamental requirement in a chemical laboratory, and, above all, in a laboratory designed for teaching purposes, than an efficient system of ventilation.

The problem which presents itself differs in one important respect from that presented by the ventilation of an ordinary hall or room, inasmuch as it is not sufficient merely to secure the removal of the impure air and its replacement by pure air of a suitable temperature. In a chemical laboratory it is generally desirable, and often absolutely necessary, to prevent the various fumes, which are evolved in the course of chemical work, from ever mixing with the bulk of the air in the laboratory. Although enormous improvements have been made in the construction and equipment of chemical laboratories in recent years, this problem still continues to offer special difficulties which have not, so far as I am aware, been overcome in a thoroughly satisfactory manner.

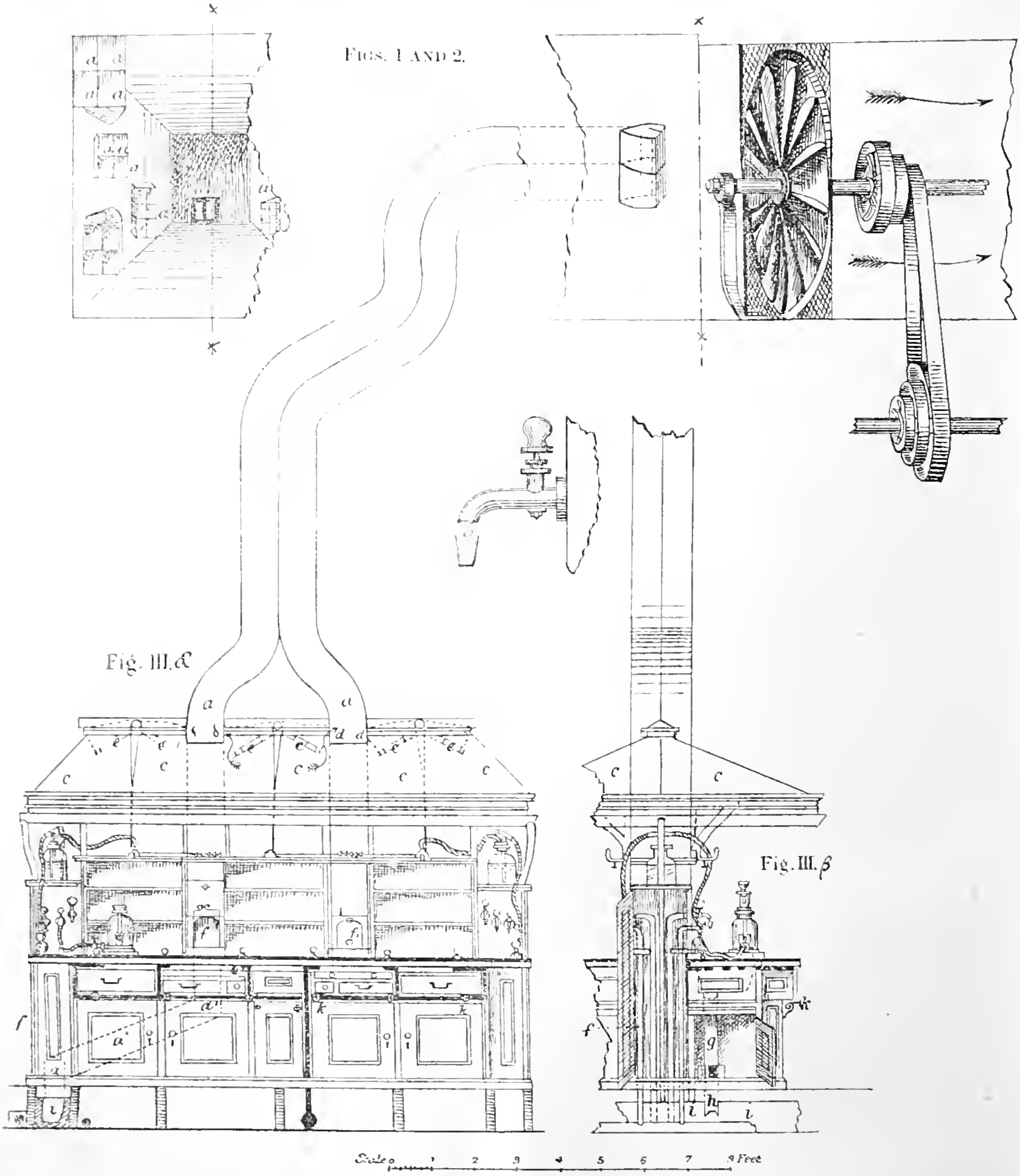
In most laboratories the usual means employed have been the erection of so-called draught cupboards for general use. A draught cupboard is most efficient as a means of preventing the admixture of the fumes evolved in it with the air in the laboratory, when *(cæteris paribus)* its dimensions are small; but a small draught cupboard is necessarily inconvenient, inasmuch as it cramps the operations of the worker, and is only available for small apparatus, or for a small portion of an extended arrangement of apparatus. In any case, a considerable number of them are necessary to meet even ordinary requirements. Larger draught cupboards, on the other hand, while more convenient in some respects, have their own peculiar disadvantages. They are always less efficient as a means of keeping the air of the laboratory pure, and when used, as they necessarily often are, by several workers at once, the greater freedom of operation is to a great extent lost; and further, when open vessels are being used, the fumes from one vessel are liable to affect the contents of the vessels near it.

A very simple and, at the same time efficient, plan, and one which has been adopted in some of the best of the Continental laboratories, is to connect each draught cupboard with a separate flue, in each of which a gas jet, or system of jets, is kept burning; the burners being either of the ordinary fish-tail kind or Bunsen burners. The jets should be situated at some distance above the bottom of the flue, an opening with a glass door opposite the jet or jets enabling one to see that the gas is burning properly, and to make any necessary repairs. Where the price of gas is low, this system presents many advantages. In the Owens College laboratory, for so long the best and most completely equipped in the United Kingdom, and in fact the only one which could be favourably compared with the great laboratories of the Continent, there is an excellent system of down draughts connected with and produced in one main central chimney. In Edinburgh it was originally intended to adopt a similar system, and the ordinary ventilation of the whole of the new University buildings is effected by a series of furnaces venting into an iron shaft which runs up the centre of a tall chimney stack, the draught flues leading into the annular space between the hot-iron shaft and the brickwork. The flues or down-shafts intended to carry off the fumes produced in the chemical laboratory lead into the central iron shaft.

From whatever cause, the draught supply, if I may use the term, available for the chemical laboratory proved altogether insufficient. It, therefore, became necessary to adopt a different system of fume extraction. This circumstance, although very annoying at the time, retarding, as it did, the opening of the new laboratories, is hardly to be regretted, for it has led to the adoption of a system in all probability far superior to anything which could have been economically attained on the above plan.

The draught is now produced by a Blackman air propeller four feet in diameter, and driven by a gas engine. The propeller or fan works at the open end of a wooden chamber (Figs. 1 and 2) 36ft. long, 5ft. across, and 5ft high. This chamber is situated immediately under the roof, and above the partition dividing the two main laboratories.

To this chamber up-shafts leading from the various places where a draught is required are conducted, and enter through the wooden sides of the chamber at different points on both sides, and also at the end opposite to the fan. The shafts, like the chamber, are constructed of deal boards, and in every case lead directly into the chamber, without intercommunication. Abrupt bends have been carefully avoided, and the end of each shaft leading into the chamber is in every case bent round, so that the mouth of the shaft faces the fan (Figs. 1 and 2, *a*, *a*). The velocity of the air drawn up is by these means rendered practically uniform in each of the shafts, and independent of the length of the shafts, or the position of their upper ends in the main chamber. The velocity of the current of air in each of them, depending as it does upon the rate at which the fan is driven, is perfectly under control, and is not appreciably affected by differences in the outside temperature, or by the direction and force of the wind. These are very great advantages which cannot, I believe, be attained by any non mechanical method. Whenever necessary, additional shafts can be run up in a day or two, and at small cost. The shafts are coated internally and externally with several layers of asbestos paint, and, in addition to this, are lined from their lower ends upwards to a height of about twenty feet with a coating of thin asbestos paper, which is caused to adhere to the painted wood by means of a solution of silicate of soda applied to both surfaces of the paper. This paper was subsequently washed with dilute hydrochloric acid, and finally, when dry, covered with a coat of asbestos paint. A piece of wood thus protected may be placed for any length of time over a powerful Argand burner, without giving the slightest sign of catching fire, provided, of course, that the flame does not come in contact with any unprotected wood. After a considerable time the wood is slowly and completely charred, the protecting coating remaining intact.



Figs. 1 and 2.

Fig. III. α

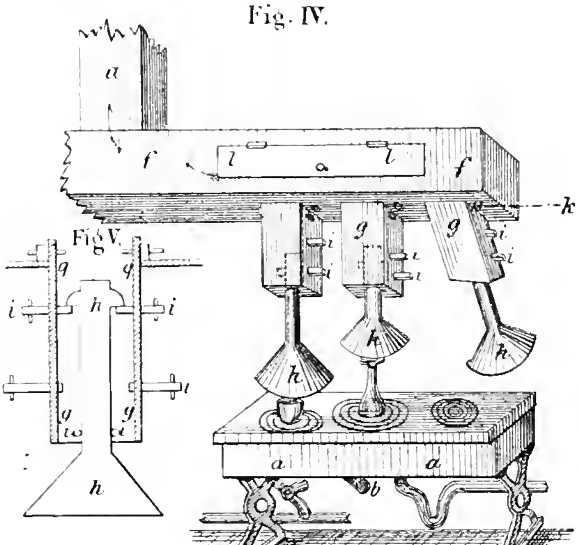
Fig. III. β

The great power of the draught thus produced has rendered it possible to dispense with draught cupboards almost entirely. The draught arrangements on the working tables are extremely simple, and may be readily understood by reference to Fig. 3. The draught shafts *a*, *a*, lead down through the ceiling of the laboratory and terminate at the top of the tables, at each working place. In each shaft there is an opening, *b*, *b*, Fig. 3, facing the worker, at a convenient height, and provided with a sliding shutter. If the worker wishes to perform any operation in which fumes are given off, he simply opens the shutter and places his apparatus opposite the opening, when the whole of the fumes are drawn up the shaft. It will be seen that the tables are further provided with glass hoods, *c*, *c*, Fig. 3. The object of these hoods is twofold. On the one hand they act as screens, preventing the fall of dust, and more especially of particles of lime or plaster from the roof, on to the tables and into the open vessels of the workers. On the other hand they collect and localise any fumes which are either accidentally or unavoidably produced at the several working tables. At the points *d*, *d*, Fig. 3, immediately below the top of the hood, there are two openings in each shaft, through which any fumes that may collect at the top of the hood are drawn away. Of course, if the air were allowed full and constant access to these upper openings, the lower draught tubes would be little or no use, as the draught through them would be almost entirely cut off. The wooden shutters, *e*, *e*, *e*, Fig. 3, swing on leather hinges, and can be opened at will to any desired extent. Being supported by cords in the manner shown in Fig. 3, they fall down by their own weight whenever the cords are slackened. In order to ensure their falling, the shutters are weighted with blocks of heavy hard wood, which have also made it possible to dispense with wheel pulleys, the cord being simply led through holes in the wood, as shown in the figure. Any arrangement of pulleys would be much more liable to get out of order, especially if made of metal, the use of which has been avoided in all the fittings as much as possible. In ordinary circumstances these shutters are left slightly open so as to permit of a slight current of air sufficient to carry off the small quantity of fumes, which are unavoidably produced during minor operations. Should, however, a large volume of fumes be on any occasion accidentally produced, the shutters can be instantly opened to the full extent, and the fumes, which collect under the hood of the table at which the accident has happened, are rapidly carried up the shaft without mixing with the atmosphere of the room generally, and thus leaving the workers at the other tables quite unaffected by them.

As a further means of keeping the air of the laboratory pure, communication is established between the draught shafts *a*, *a*, and the open gutters or waste pipes near the points where the sinks drain into them by means of the shafts, one of which, a^1 a^1, is indicated in broken lines in Fig. 3.

Another way of utilising the draught in connection with the steam-baths, is shown in Fig. 4. Each steam-bath consists simply of an iron box (*a*, *a*). The steam passes first through a long twisted coil of leaden pipe lying in the bottom of the box. The condensed water is run off at a point higher than the coil of pipe, so that the latter is completely immersed in the water. Every morning, before the laboratories are opened, steam is turned on by means of the tap *b*, and passing through the coil heats up the water, and is in part condensed in the coil, the remainder finally bubbling up through the water. As soon as the water is fairly boiling, the tap is nearly closed, so that while little or no steam escapes through the holes in the top of the bath, the whole arrangement is kept constantly at a temperature of very little below the boiling-point. If it is desired to use the bath, the tap is opened to any desired extent, the water then immediately begins to boil, and steam escapes from the holes at the top of the bath, and plays on the bottom of any vessel supported over them. This extremely convenient form of steam-bath was, I believe, first introduced into laboratories in Germany, by Dr. Hirzel, of Leipzig. The usual method of carrying off the fumes from such a steam-bath has been to build a draught cupboard over it, but, as I have before said, there is constant danger of the fumes from one vessel affecting the contents of the vessels near it. To obviate this and other difficulties, I have devised the arrangement shown in Fig. 4. Some four feet above the steam-bath is a wooden box or chamber *f*, *f*, communicating as shown in the figure with a draught shaft *a*, at a point not immediately above the steam-bath, but a little to one side. In the bottom of this chamber square holes are cut, through which the upper ends of the wooden frames *g*, *g*, *g* pass freely. These frames swing on pins resting on the bottom of the box. The wooden frames in turn support the stoneware funnels *h*, *h*, *h*. The upper ends of the necks of these funnels have projecting portions or ears which rest on the movable pegs *i*, *i*, working at different heights in the sides of the frames. The ears of the funnels slide up and down in grooves, so as to keep the funnels in position when being raised or lowered from one level to another. By these means the mouth of the funnel may be placed over a shallow basin, or raised so as to accommodate a tall-necked flask, as occasion requires. A continual current of air passes up through the funnels, carrying off the fumes from the vessels beneath them, so that the fumes from one vessel are entirely cut off from the neighbouring vessels. The funnels and frames can be swung back to the position shown at the right hand of Fig. 4, and may be held there by the wooden catch *k*. This enables the worker to perform conveniently any operation, such as filling up the vessel or stirring its contents without taking it away from the bath. The door *l*, *l*, swinging on leather hinges, gives access to the interior of the chamber, and permits of the frames and funnels being removed bodily by simply withdrawing the supporting pins on which they swing. No condensation takes place either in the funnels, the frames or the draught box, unless the draught is insufficient, or the steam is allowed to escape from the steam-bath much more freely than is necessary. Even in these cases condensation only takes place in winter, if the temperature of the laboratory be allowed to fall uncomfortably low. In any case the condensed drops do not fall into the evaporating vessel.

Fig. IV.



Figs. 6 and 7 give a front and bird's-eye view of an arrangement for supplying the laboratories with water at a high and constant pressure. The pressure at which the water is supplied by the street main is liable to daily and hourly variation, and is frequently cut off without warning, or does not rise to the level of the laboratories. In order to obviate the very great inconvenience and delay caused by this state of things, water is pumped up from a large low level cistern by the force pump *a*, *a*, driven by the same gas engine which drives the Blackman air propeller above mentioned. The water is pumped in at the bottom of the tank *b*, *b*, *b*, and, as it rises, compresses the air in the tank, forming an elastic air cushion. As soon as the pressure reaches a certain point, regulated by the position of the ball *c*, the conical valve *d* rises and shuts off the gridiron valve *e*, *e*, thus cutting off the water supply. In practice it has been found that the apparatus works much more smoothly if the gridiron valve be adjusted so as never to close entirely. There is thus a slight, but constant circulation of water from the cistern through the pump and tank and back to the cistern. The pipes *f*, *f* are the supply pipes to the laboratories. If a small quantity of water be drawn off, the elastic air cushion keeps the pressure practically constant, and gives, should more water be drawn off, the valves *d* and *e* time to act. The pressure at which the water leaves the tank is kept, in the Edinburgh University Laboratory, at twenty-five pounds to the square inch, but can easily be increased.

A hose is kept constantly attached to tank *b*, so that in case of fire a powerful stream of water can be immediately directed on almost any part of the new buildings. The general arrangements of the working tables, a front and side view of which are given in Fig. 3 (*a*, *β*), do not here require explanation, but there are some points in connection with these tables which are novel and may be briefly described.

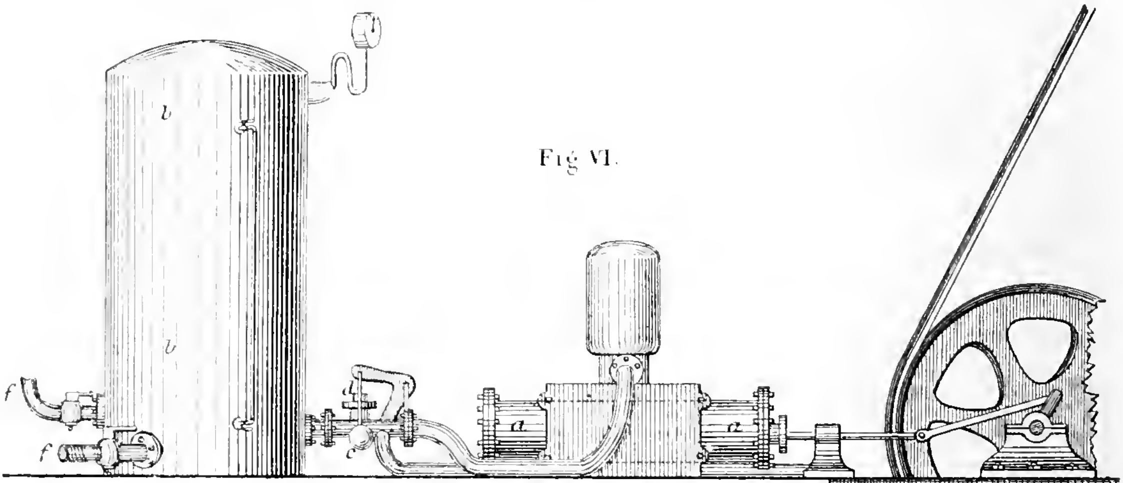


Fig VI.

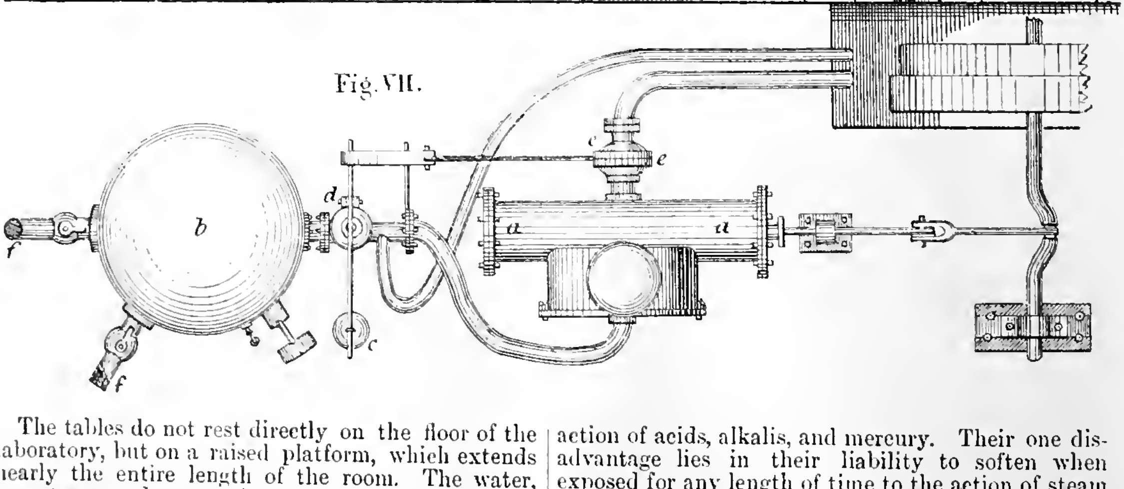


Fig. VII.

The tables do not rest directly on the floor of the laboratory, but on a raised platform, which extends nearly the entire length of the room. The water, gas, steam, and waste pipes run along the concrete floor beneath this platform. All these pipes can be laid bare at a moment's notice. The steam water and waste pipes are led along each end of the tables, and the two former pass up through the platform into the compartments *f*, *f*, *f*, which are rather projections from, than parts of, the tables themselves. These pipes are thus entirely shut off from the cupboards and drawers, etc., of the tables, and can be removed bodily without interfering with the tables in the slightest degree, and without opening a single drawer or cupboard. The porcelain sinks, of which there are four on each table—that is, one at the end of each working bench—rest loosely in holes cut in the table, and are therefore easily removed. Communication between each sink and the open waste pipe or gutter is effected by means of a short piece of stiff rubber hose or piping *g*, which passes at its upper extremity over the neck of the sink, while its lower extremity is inserted into the collar piece *h*, resting on the platform, and having its lower end hanging freely in the course of the gutter below. These collar pieces, the open gutters *i*, *i*, and the waste pipes to which these latter lead, are made of a composition of alternate layers of coarse brown paper and asphalte. Some of these pipes were brought from Germany, but Messrs. Barton & Sons, Edinburgh, have succeeded, without much difficulty, in manufacturing them. Pipes made of this material combine the advantages accruing from the use of lead or stoneware pipes, as they may be bent and jointed with the greatest facility, and resist the action of acids, alkalis, and mercury. Their one disadvantage lies in their liability to soften when exposed for any length of time to the action of steam or hot water. Hot water may be run down them at intervals without injury, but a constant flow of hot water or steam, or contact with a hot pipe, may lead in time to their collapse. In practice, however, by using the most ordinary precautions, such a contingency may be easily avoided, though, of course, it is certain to occur if these pipes are laid alongside of, or across, a hot pipe, or are used as a means of carrying off an escape of steam. By the arrangements described above, stoppages in the waste pipes are made almost impossible, and in any case repairs can be effected with a minimum of interference with the work of the laboratory.

With regard to the gas supply to the tables, it will be noticed by reference to Fig. 3. *a* and *b*, that while the nozzles are at the back of the tables underneath the reagent shelves, the wheel taps *k* are all at the front. In order to secure this very convenient arrangement, it was necessary that the cross pieces from the taps to the nozzles should pass through the woodwork, between and behind the drawers. With this exception the gas pipes are all easy of access. Fig. 8 gives a view of the gas, steam, and water supply to a stone table intended for combustions and similar operations. These arrangements for gas supply are very much the same as those adopted in the Chemical Laboratory of the University of Strasburg, from an inspection of which I have derived much most valuable suggestion. Fig. 10 shows a convenient arrangement of draught, gas, and steam supply to a small draught cupboard. It will be observed that there are no projecting nozzles or taps on the floor of the cupboard, these being all outside.

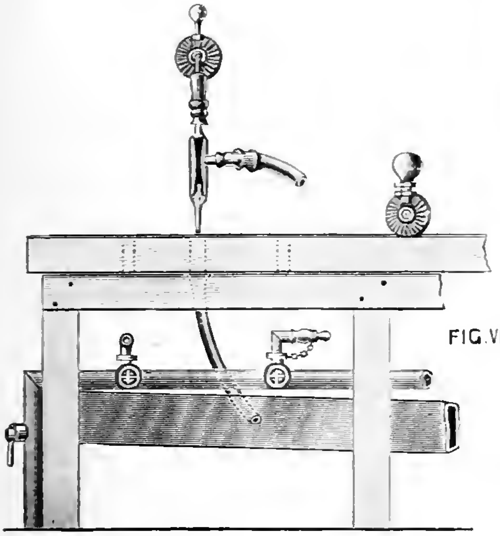


FIG. VIII

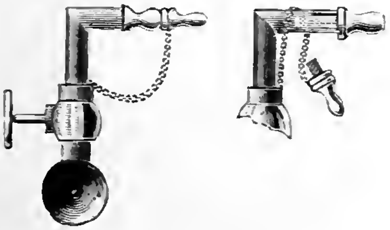


FIG. IX.

The very convenient form of small steam bath shown in this figure is made of copper, and provided with a set of porcelain rings. The steam flows in by *a*, and the condensed water running out by *b*, *b* and flowing through the small indiarubber tube is finally led into the small waste pipe *c*, *c*. This form of steam bath is described by the late Professor Pebal in his elaborate account of the Chemical Laboratories of the University at Gratz. Fig. 11 gives a view of another piece of apparatus also described by Professor Pebal, which has been found extremely useful. It is made of a peculiar light kind of porous clay, glazed on the outside. When in use it rests on an iron stand. On lighting an ordinary Bunsen burner beneath it the flame impinges upon the circular and unattached disc *m*, and not directly on the vessel which is to be heated. The heated gases are thus distributed very uniformly over the bottom of the vessel or flask. This apparatus answers all the purposes of a small sand bath, but is much

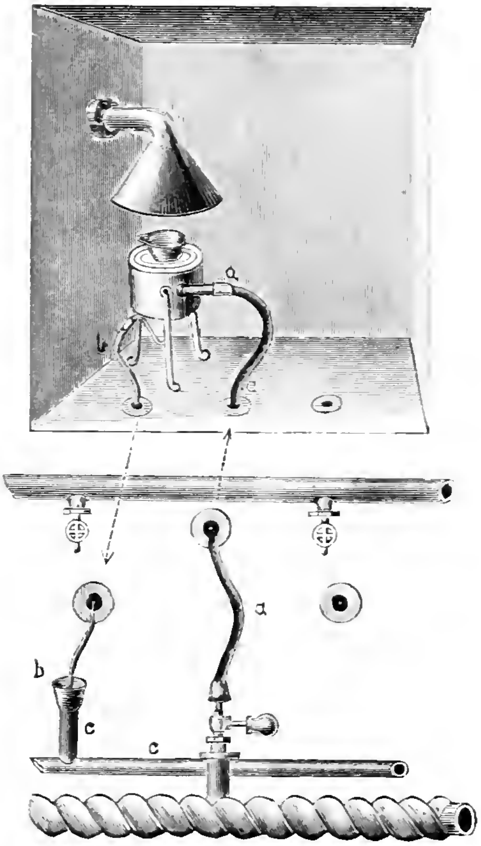


FIG. X.

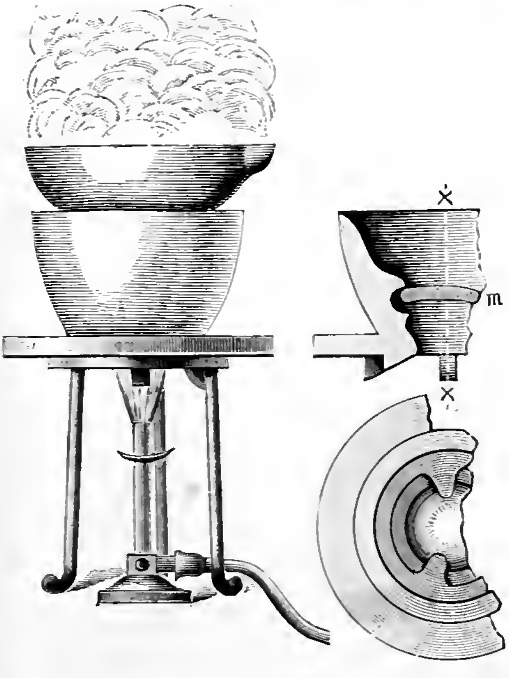


FIG. XI.

cleaner and more easily regulated. Solutions may be evaporated to dryness on it, even in glass vessels, without spirting and without cracking the glass.

Improved Filtering Apparatus.

This will be best understood by a reference to Figs. 12 and 13. The bell-jar A (Fig. 12) rests during filtration on a square block C, of hard wood, preferably Spanish mahogany, 25cm. square and 25mm. thick. The cross pieces *c*, *c* are of the same wood and prevent warping. Over C is laid a sheet of soft vulcanised rubber *d* of good quality, and not less than 3mm. thick. In the centre is a circular disc *e*, also of hard wood, 13cm. in diameter and about 20mm. thick, which is held in position by four strong brass screws, which pass down through the rubber into the square block below. In order to prevent air leaking through the holes thus made, they are rendered quite air-tight by embedding the screw heads, which are sunk slightly below the surface of *e*, in red lead, and by laying, previous to screwing down, layers of red lead on both sides of the rubber sheet. The red lead should not, however, spread beyond the disc *e* on either side of the rubber sheet, so that the latter lies quite free except where it is held down by the disc. In *b* is fitted a single bore rubber cork holding the brass tap *f*. This tap is simply an ordinary brass tap, converted into a three-way tap by boring a hole S through one outer wall and through one wall of the plug. It enables the operator to establish communication between—(1) The bell-jar and pump; (2) The outer air and both bell-jar and pump; (3) The outer air and pump, the bell-jar being shut off; (4) The outer air and bell-jar, the pump being shut off. After fitting in the cork and tap, the knee-piece *h* is screwed on. The object of this knee-piece will be explained later on. If the mouth *a* be closed by a rubber stopper, and the tap *f* connected by a rubber tube with a water-pump or other exhausting apparatus, as the pressure inside diminshes, the rubber sheet bulges up inside the bell-jar, and pressing against the lower edge, closes up any interstices due to irregularity on its own surface, or to imperfect grinding of the glass. A well-made water pump will give within half-an-hour a high degree of exhaustion, and this without the use of any lubricant whatever. Where a very high degree of exhaustion is required, the application of a little grease outside round the lower edge of the bell-jar is advisable. The apparatus in this form can, therefore, be used for drying substances in vacuo, etc. For the purpose of rapid filtration such complete exhaustion is not, as a rule, required. It is, indeed, often positively detrimental, and defeats the object in view. In practice the most convenient, though not the simplest mode of using the apparatus for filtration, is that shown by Fig. 13. The funnel is supported by a small conical rubber stopper *i* in the upper and enlarged end of the tube *k*, which is in turn supported at the mouth *a* of the bell-jar by the larger rubber stopper *l*. The hole in this stopper should be sufficiently wide to permit of the glass tube *k* sliding easily up and down in it. The lower end of the tube should be ground off at an angle and bent as shown in the figure. It is then easy to bring the end of the tube in contact with the side of the vessel in which it is desired to collect the filtrate, and thereby to entirely obviate any danger of loss by spirting.

All the essential parts of the apparatus have been now described, everything else which is required for

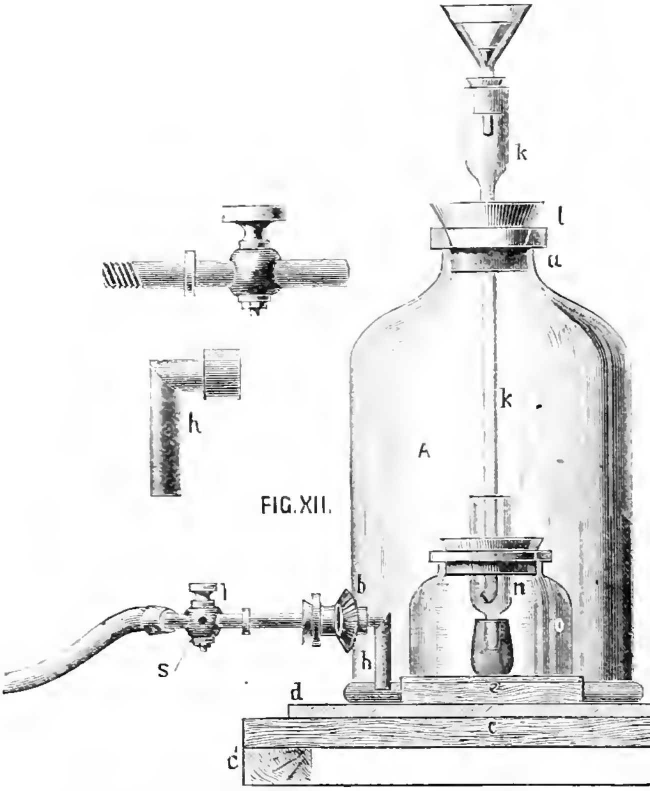


FIG. XII.

FIG. XIII.

filtration being either in ordinary laboratory use, or else can be made with but little time and trouble, and at almost no cost.

Before commencing operations it is well to slightly moisten the rubber sheet *d* with water. This is not by any means absolutely necessary, but causes a quicker gripping of bell-jar and rubber. The tap being in position No. 2, and connected with a water pump in full action, filtering is commenced by first filling up the filter nearly full with the liquid to be filtered, and then establishing communication between the pump and the bell-jar by turning the tap to position No. 1. During the operation of transferring the precipitate on to the filter, it is often necessary to lessen the rate of filtration by diminishing or destroying the difference of pressure outside and inside of the bell-jar. This can be quickly and easily done by giving the tap a half turn back to position No. 2, and thus allowing air to rush in both to the pump and to the bell-jar. The use of the knee-piece *h* will be now apparent, for by it the inrush of air is diverted away from the vessel inside, which might otherwise be blown against the side of the bell-jar, and upset or broken. As it is, however, the vessel inside is not at all affected by the inrush of air, however suddenly the tap be opened. In this connection another use of the knee-piece may be pointed out. Several of the otherwise very convenient and inexpensive high-pressure water pumps now so much used have a tendency to allow the water to run back under certain conditions, especially when a high degree of exhaustion is attained. Filtering directly in the usual way into an exhausted flask, such an accident would cause the loss of an analysis, and a valve is therefore usually placed between the pump and the flask. Such a valve is quite unnecessary while using the above apparatus. The running back of the water can be at once stopped without diminishing the pressure inside the bell-jar, by giving the tap a quarter turn so as to admit air to the pump only. Even if water does run back into the bell-jar, no harm is done, and if the knee-piece be turned downwards as shown in the figure, the pump will suck back the water again almost to the last drop.

It is sometimes necessary in quantitative analysis to filter a small quantity of liquid directly into a small weighed platinum basin or crucible—for instance, in filtering the alkaline chlorides from the last traces of magnesia in a silicate analysis, or to take another example in the purification of minute quantities of alkaloids.

This may readily be done by the arrangement shown in Fig. 12.

In order to avoid loss by spirting, the tube does not dip directly into the crucible, but into the glass tube *n*. This tube may be made out of a broken pipette, and is supported by a loosely-fitting cork in the small bell-jar *o*, which may be most conveniently made by cutting off the lower half of an ordinary wide-mouth bottle. When the filtration is over the small funnel and cork should be removed, and the wide part of the tube *k* washed with a very little water, which serves at the same time to wash down the inside of the tube *n*. By this means the amount of wash-water is reduced to a minimum. In the estimation of alkaloids the solvent is often chloroform or ether, which dissolve indiarubber, so that in such cases a small ordinary cork should be substituted for the rubber stopper. It may be further pointed out that with this apparatus it is an easy matter to filter liquids containing hydrofluoric acid, by using a platinum funnel and filtering directly into a platinum basin or other platinum vessel.

The apparatus as above described has been in general use in the Chemical Laboratories of the University of Edinburgh for the last four or five years, and has been proved to meet the simplest requirements of qualitative analysis equally with those of the most exact quantitative analysis.

The following has been found a convenient method of preserving sulphuretted hydrogen water. The bottle A (Fig. 14) is filled up to the neck with the sulphuretted hydrogen water. The double-bored stopper bearing the tubes *a*, *a*, *a* and *b*, *b*, *b* is then loosely inserted. The tube *a*, *a*, *a* is then connected with the ordinary coal-gas supply, and the air in the neck of the bottle displaced by gas. While this is taking place, suction is applied at the end or ends of the tube *b*, *b*, *b*, so as to convert it into a syphon, after which it is closed by an ordinary nipper tap. The stopper is now firmly pressed into the neck of the bottle. By this arrangement the sulphuretted hydrogen solution is preserved from oxidation, and can always be run off perfectly clear, even though left standing for months. By the use of a T tube, as shown in the figure, the sulphuretted hydrogen solution can be supplied from one bottle to both sides of a working table. The gas tap should, as a rule, be kept closed, and need only be opened for an instant whenever the sulphuretted hydrogen water ceases to flow. The tap should be lubricated with vaseline, and not with grease. Should the sulphuretted hydrogen water become turbid, it may be safely concluded that air has leaked in owing to some imperfection in the rubber connections.

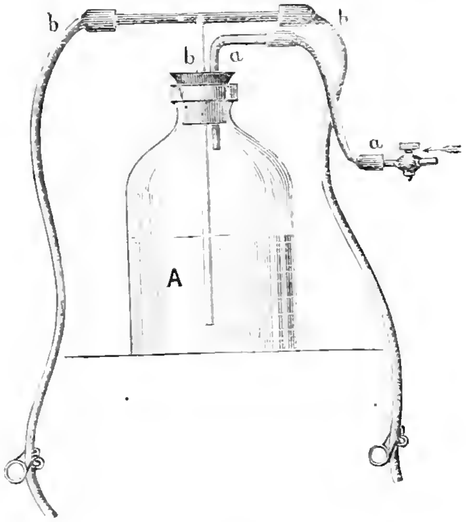


FIG. XIV.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Improvements in Apparatus for Purifying Water. H. J. Allison, London. From J. H. Blessing, Albany, U.S.A. Eng. Pat. 15,215, Nov. 23, 1886. 8d.

THE improved apparatus consists of a cylinder containing a porous body, such as sand, and fitted with a single reversing valve serving for both induction and

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* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.........	½d.
Above 8d., and not exceeding 1s. 6d...	1d.
,, 1s. 6d., ,, ,, 2s. 4d...	1½d.
,, 2s. 4d., ,, ,, 3s. 4d...	2d.

eduction purposes; the base of the filtering cylinder is formed by a grating, the holes of which are fitted with plungers to which a reciprocating motion can be imparted in order to keep the passages free. The filtering medium is cleaned by a reversal of the current of water combined with agitation secured by means of endless chains passing through the body of the media.—C. C. H.

II.—FUEL, GAS, AND LIGHT.

Improvements in Illuminant Appliances for Burners. O. Imray, London. From C. A. von Welsbach, Vienna, Austria. Eng. Pat. 3592, March 13, 1886. 6d.

This specification contains the results of the researches of C. A. von Welsbach since filing the Provisional Specification 15,286, 1885, and has reference to the employment of hoods or caps made by impregnating fabric with solutions of the salts of certain rare metals. A cap which is flexible when incandescent is obtained by the use of thorina and magnesia, or thorina, zirconia, and lanthana, or thorina, magnesia and alumina. A greenish light is given by erbia and thorina; a yellow by thorina and lanthana; an orange by thorina and neodymia. It is not necessary to treat the impregnated fabric with ammonia, as described in the specification above referred to.—A. R. D.

Improvements in Means or Apparatus for Supplying Liquid or Gaseous Fuel to Furnaces or Fireplaces. F. Mörth, Vienna, Austria. Eng. Pat. 4135, March 24, 1886. 8d.

Underneath the firegrate of the furnace is placed a series of horizontal tubes perforated on the top. Through these perforations a mixture of superheated steam and hydrocarbon is injected, so that it impinges on the underside of the fuel on the bars, and by its decomposition greatly increases the intensity of the combustion. The mixture of steam and hydrocarbon may also be introduced above the firegrate, if desired, through a bent tube fixed in the fore part of the furnace, and so perforated on the side next the fire that the jets issue in slightly inclined rays along the surface of the grate. The improvements include a special kind of injector, which effects the mixture of the hydrocarbon and superheated steam.—A. R. D.

Improvements in the Mode of and Means or Appliances for Making Oil Gas. J. B. Fowler, Northallerton. Eng. Pat. 16,142, Dec. 9, 1886. 8d.

This specification describes a process and apparatus for mixing oil with steam and passing the same into a heated retort. Suitable arrangements are made for washing the gas and recovering any undecomposed oil. For particulars the specification must be consulted.

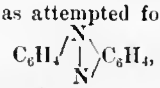
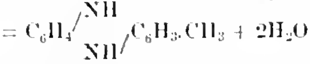
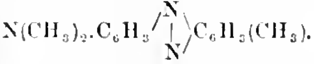
—A. R. D.

Utilising Hydrocarbon Gases obtained in the Distillation of Petroleum, Rosin, and the like. G. T. Beilby, St. Kitts, and J. B. McArthur, Midcalder. Eng. Pat. 3738, March 17, 1887. 4d.

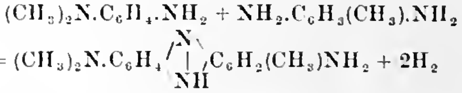
The end of the condensing worm is luted, and the uncondensed gases are drawn off by a branch pipe to a gasholder. They may be applied to any of the purposes for which ordinary coal- or oil-gas is available.—A. R. D.

IV.—COLOURING MATTERS AND DYES.

Phenazine (Azophenylene) as a Source of Colouring Matters. A. Bernthsen and H. Schweitzer. Ber. **19**, 2604—2607.

Bernthsen has attempted for a long time to prepare the compound  $C_6H_4\left\langle\begin{matrix}N\\|\\N\end{matrix}\right\rangle C_6H_4$, which, on account of its analogy with anthracene, acridine and thiodiphenylamine, might be expected to yield colouring matters. Meanwhile, Merz has prepared the homologue, methylphenazine,  $C_6H_4\left\langle\begin{matrix}N\\|\\N\end{matrix}\right\rangle C_6H_3.CH_3$, the dihydro derivative of which he obtained by heating orthotoluylenediamine with catechol: $C_6H_4(OH)_2 + (NH_2)_2C_6H_3.CH_3$  $= C_6H_4\left\langle\begin{matrix}NH\\NH\end{matrix}\right\rangle C_6H_3.CH_3 + 2H_2O$ (*Ber.* **19**, 725). The authors have obtained the same methylphenazine from a colouring matter belonging to the toluylene red group. Witt's toluylene red, $C_{15}H_{16}N_4,HCl$ (*Ber.* **12**, 931), contains an amido group, which may be eliminated by the action of nitrous acid; the resulting compound very closely resembles eurhodine (*Ber.* **18**, 1119), one of the quinoxalines (this Journal, 1886, 320—321; 377—378). The same observation was simultaneously made by Witt, who found that the acetyl compound of toluylene red resembles eurhodine. The compound obtained by the authors from toluylene red has the formula $C_{15}H_{15}N_5$. It forms beautiful garnet-red needles or prisms, which exhibit a green lustre. It possesses basic properties and dissolves in dilute acids forming a violet liquid; but with concentrated sulphuric acid it gives a red-brown solution, which when diluted becomes at first green, then blue and finally violet. Alcohol forms a red, and ether a yellowish-red solution with a golden-yellow fluorescence. Like eurhodine, it sublimes without decomposition. Its formula is therefore  $N(CH_3)_2.C_6H_3\left\langle\begin{matrix}N\\|\\N\end{matrix}\right\rangle C_6H_3(CH_3)$. By the oxidation of paraphenylenediamine, instead of nitroso-(amido)-dimethylaniline with metatoluylenediamine, a simpler toluylene blue, and from this a toluylene red, is obtained, the $N(CH_3)_2$ group being replaced by NH_2. When this compound is treated with nitrous acid, methylphenazine is obtained in the form of yellow needles, melting and subliming at 117° to 117·5°. It possesses basic properties, and forms a bluish-red solution with concentrated sulphuric acid. The compound is obviously homologous with the azophenylene (phenazine) described by Claus, which is therefore the basis of the toluylene red colouring matters. The formation of toluylene red is represented by the following equations:—

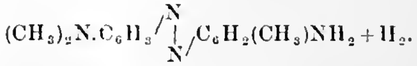
(1)



$$(CH_3)_2N.C_6H_4.NH_2 + NH_2.C_6H_3(CH_3).NH_2$$
$$= (CH_3)_2N.C_6H_4\left\langle\begin{matrix}N\\|\\NH\end{matrix}\right\rangle C_6H_2(CH_3)NH_2 + 2H_2$$

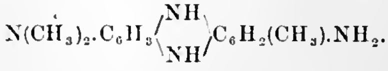
(Toluylene blue).

(2) Toluylene blue—



$$(CH_3)_2N.C_6H_3\left\langle\begin{matrix}N\\|\\N\end{matrix}\right\rangle C_6H_2(CH_3)NH_2 + H_2.$$

Leucotoluylene red has consequently the formula:

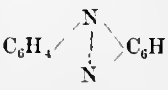


$$N(CH_3)_2.C_6H_3\left\langle\begin{matrix}NH\\NH\end{matrix}\right\rangle C_6H_2(CH_3).NH_2.$$

The analogy with leucomethylene blue, leucothionine, and so on, is obvious. The part played by sulphur in the methylene blue group is taken by an imido group in the toluylene red compounds. It follows also that the safranines are derivatives of phenazine.—S. Y.

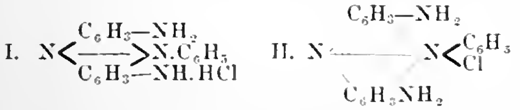
Constitution of the Safranines. A. Bernthsen. Ber. **19**, 2690—2693.

In a previous paper (*Ber.* **19**, 2607) the author has shown that very probably the safranines are derived from *phenazine*—



$$C_6H_4\left\langle\begin{matrix}N\\|\\N\end{matrix}\right\rangle C_6H_4$$

from which the colours of the toluylene-red class are also derived. The simplest member of this class of colours is Witt's phenosafranine $C_{18}H_{14}N_4HCl$, which may be regarded as derived from the simplest member of the toluylene-red class, *diamidophenazine*, $C_{12}H_6.N_2.(NH_2)_2$, by the exchange of one atom of hydrogen with C_6H_5. This substitution may, according to theory, take place in very different positions, but owing to the discovery of Nietzki, that the indamines are intermediate products of the safranine reaction, it appears probable that it takes place with that nitrogen atom which unites the two other phenyl groups. Thus, leucophenosafranine would be formed by the oxidation of equal molecules of *p*-diamidodiphenylamine (leuco-indamine) and aniline : $NH_2.C_6H_4.NH.C_6H_4.NH_2 + C_6H_5.NH_2 = NH_2.C_6H_3:(NH)(N.C_6H_5):C_6H_3.NH_2 + 4H$. If this is correct, only primary amines are capable of forming safranine when oxidised with leuco-indamine; and, according to Nietzki, such is really the case. The ordinary formation of safranine by oxidation of one molecule paradiamine with two molecules monamine, would be expressed in the following manner :—$NH_2.C_6H_4.NH_2 + 2C_6H_5.NH_2 = NH_2.C_6H_3(NH)(N.C_6H_5)C_6H_3.NH_2 + 6H$. This theory explains why, in the safranine reaction, in one of the monamines, the para-position to the nitrogen atom must be free, although the monamine need not be a primary one. It also accounts for the presence of two amido groups. The similarity between leucophenosafranine, $NH:(C_6H_3.NH_2)_2:NC_6H_5$, and leucothionine (methylene blue), $NH:(C_6H_3.NH_2)_2:S$, is very pronounced. Both can be obtained from *p*-diamidodiphenylamine, the former by oxidation with aniline, and the latter by warming with sulphur. For the constitution of the colours themselves, which contain two H atoms less than the leuco-compounds, the two possible expressions may serve—



$$\mathrm{I.}\quad N{<}\begin{matrix}C_6H_3-NH_2\\ \rule{2em}{0.4pt}\\ C_6H_3-NH.HCl\end{matrix}{>}N.C_6H_5 \qquad \mathrm{II.}\quad N\begin{matrix}C_6H_3-NH_2\\ \rule{4em}{0.4pt}\\ C_6H_3.NH_2\end{matrix}N{<}\begin{matrix}C_6H_5\\ Cl\end{matrix}$$

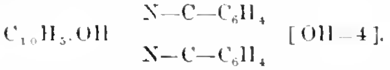
The presence of two intact amido-groups in safranine points to formula II., which shows this substance to be a real phenazine derivative, a *diamidophenylphenazonium chloride*, which would explain its non-basification by alkalis. However, the complete analogy with the methylene blue group speaks for formula I. Nietzki at one time supposed safranines to be triphenylamine derivatives, but leucosafranine cannot be triamidotriphenylamine, $N.(C_6H_4.NH_2)_3$, because it contains two H atoms too little; but it nevertheless can be considered as a derivative of diphenylamine, as the following change in the formula will show :—$C_6H_5.N:(C_6H_3.NH_2)_2:NH$ = leucosafranine.—T. L. B.

Constitution of Nitranilic Acid. R. Nietzki. Ber. **19**, 2727.

When the *diamidotetroxybenzene hydrochloride*, produced by reducing nitranilic acid, is distilled over zinc dust, a small quantity of a crystalline base is obtained. This was found to be *p*-phenylenediamine, thus confirming the results of Hantzsch (*Ber.* **19**, 2398), who has shown that nitranilic acid is *p-dinitrodihydroxyquinone*, he having obtained it by treating dihydroxyquinoneterephthalic acid with nitric acid. With such a reaction as the zinc-dust distillation, the possibility of intermolecular change is not avoided, but the whole behaviour of the diamidotetroxybenzene shows that it is no orthodiamine. Phenanthrenequinone oxidises it simply to *di-imidodihydroxyquinone*, forming no condensation products (Hinsburg's reaction for orthodiamines). A simpler reaction for these bodies is obtained with croconic acid. The potassium salt of this acid on simply mixing with a solution of an orthodiamine salt gives rise to the formation of a dark coloured precipitate of the corresponding croconquinoxaline. With diamidotetroxybenzene, however, a yellow crystalline precipitate, of the croconate, only was formed. Ladenburg's reaction with benzaldehyde (*Ber.* **11**, 600) also gave no result.—T. L. B.

On the Eurhodines and Laurent's Naphthase. Otto N. Witt. Ber. **19**, 2791—2796.

The sulphonic acid of the ortho-naphthylenediamine, obtained by reducing azo-colouring matters derived from naphthionic acid, is completely converted by condensation with phenanthrenequinone into *diphenylenenaphthazine sulphonic acid.* When this sulphonic acid is fused with caustic potash, the corresponding eurhodol is easily and quantitatively obtained. The melt is at first yellow, but suddenly becomes of a cinnabar-red colour. The reaction is then finished; the mass dissolved in water and acidified with an excess of HCl, deposits the hydrochloride of the new eurhodol as an insoluble cinnabar-red powder. This eurhodol is quite insoluble in all solvents, but may be obtained in silky needles by basifying a boiling solution of the hydrochloride in phenol, with aniline. It forms fine pure yellow needles, subliming in the characteristic voluminous form. Concentrated sulphuric acid dissolves it with an intense pure blue colouration, which a very slight amount of water changes suddenly into a splendid carmine red. The sulphonic acid, obtained by heating the above blue solution until it has become yellow, dyes wool a sulphur-yellow colour. Friction renders it so electric that on rubbing in an agate mortar the particles disperse themselves in all directions. Its constitution is as follows :—



$$C_{10}H_5.OH\begin{matrix}N-C-C_6H_4\\ N-C-C_6H_4\end{matrix}\qquad[OH-4].$$

By using β-naphthoquinone instead of phenanthrenequinone in the above reaction, the sulphonic acid of α-β-naphthazine was obtained, which, on fusion with caustic potash, yielded a similar eurhodol. The mother substance of these bodies—viz., naphthazine,

$$C_{10}H_6\begin{matrix}N\\ |\\ N\end{matrix}C_{10}H_6$$

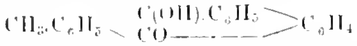
the author has found to be identical with the compound obtained by Laurent from the distillation of α-nitronaphthalene with quicklime, and by him named naphthase (*Ann. Chem. Pharm.* **9**, 384). It is best obtained in the following manner :—4·6grms. *o*-naphthylenediamine-dihydrochloride are dissolved in the least possible quantity of water. This solution is then mixed with 50cc. glacial acetic acid, 5grms. sodium acetate crystals, and well cooled in a freezing mixture. A likewise cold solution of 3·2grms. β-naphthoquinone in 50cc. of glacial acetic acid, is then run into it, and the whole allowed to stand a few hours. The new azine is obtained as a dark brown precipitate, which, after washing with alcohol, is purified by sublimation, forming long yellow needles or woolly flocks, which melt at 275°. When quickly heated it can be distilled. Sulphuric acid dissolves naphthazine, forming a pure violet-coloured solution, which, on dilution, becomes orange-yellow, the free base being finally precipitated. Alcohol, benzene, and acetic acid dissolve it but sparingly. It is more soluble in phenol and aniline. Naphthalene dissolves it readily at the boil, depositing it in beautiful needles on cooling, which are then freed from the solvent by washing either with alcohol or benzene.—T. L. B.

Diphenylmetaxylylmethane and Diphenylorthoxylylmethane. W. Hemilian. Ber. **19**, 3061—3075.

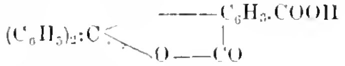
The author has already described the formation of diphenylparaxylylmethane from diphenylcarbinol and paraxylene, (*Ber.* **16**, 2360).

Diphenylmetaxylylmethane $(C_6H_5)_2.CH.C_6H_3(CH_3)_2$ is obtained by heating together diphenylcarbinol, metaxylene and phosphoric anhydride. It crystallises from alcohol or ether in large prisms melting at 61·5°. On oxidation with chromic acid mixture it yields a resinous mass, which is partly soluble in a concentrated soda solution. By extracting the insoluble portion with ether, *diphenylmethylphthalide* $C_{21}H_{16}O_2$ is obtained. This compound is isomeric with the product obtained by the oxidation of diphenylparaxylylmethane. It crystallises from alcohol in lustrous prismatic crystals, melting at 179°, and distilling without decomposition above 360°.

Methyltriphenylmethane carboxylic acid $(C_6H_5)_2CH.C_6H_3.CH_3.CO.OH$ is obtained by first heating diphenylmethylphthalide with a concentrated solution of alcoholic soda and then reducing the resulting sodium methyltriphenylcarbinolorthocarboxylate with zinc dust. The solution thus obtained is decomposed with hydrochloric acid and the precipitate recrystallised from alcohol. Methyltriphenylmethanecarboxylic acid forms large tabular crystals melting at 203°, and distilling without decomposition at a higher temperature. It is readily soluble in hot alcohol, ether and glacial acetic acid. It is a monobasic acid forming crystalline salts, which are mostly sparingly soluble in water. By careful oxidation it is easily reconverted into diphenylmethylphthalide. By the action of dehydrating agents, derivatives of methylphenylanthracene are obtained. Concentrated sulphuric acid converts it into *methylphenylanthranol* $C_{21}H_{16}O$, the yield of which is, however, extremely small. By oxidising methylphenylanthranol with chromic acid, *methylphenyloxanthranol*—


$$CH_3.C_6H_5 < \begin{matrix} C(OH).C_6H_5 \\ CO \end{matrix} > C_6H_4$$

is formed. It crystallises from glacial acetic acid in large colourless prisms melting at 213°, is insoluble in alkalis, dissolves in concentrated sulphuric acid, forming a purple solution, and is converted into methylphenylanthranol by reducing agents. The portion of the products of oxidation of diphenylmetaxylenemethane which is soluble in soda is decolourised with animal charcoal and saturated with hydrochloric acid. The flocculent precipitate is recrystallised from glacial acetic acid and alcohol, crystals of *diphenylphthalidecarboxylic acid* being formed, having the formula—


$$(C_6H_5)_2{:}C \begin{matrix} -C_6H_3.COOH \\ | \\ O-CO \end{matrix}$$

and melting at 228°. This acid is monobasic, dissolves readily in alcohol, ether, benzene and glacial acetic acid, and forms salts which are mostly insoluble in water. When distilled with excess of barium hydroxide, it yields benzophenone and benzene, whilst by careful fusion with caustic alkalis the salts of isophthalic and benzoic acids are formed, besides benzophenone.

Triphenylmethanedicarboxylic acid $(C_6H_5)_2CH.C_6H_3(COOH)_2(1:2:4)$ is obtained by treating an alkaline solution of the preceding anhydro acid with zinc dust, filtering the solution and decomposing the filtrate with hydrochloric acid. The white curdy precipitate thus obtained is crystallised from alcohol, when it forms slender lustrous needles which melt at 278°, and are readily soluble in alcohol and glacial acetic acid. Its salts are, as a rule, easily soluble in water, but the silver salt is insoluble in water and alcohol. When distilled with excess of barium hydroxide, triphenylmethane is obtained. On oxidation it is converted into diphenylphthalide carboxylic acid. It dissolves in concentrated sulphuric acid, forming a greenish-yellow solution, which on warming changes first to green, then indigo blue and finally assumes a purple colour.

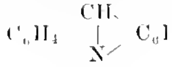
Diphenylorthoxylylmethane $(C_6H_5)_2CH.C_6H_3(CH_3)_2$ is obtained by heating together diphenyl carbinol orthoxylene and phosphoric anhydride. It crystallises from alcohol in long lustrous needles melting at 68·5°, and distilling above 360°, and dissolves readily in alcohol, ether and glacial acetic acid. On oxidation with chromic acid mixture it yields a solid mass, which is partly soluble in a concentrated soda solution. The residue does not, however, contain a phthalide derivative. The soluble portion consists of a mixture of several acids. By further oxidising the solution with potassium permanganate, filtering and saturating the filtrate with hydrochloric acid, a white crystalline precipitate is obtained, which on recrystallisation from boiling water yields *triphenylcarbinoldicarboxylic acid* $(C_6H_5)_2C(OH).C_6H_3(COOH)_2$. This acid is crystalline, readily soluble in alcohol, ether and glacial acetic acid, sparingly soluble in benzene, and almost insoluble in petroleum spirit. Its salts form amorphous precipitates mostly insoluble in water. It melts at 180°, and is at the same time resolved into water and the anhydride. It is not changed by reducing agents. When distilled with excess of barium hydroxide it yields triphenylcarbinol melting at 158°, the following reaction taking place:—

$$(C_6H_5)_2C(OH).C_6H_3(COOH)_2 = 2CO_2 + (C_6H_5)_3C.OH.$$

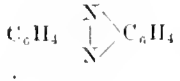
—D. B.

A New Synthesis of Thiodiphenylamine. A. Bernthsen, Ber. **19**, 3255—3256.

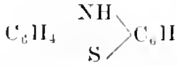
Recent experiments have shown the similarity between the chromogen anthracene and the acridine compounds—


$$C_6H_4 \begin{matrix} CH \\ | \\ N \end{matrix} C_6H_4$$

phenazine—


$$C_6H_4 \begin{matrix} N \\ | \\ N \end{matrix} > C_6H_4$$

and thiodiphenylamine—


$$C_6H_4 \begin{matrix} NH \\ S \end{matrix} > C_6H_4.$$

Anthracene is known to be a diorthodiphenylene compound, also the same constitution is held most probable for acridine by the formation of quinolinedicarboxylic acid, and for phenazine on account of its synthesis. By the formation of thiodiphenylamine by the condensation of *o*-amidophenylmercaptan and catechol (pyrocatechin) the author has obtained strong proof of a like combination of the atoms in this substance. The reaction, which may be expressed as follows: $NH_2.C_6H_4.SH + C_6H_4(OH)_2 = C_6H_4 < \genfrac{}{}{0pt}{}{NH}{S} > C_6H_4 + 2H_2O.$ takes place on heating in a sealed tube for thirty hours at 220—240°. Hydrogen sulphide is given off on opening the tube, and the yield is small.—T. L. B.

Quinoline Red. A. W. Hofmann. Ber. **20**, 4—20.

The above-named colouring matter was discovered by E. Jacobsen, and is obtained by the action of benzyltrichloride upon quinoline in the presence of zinc chloride. 100grms. coal-tar quinoline, boiling at 235—240°, are mixed with 25grms. dry zinc chloride, warmed upon the water bath, and 40grms. benzyltrichloride, added drop by drop, agitating the mixture well in order to keep the temperature below 120—130°. This takes about three to four hours. The tarry product is then treated with a thin milk of lime (100CaO to 1000cc. water), and the excess of quinoline distilled off with steam. The boiling limed solution is now filtered off, and the colour precipitated by the addition of hydrochloric acid in excess, as a fine crystalline powder. The zinc and lime salts are difficult to remove by mere recrystallisation, so, for analytical purposes, the colour was made without zinc chloride; but the temperature had to be raised to about 150°, and the yield was very poor. About 50 per cent. of the quinoline is recovered; deducting this, the yield of colouring matter averages 10 per cent. upon the base used. This recovered base only gave traces of colour on repeating the treatment with benzyltrichloride, a fact which pointed either to a different base being present in the raw quinoline, or that, as in the magenta process, two homologous bases were needed to form the colour. E. Jacobsen and C. L. Reimer (*Ber.* **16**, 1086) having discovered quinaldine in crude quinoline, considered that the colour was derived from this base and quinoline, as neither base *alone*, when treated with $C_7H_5Cl_3$ gave any colour. A repetition of these experiments with *pure* samples of these bases showed, however, that only about 1¼ per cent. of colour was formed, while the properties and shade of the two substances appeared somewhat different. Later on Hoogewerf and Van Dorp, having detected the presence of *isoquinoline* in the coal-tar quinoline (*Rec. Trav. Chim.* **4**, 125—129), experiments were made with this pure base, melting at 20° and boiling at 235—236°, obtained from phthalic acid by Gabriel's process. Heated alone with $C_7H_5Cl_3$ and $ZnCl_2$, isoquinoline gave no colour reaction, but a mixture of 1mol. isoquinoline and 1mol. quinaldine produced a colouration at 120°, and the yield averaged about twice as much as was obtained from raw quinoline and 8½ times as much as from a mixture of quinoline and quinaldine. The properties of the colour thus obtained are similar to those of that obtained in the ordinary way. From very dilute hot hydrochloric acid it crystallises in thin quadratic and brown leaflets or prisms, and by evaporation of the alcoholic solution, forms long pyramidal prisms. It is soluble in acetic acid, phenol and alcohol with crimson colouration showing yellow-red fluorescence, but is insoluble in ether and benzene. It dyes wool and silk a fugitive pink with indication of a yellow fluorescence, whilst the ordinary quinoline red has a slight violet tone. Both bodies show two dark ill-defined absorption bands between F and D, maximum absorption being at 540 and at 500, those shown by the iso-colour being clearer defined and more intense. Photographically, both colours act as good sensitisers for yellow, orange and yellow-green light. Bromide of silver gelatin plates dipped in solutions of both colours (1 : 12,500), and dried and exposed to the solar spectrum, were extremely sensitive to the region between E—D¼ C.

The hydrochloride of this colour is very hygroscopic, and only parts with its moisture at 120—140°. The analysis gave figures pointing to the formula—$C_{26}H_{19}N_2Cl$, which agrees with the equation—

$$C_9H_7N + C_{10}H_9N + C_7H_5Cl_3 = C_{26}H_{19}N_2Cl + 2HCl.$$

The analysis of the platinum double salt $2(C_{26}H_{19}N_2Cl)PtCl_4$ entirely confirmed this supposition; this salt precipitates from the alcohol solution of the colour as a carmine powder, entirely insoluble in water, alcohol, and hydrochloric acid. Quinoline red is reduced to a leuco-compound by treatment with zinc and HCl. When heated with an excess of alcoholic ammonium sulphide in a sealed tube to 200° for eight or ten hours, it is split up into benzylmercaptan, and a weak base $C_{19}H_{14}N_2$, which forms gold yellow brilliant leaflets, melting at 231°, subliming easily, insoluble in water, soluble in ether, benzene, CS_2, acids, and phenol. The reaction is as follows:—

$$C_{26}H_{19}N_2Cl + H_2S + 2H = C_{19}H_{14}N_2 + HCl + C_7H_5S.$$

Hydrochloric acid converts quinoline red into quinolines and benzaldehyde. Oxidation produces benzoic acid. Distillation over zinc dust gives a mixture of bases; one of them melting at 86°, has the formula $C_{17}H_{15}N$.

This colour cannot be regarded as an analogue of malachite green, in spite of its method of formation, owing to the difference in the behaviour of the two substances with ammonium sulphide—the green simply being reduced to its leuco-compound, and also on account of the stability of its salts in the presence of alkali. Further, it has been found impossible to obtain the red by the benzaldehyde and $ZnCl_2$ reaction. Its formula may therefore be expressed as $C_6H_5.CCl(C_9H_6N)(C_9H_5(CH_3)N)$, or $C_6H_5.CCl(C_9H_6N)(CH_2.C_9H_6N)$; accordingly as the condensation has taken place in the nucleus or in the methyl group of the quinaldine. Further investigation of the reduction bases may throw more light on the constitution of this colour, but attempts to obtain the yellow base of the probable formula—$C_9H_6N-CH_2-NC_9H_6$, by the action of methylene diiodide on quinoline or isoquinoline, have entirely failed.
—T. L. B.

Researches on the Relation between the Molecular Structures of Carbon Compounds, and their Absorption Spectra. Part VIII.—A Study of Coloured Substances and Dyes. W. N. Hartley, J. Chem. Soc. (Trans.), 1887, 152—200.

A COLOURED substance is one which absorbs rays at either end of the spectrum or selects rays of certain wave length from the middle of the same. All fluorescent bodies are therefore coloured, and benzene and other compounds which exhibit selective absorption of ultra-violet rays are coloured, though the eye cannot detect it, whilst coloured bodies in the ordinary sense of the term only absorb rays limited by the violet and red ends of the spectrum; thus there are visible and invisible colours. Selective absorption bands seem to be the effect of molecular vibrations, and depend upon the rate of the latter; so that if we desire to convert benzene or such a substance into one visibly coloured, it is necessary to alter its rate of vibration so that its molecule will absorb rays with oscillation frequencies occurring within the limits of visibility. A *chromogen* is therefore an "invisible" coloured substance, and a *chromophor* is an atom, or group of atoms, which reduces the rate of molecular vibrations to within the visible limit. Oxygen and nitrogen, when united in a certain manner are chromophors, and when united to carbon under certain conditions, as in uric acid, constitute a chromogen readily changed into murexide. The condensation of oxygen tends to form highly coloured substances, as shown in the ferrates, manganates, red-lead, etc. In the benzene nucleus, the introduction of N and O atoms by reducing the rate of the molecular vibration to within the limit of visibility—*i.e.*, to less than the rate of violet light—produces colours and dyes, as in quinone, azobenzene, etc. The author has studied a number of nearly related colouring matters of the triphenylmethane and azobenzene series. The absorption curve of triphenylmethane resembles that of benzene in its general character; but the vibration rate is much reduced by the linking of three benzene nuclei, and this rate is further reduced in the following increasing order of intensity by the introduction of imido-, amido- and hydroxyl-groups, and the combination of these imido- and amido-groups with hydrochloric acid, as in rosaniline hydrochloride. In azobenzene, as compared with benzene, the rate is also very considerably reduced, and in many members of this series the amplitude of the vibration is virtually the same, though of course not entirely alike, showing what an important influence the doubly united nitrogen has in the production of the colour. The curves of all the dyes in each series follow each other closely, the modification being such that the molecules of the greatest mass transmit the least light and vibrate less rapidly.

Uric acid exhibits an extraordinary absorptive power in layers 15mm. thick, in very dilute aqueous solution 1 : 15,000). The investigations have shown that when (absorption takes place in the visible region, the ultra-violet rays of the spectrum are also absorbed.—T. L. B.

A Blue Colouring Matter for Cotton. H. Müller. Chem. Zeit. **10**, 1400 (Société Industrielle de Mulhouse, Oct. 1886).

WHEN a solution of the diazo derivative of diamidodiphenetol $NH_2(OC_2H_5)C_6H_3—C_6H_3(OC_2H_5)NH_2$ is poured into a solution of α-naphtholsulphonic acid, in the proportion of two molecules of the sulphonic acid to one molecule of the diazo compound, a blue colouring matter is obtained, which in both acid and alkaline solution, dyes cotton directly without a mordant. The colour withstands the action of acids and soap.—S. Y.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Improvements in Dyeing Textile Goods and Materials. Henry Kershaw, Salford. Eng. Pat. 3732, March 17, 1886. 4d.

THIS invention relates to the dyeing of cotton and other vegetable fibres and of goods and yarns made therefrom. Chromium sulphate and ferric sulphate or other salts of chromium or iron, are dissolved in water, and sodium bicarbonate or commercial soda added, the quantity of alkali used being such that precipitation of the oxides does not take place. The goods —say for example, cotton piece goods—are thoroughly saturated, by passing the goods through the solution or by other suitable means, afterwards squeezed and suitably dried. The goods are then treated with a weak boiling solution of silicate of soda, carbonate of soda or a solution of soap. By these means greenish-grey colours are obtained, the silicate of soda solution producing greener shades than the sodium carbonate or the soap solution.—S. H.

VII.—ACIDS, ALKALIS, AND SALTS.

Improvements in the Concentration of Sulphuric Acid and in Apparatus for that Purpose. H. J. Leslie, London. From R. Finch, Mülheim, Germany. Eng. Pat. 2207. Feb. 15, 1886. 8d.

A is an evaporating furnace, which is in connection with two towers B and C, loosely filled with any acid-proof refractory material. The first tower communicates with the escape flue D, and at the top with the second tower C, from the bottom of which there is a flue E to the chimney. The evaporating furnace A is provided with a lead tank H, which is lined with a layer of sheet asbestos I, upon which is built a thick lining K of silica brick. The top of the furnace is formed by a low arch L, lined inside with silica bricks, and covered outside with lead. At the one end of the chamber thus formed is the escape flue D, and at the other end is the deep fireplace N for the combustion of smokeless fuel. The weak acid enters the apparatus through the syphon pipes F on the top of the towers, and gradually flowing downwards, comes into intimate contact with the hot gases from the evaporating furnace, and thus becomes concentrated to a certain degree before entering the furnace proper. At the same time, sulphuric acid vapour that may have escaped with the furnace gases into the tower becomes condensed, and passes back into the evaporating furnace. The acid proceeding from the bottom of the tower B is led by a pipe O to a syphon P into the chamber, where the hot gases effect its concentration to any required degree, even to a specific gravity of 1·845. The lead tank can be extended round three sides of the furnace so as to form an external trough Q for cooling the concentrated acid, this trough being also lined with asbestos and brick. By the above-described construction, the metallic parts are said to be effectually protected from being attacked by the acid, while a considerable economy of fuel is brought about. The apparatus is also comparatively cheap.—S. H.

Improvements in the Preparation of Sulphate of Alumina. J. J. Hood and A. G. Salamon, London. Eng. Pat. 1881, Feb. 9, 1886. 6d.

THE object of this invention is the removal of iron from aluminium sulphate. This is effected by the use of meta-stannic acid or its salts. The aluminium solution, preferably concentrated, is heated, and the iron contained in it oxidised to ferric oxide by bleaching powder. No free acid must be present; and to this end, as also in order to make the aluminium sulphate somewhat basic, a slight excess of calcium carbonate is added. Meta-stannic acid in the moist state is then added in suitable quantities, and the whole mass agitated until a sample drawn shows the absence of iron in solution. The agitation is then stopped, the mass allowed to subside, and the solution of aluminium run off to be treated as may be desired. Any tin in solution may be removed by the addition of sulphuretted hydrogen. The sediment of meta-stannic acid and iron may be repeatedly used until it has taken up so much iron as to impair its efficiency. It is then treated with strong sulphuric acid, and allowed to stand for some hours. The iron sulphate is then removed by washing, and the treatment with sulphuric acid repeated if necessary. The meta-stannic acid is then again suitable for use.—S. H.

Fig 3

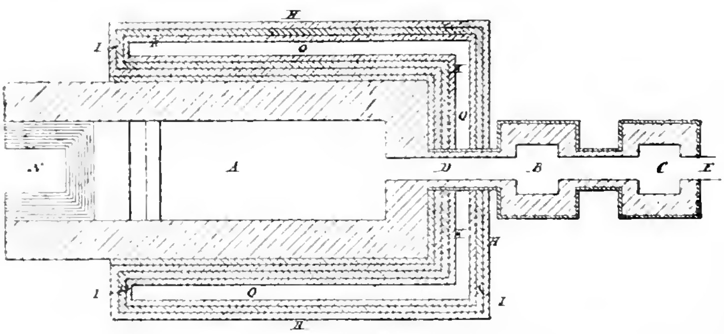
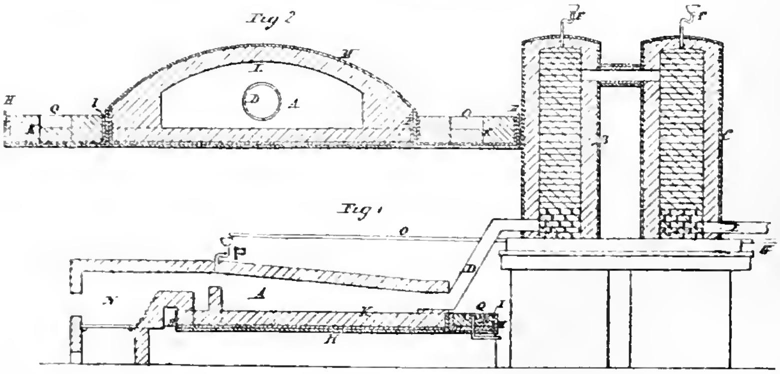


Fig 2

Fig 1



Improvements in obtaining Ammonia and Hydrochloric Acid from Ammonium Chloride. L. Mond, Northwich. Eng. Pat. 1048, Jan. 23, 1886. 4d.

THE inventor described in a previous specification (Eng. Pat. 65, 1886) a method for obtaining ammonia and hydrochloric acid from ammonium chloride by the aid of nickel protoxide or other metallic oxides. He now finds that these oxides can be with advantage replaced by their combinations with acids, which are not volatile at the temperatures employed in this process, such as silicic, phosphoric, boric, tungstic, antimonic and other acids. On employing these salts in place of the oxides, the process can be completed at a lower temperature. In addition to those salts, the salts of the acids mentioned with the oxides of the alkaline earths, can be used with the same advantage.—S. H.

Improvements in obtaining Ammonia and Chlorine from Ammonium Chloride. L. Mond, Northwich. Eng. Pat. 1049, Jan. 23, 1886. 4d.

With respect to a previous specification (Eng. Pat. 66, 1886) in which the action of ammonium chloride vapour on nickel protoxide and other oxides was described, it has been found that these metallic oxides may be, with advantage, replaced by their combinations with acids, which are not volatile at an elevated temperature, such as silicic, phosphoric, boric, tungstic, antimonic acids, and others. The salts of these acids with the oxides of all the alkaline earths, may be used for the same purpose.
—S. H.

Improvements in obtaining Compounds of Cobalt from Solutions of the same. G. Perry, Harwell Steventon. From M. Perry, Sydney. Eng. Pat. 1288, Jan. 28, 1886. 4d.

This invention relates to precipitating pure cobalt compounds from solutions containing cobalt together with nickel, manganese and iron. The solution to be treated is brought to the boiling-point, and while boiling, a boiling solution of sodium hydrate of 8 to 10 per cent. strength is added. The cobalt is precipitated as a hydrate, which, by continued boiling, becomes a basic sulphate. If the precipitate contains nickel, manganese, or iron, it is treated with more boiling mother-liquor containing cobalt, when the foreign metals will go again into solution, and will be replaced by cobalt precipitated from the added liquor.—S. H.

Improvements in obtaining Compounds of Cobalt from Solutions containing the same. M. Perry, Sydney. Eng. Pat. 1289, Jan. 28, 1886. 4d.

This invention refers to a method of precipitating a pure salt of cobalt from solutions containing cobalt, together with nickel and manganese. The clear solution of the sulphates is heated at the boiling temperature with metallic iron, when pure cobalt is precipitated as a hydrate, which by continued heating can be converted into a basic sulphate. As long as there is cobalt in solution, no nickel or manganese will precipitate.—S. H.

An Improved Process for Manufacturing Sulphates of Metals from their Oxides. A. M. Graham, Lewisham. Eng. Pat. 1831, Feb. 8, 1886. 6d.

This invention relates to a process by which the oxides of readily oxidisable metals, such as manganese or iron, may be converted into sulphates. In carrying out the process with reference to manganese, the peroxide of this metal in a state of fine division is mixed with finely-powdered iron pyrites and clay or flint. The intimate mixture of the different ingredients is heated in an iron pan, at first to about 400° or 500° F., the heat being then gradually increased to incipient redness, and continued for seven or eight hours. After this time, the mass is removed from the pan, allowed to cool, moistened with water, and exposed to the atmosphere until the sulphates are rendered soluble, which is usually the case in less than a fortnight. The mixed sulphates are then dissolved out, and the iron peroxidised by the usual methods. If the residue contains manganese it is treated over again in the same manner. The object of the clay or flint is to keep the mass in a sufficiently fine state of division to allow the passage of air through it.—S. H.

An Improved Process for the Production of Carbonate of Sodium or of Potassium, and Hydrate of Strontium or of Barium. E. F. Trachsel, Holloway, Middlesex. Eng. Pat. 3406, March 10, 1886. 6d.

An intimate mixture of sulphate of soda and sulphate of strontia, or of baryta and coal, is ignited for the reduction of the sulphates. The mass is then lixiviated with hot water and allowed to cool, when crystals of strontium or barium hydrate are deposited, thus: $Na_2S + SrS + 2H_2O = 2NaSH + Sr(OH)_2$, and $Na_2S + BaS + 2H_2O = 2NaSH + Ba(OH)_2$. The mother-liquor is then further boiled down, and on cooling deposits nearly all the strontia or baryta still contained in it. The remaining mother-liquor is practically a solution of sodium sulphydrate, which is treated with carbonic acid, the action being as follows:—$2NaHS + CO_2 + H_2O = Na_2CO_3 + 2H_2S$. The sulphuretted hydrogen given off during the carbonating process is either converted into sulphurous acid or sulphur (depending on the amount of oxygen present) by passing it through a "Claus" kiln.—S. H.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Composition of Old Ceramic-ware. E. Jensch.
Ber. **19**, 2850—2853.

The author has met with so few published analyses of old ceramic-ware (which occurs in great abundance in Brandenburg), that he has taken the opportunity lately afforded him of analysing pieces chipped from German urns from some of the ancient burying-places. An estimation of the water in them gave the following results:—

	1	2	3	4	5	6
Water, per cent.	1·21	3·46	0·88	2·02	5·29	3·71
	7	**8**	**9**	**10**	**11**	**Mean.**
Water, per cent.	1·53	0·62	1·31	0·79	1·64	1·95

	1	2	3	4	5	6	7	8	9	10	11	Mean.
SiO_2	60·83	59·74	62·46	66·70	61·32	58·89	53·24	68·11	64·57	59·18	63·08	61·68
Al_2O_3 ..	30·76	31·81	27·27	31·10	36·57	37·61	36·88	26·29	27·70	30·32	29·87	31·50
Fe_2O_3 ..	2·42	1·09	3·17	·51	1·07	1·10	2·11	·15	1·77	1·70	1·12	1·52
FeO	·57	1·61	·44	—	·33	—	·38	1·32	—	·43	·50	·51
CaO	·19	1·51	1·21	·22	·18	1·43	1·51	1·23	2·83	2·21	1·32	1·20
MgO ..	·66	1·83	·89	·35	·21	—	1·03	·76	·28	·85	·49	·82
Alkalis.	2·85	2·07	2·93	·95	·13	·64	2·36	1·22	·69	2·49	2·18	1·06
P_2O_5 ..	·09	—	·01	—	—	·01	·62	—	·75	·07	·02	·14
SO_3	—	—	·11	—	—	·02	·10	·01	—	·01	·04	·03
MnO ..	·70	·05	·23	—	—	—	·07	—	·27	·82	·16	·21
Total..	99·77	99·35	98·73	100·16	99·81	99·70	98·30	99·39	98·66	98·34	98·78	99·25

It was also of interest to know what amount of water might exist in chemical combination, the ware having now been exposed to the action of moist earth for so many centuries. The pieces, after being dried at 105°, were raised to a bright red heat, when they lost the following:—

Per Cent.	1	2	3	4	5	6
Loss of weight	2·36	3·17	1·55	8·30	4·23	5·01
Collected H_2O	2·21	—	1·48	8·32	4·17	4·82

Per Cent.	7	8	9	10	11	Mean.
Loss of weight	9·40	1·88	2·42	3·30	2·67	4·02
Collected H_2O	—	—	—	3·11	2·18	3·80

The analysis of these ignited pieces gave the results as shown in table on preceding page. On account of the remarkably high percentage of P_2O_5 in Nos. 7 and 9, this determination was repeated several times with the surprising result, that the phosphoric acid was found to be unequally distributed through the ware.

	a	*b*	*c*	*d*	*e*	
No. 7	·26	·85	·32	·74	·66	Per cent.
No. 9	·41	·12	·97	·30	·36	P_2O_5

An analysis of the clay taken from the same district gave the following:—

SiO_2	62·67
Al_2O_3	29·34
Fe_2O_3 FeO	3·56
CaO	1·17
MgO	0·53
Alkalis	2·02

It may therefore be supposed that the ware was made at the spot where the clay was found.—J. W. L.

An Improved Method of Uniting Metal and Glass. H. H. Lake, London. From B. B. Schneider, New York, U.S.A. Eng. Pat. 3728, March 16, 1886. 8d.

THE union of metal and glass is effected by coating the contact surface of the former with a vitreous enamel or with glass powder fused on, and pressing the two together while in a heated state. By this method it is claimed that glass linings can be fastened in metal cups, metal handles secured to glass vessels, and other similar effects produced.—E. T.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Improvements in the Manufacture of Cements or Plasters. C. D. Alison, Camberwell. Eng. Pat. 1126, Jan. 27, 1886. 4d.

THE improved cement consists principally of a non-diatomaceous silicious earth in a finely divided state mixed with various salts of lime, magnesium, sodium, potassium, barium, and zinc. The following mixture gives good results as a fire-proof cement:—Silicious earth 83 per cent., silicate of soda 15 per cent., ground gypsum 2 per cent.—C. C. H.

X.—METALLURGY, Etc.

An Improved Method of, and Means for, Extracting Spelter, and in Apparatus for Treating the Waste Products. W. Tooth, Newington, Sussex. Eng. Pat. 1102, Jan. 25, 1886. 8d.

THE mouth of the fire-clay retort is flanged, and thus fitted air-tight to a front plate by T-headed bolts aided by a lute. To this plate is hinged (horizontally) a conical nozzle, having at its highest point a narrow tubular exit for gases, and at the bottom, which is made level, a plugged tap-hole. In the front is a small cap, removable at will, to facilitate the inspection of the retort during the operation. When coal is employed in the reduction, the hydrocarbon gases may be collected and stored. Calcium carbonate is added to the charge, the proportion depending upon the quantity of alumina and silica present; the residue in the retorts may then be used as a substitute for Portland cement.—W. G. M.

A New or Improved Powder for Hardening Metals. L. A. Groth, London. From C. Beckstein, Reutlingen, Germany. Eng. Pat. 3632, March 15, 1886. 4d.

AFTER extracting the colour from the cochineal insect, 100 parts of the residue are mixed with 212½ parts of phosphoric acid and sufficient nitrogenous organic substance to give 32¼ parts of nitrogen; the mixture is then evaporated, dried and 50 parts of soot added. Sheet-iron may be hardened by heating in contact with this powder in hermetically closed boxes.—W. G. M.

An Improved Basic Lining for Metallurgical Apparatus. A. M. Clark, London. From H. Harmet, St. Etienne, France. Eng. Pat. 3867, March 18, 1886. 6d.

BLOCKS of pure lime, prepared in the usual manner by the calcination of natural limestones, are maintained at a sufficient heat to prevent absorption of water until they can be cut, preferably by means of a band saw, into bricks of the required size. These bricks are either maintained hot or are waterproofed by plunging them into tar or pitch. They must be laid rapidly in position and be backed by a couple of inches of coke and tar mixture, to protect the metallic sheathing from the action of any of the fluid charge which may find its way through cracks in the lining. The furnaces must then be blown in immediately. The old linings, as well as the dust produced by the band saws, may be used as a part of the basic Bessemer lime charge.—W. G. M.

Improvements in the Treatment of Fume in Lead Works. J. Warwick, Newcastle-on-Tyne. Eng. Pat. 12,861, Oct. 9, 1886. 8d.

THE fume is passed through a series of flattened corrugated siphon-pipes, cooled by air or water, on its way to the chimney.—W. G. M.

An Improved Process for Treating and Desilverising Copper Matte and Copper Ores analogous to Copper Matte. H. E. Newton, London. From J. J. and R. Crooke, New York, U.S.A. Eng. Pat. 16,386, Dec. 14, 1886. 8d.

SINCE, in the removal of silver and gold from mattes by fusion over a bath of molten lead, the formation of any lead sulphide interferes with the separation, the inventor proposes to place iron bars beneath the lead but not in contact with any of the matte. The lead is thus desulphurised and the iron sulphide formed rises through the metal bath and unites with the regulus or slag. A reverberatory furnace is employed, having a sloping bottom, with a tap-hole at the upper side for matte, and one on the lower for lead. In the wall of the lower side, at the level of the sole, are several arched recesses communicating with vertical channels in the wall, in which rest the soft iron rods intended for desulphurising. In working the furnace, the lead level must always be above the recesses. If preferred, an already hard lead may be used to extract the first portion of the precious metals with antimony and arsenic, the final treatment being effected with pure lead. The iron bars must be withdrawn during the time that lead is absent from the furnace.

—W. G. M.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

Some Derivatives of Erucic Acid and Brassidic Acid. C. L. Reimer and W. Will. Ber. **19**, 3320—3327.

IN order to obtain erucic acid from rape-seed oil, the authors adopt the following method:—After saponifying the oil with alcoholic potash, the bulk of the alcohol is distilled off and the residue treated with sulphuric acid, when the fatty acids separate. To obtain erucic acid, this mixture of fatty acids is treated with three times its volume of 95% alcohol and the solution cooled to 0°, when the erucic acid separates out in a crystalline form. By one repetition of this process it is obtained chemically pure.

To prepare brassidic acid, it is recommended to heat erucic acid with dilute nitric acid until the former melts (instead of till an evolution of gas commences), and then add sodium nitrite. The formation of oxidation products is thereby avoided. It is not necessary to start from pure erucic acid, for simply by treating the mixture of fatty acids obtained from rape-seed oil in this manner, the brassidic acid is readily obtained, and can be easily purified on account of its slight solubility in alcohol. The derivatives of these two acids described are substitution products in the carboxyl group. Although tri-erucin could not be isolated from rape-seed oil, tri-brassidin can be obtained by treating with nitric acid and sodium nitrite. This body, like the tri-glycerides of palmitic, stearic and myristic acids, possesses a double melting-point. The so-called "stearin" of the oil merchant, a yellow-white substance which separates in the bottom of rape-seed oil barrels after long standing, is di-erucin. This is readily converted into di-brassidin. They are both crystalline bodies. The ethyl-ethers of these acids closely resemble one another, as do their anhydrides obtained by the action of phosphorus tri-chloride. Their amides and anilides are crystalline bodies; the former, when treated with phosphorus pentoxide, appear to yield the corresponding nitriles, but these have not been obtained pure. The ketones of these acids, obtained by the distillation of their respective calcium salts, differ from one another and are both crystalline bodies.—C. A. K.

XII.—PAINTS, VARNISHES, AND RESINS.

Improvements in, or relating to, Enamelling or Coating Wood, Paper, Cloth, Papier-mâché, and other Fibrous or Porous Materials, with Comparatively Impervious Coating or Enamel. W. P. Thompson, Liverpool. From J. A. Pond, Auckland, New Zealand. Eng. Pat. 3572, March 13, 1886. 8d.

THE enamel, which is composed of shellac, is applied, either in the liquid or solid state, to the surface to be coated under great pressure, and at a temperature of 230—300° F. For certain purposes a small percentage of beeswax, stearic, oleic, or any other fatty acid is added. The surface of the material to be enamelled is first varnished with a solution of shellac in methylated spirit.
—E. G. C.

An Improved Composition or Paint for Preventing Attachment of Barnacles to the Bottoms of Iron and Steel-plated Ships. A. C. Ireland and J. R. Bowbeer, Bristol. Eng. Pat. 3636, March 15, 1886. 6d.

THE composition consists of 35% copper sulphate, 40% oxide of iron, 15% pulverised black lead and 10% calcium carbonate, the proportions being varied according to requirement.—E. G. C.

Manufacture of an Elastic Compound in Imitation of Caoutchouc. O. Imray, London. From A. K. Kissel, Frankfort-on-Main, Germany. Eng. Pat. 4918, April 8, 1886. 4d.

ELASTIC compounds have already been made consisting of oil, sulphur and copal, but owing to the expense of copal, could not be used as substitutes for caoutchouc. In this invention the expensive copal is replaced by resin hardened by treatment with caustic lime, etc., as described in Eng. Pat. 8036, 1884. The proportions of the ingredients and temperature employed depend upon the degree of hardness and elasticity required.
—E. G. C.

XIV.—AGRICULTURE, MANURES, Etc.

Chemical Study of Vegetable Albinism: Part III.—Experiments with Quercus rubra. A. H. Church. J. Chem. Soc. (Trans.) 1886, 839—843.

IN two former papers (*J. Chem. Soc.* 1879, 33—41; 1880, 1—6) the author described some conspicuous chemical differences between the white and green foliage of seven distinct plants. The conclusions arrived at from these experiments are now corroborated by comparative analyses of the ordinary foliage and of an albino bough of a forest tree (*Quercus rubra*) in Kew Gardens. The albino leaves are on the average smaller and thinner than the corresponding green ones; the albino bough, its branches and twigs, are of less diameter and length than neighbouring green boughs of corresponding age. The leaves gave on analysis—

	White	Green.
Water	72·69	58·08
Organic Matter	24·65	40·33
Ash	2·66	1·59

The ash of the two sorts of leaf gave on analysis—

		White.	Green.
Ash in dry leaves of *Quercus rubra*		8·33	3·85
100 parts of ash contained—	K_2O	49·38	29·10
	CaO	8·25	21·50
	MgO	6·52	9·55
	Fe_2O_3	0·82	1·24
	Mn_3O_4	2·08	2·36
	P_2O_5	14·25	15·80
	SO_3	7·18	10·05
	Cl	4·25	1·25
	SiO_2	3·15	1·25

These analyses, like those of 1877—79, show the preponderance of potash over lime in the albino foliage, of mineral matter over organic, and the remarkable deficiency of lime. As regards the nitrogen, the results which have been obtained with the scarlet oak are placed side by side with those formerly obtained with *Elæagnus pungens*—

	ELÆAGNUS PUNGENS.		QUERCUS RUBRA.	
	White.	Green.	White.	Green.
Total Nitrogen	4·23	2·82	3·94	2·78
Albuminoid Nitrogen	1·83	1·81	2·65	2·41
Non-albuminoid Nitrogen	2·40	1·01	1·29	0·37

There is no doubt the excessive quantity of non-albuminoid nitrogen contained in the albino foliage is another sign of imperfect elaboration.

Notwithstanding the absence of chlorophyll, and the smaller percentage of total organic matter, the white leaves yield a larger ether extract than the green leaves—5·35 and 5·15% of the dry leaves respectively.

The author's previous conclusion is reaffirmed, that "white leaves are related to green pretty much as immature leaves are to mature, tubers to foliage, petals to green bracts, vegetable parasites to their hosts."
—J. M. H. M.

XV.—SUGAR, GUMS, STARCHES, Etc.

Arabinose. H. Kiliani. Ber. **19**, 3029—3036.

THE author now includes arabinose in his researches on the action of HCN and HI on carbohydrates (*Ber.* **18**, 3066; **19**, 221, 767, 1128, 1914). He obtained the arabinose from cherry-tree gum, as suggested by Bauer (*J. Prakt. Chem.* **30**, 379; **34**, 46). The best results were obtained as follows:—One part cherry-tree gum, in 8 litres of 2 per cent. H SO_4, was heated on the water-bath for 18 hours. The solution was neutralised with hot concentrated $Ba(HO)_2$ solution, concentrated, without previous filtration, to a small volume, and then several volumes 96 per cent. alcohol added, the whole being well shaken. The clear solution was decanted, the greater part of the alcohol distilled off and the residue evaporated to a thin syrup. After again treating with alcohol in like manner the residue crystallised and after removal of the mother-liquor had a pure white colour, and was obtained quite pure by recrystallisation from alcohol. The remainder of the arabinose left in the mother-liquor could be obtained by further purification with alcohol. That the substance thus obtained was really arabinose was proved (1) by the rotatory power $[\alpha]_D = + 105 \cdot 1°$; (2) because nitric acid produced no trace of mucic acid; (3) by oxidation with Br which gave Bauer's arabonic acid. In consequence of several remarkable features of the last reaction, the arabonic acid was studied somewhat more completely. Results generally confirmatory of Bauer's were obtained, but the analytical numbers for the calcium salt agreed best with the formula $(C_5H_9O_6)_2Ca + 5H_2O$. The arabonic acid would, therefore, be a tetrahydroxyvalerianic acid, and although Bauer's analytical data of the free acid do not agree at all with such a compound, the author believes that it was not the free acid but the dehydro acid which Bauer obtained, the analytical numbers agreeing well with such a formula. If these results are correct, arabinose is an α-ketone, which by the action of Br is quantitatively split up into arabonic acid and carbonic or formic acid.

Action of HCN on Arabinose.—One part of arabinose was dissolved on the water-bath in one part of water, and after cooling, an equivalent quantity of 60 per cent. HCN added, the solution being kept in a well-closed flask placed in a vessel of water at the ordinary temperature. After standing 8 days, crystals of the amide of arabinose-carboxylic acid $C_7H_{15}O_7N$ separated. On heating to 130° this amide turns yellow, and at 160° it decomposes with rapid disengagement of gas. In order to prepare the acid itself, the amide was decomposed with baryta water, the Ba precipitated with H_2SO_4 (one or two drops of HCl added keep the solution clear) and the solution concentrated, when, on cooling, colourless shining needles separated. These are easily soluble in water, difficultly soluble in alcohol, and have a neutral reaction. The substance appears to be the dehydro-arabinose-carboxylic acid $C_7H_{12}O_7$, and not the acid itself. It melts at 145—150°, and possesses a rotatory power of $[\alpha]_D = - 54 \cdot 8°$. Although these properties agree closely with those of the dehydrodextrosecarboxylic acid, the crystalline form, which is rhombic, is entirely different, and the action of HI on the arabinosecarboxylic acid produces only a dehydro acid, whereas the dextrosecarboxylic acid produces the normal heptoic acid, thus proving the dissimilarity. The barium and calcium salts were prepared by boiling the dehydro acid with the respective carbonates. They are amorphous, and the analysis of the calcium salt coincided with the formula $(C_7H_{13}O_8)_2Ca$.

—J. W. L.

The Formation and Composition of the Humus Substances. M. Conrad and M. Guthzeit. Ber. **19**, 2844—2850.

THE authors' experiments show that with diluted H_2SO_4, cane sugar is split up, and of the invert sugar as first formed, the levulose is more rapidly decomposed than the dextrose, and that, from the former, ulmin is the principal product, the dextrose producing ulmic acid, which, however, changes to insoluble humin by continued boiling with an acid. They further prove that formic and acetopropionic acids are formed almost exactly in equal molecular proportions. From Tollen's researches it may be inferred that two reactions take place together, producing, besides water, formic and acetopropionic acids on the one hand and humus substances on the other. The authors have, however, as yet, no experimental results to prove this. Another of Sestini's experiments was again carried out—viz., that of heating the humus substances; and the results coincided with his, vapours condensing to a colourless liquid being given off, which reduced silver salts. In the following tables the main results of the experiments are placed together, and require no further explanation than that the humus substances were dried at 110—120° for analysis:—

A.—DECOMPOSITION OF THE SUGARS WITH SULPHURIC ACID.

	Sugar.	Dilute Acid.	Containing H_2SO_4.	Amount of Humus obtained.	Composition of the Humus Substance.	
	Grms.	cc.	Grms.	Grms.	C %	H
Cane Sugar ..	20·0	50	3·57	2·6	63·5	4·2
Galactose	10·5	25	1·80	0·17	—	—
Levulose	10·5	25	1·80	2·6	63·3	4·1
„	10·5	20	1·7	2·9	63·3	4·6
Dextrose	10·5	50	3·5	0·13	—	—
„	10·5	25	1·75	0·20	62·3	4·4
„	10·5	25	8·6	0·95	—	—
„	10·5	25	11·8	2·40	63·7	4·6
„	10·5	25	15·2	3·00	—	—
„	10·5	25	23·2	3·2	65·17	4·5

B.—DECOMPOSITION OF THE SUGARS WITH HYDROCHLORIC ACID.

	Sugar.	Dilute HCl.	Containing HCl.	Amount of Humus obtained.	Composition of the Humus Substance.	
	Grms.	cc.	Grms.	Grms.	C %	H %
Cane Sugar ..	20·0	60	4·19	3·65	65·5	4·5
„ ..	26·0	50	5·11	3·80	—	—
„ ..	20·0	50	9·40	5·40	—	—
Milk Sugar ..	21·0	50	4·90	3·70	—	—
„ ..	21·0	50	4·87	3·91	—	—
Maltose	10·5	50	4·87	1·35	65·2	4·5
„	10·5	50	4·87	1·33	65·2	4·2
Arabinose ..	10·5	50	4·85	3·94	65·6	4·1
„ ..	10·5	50	4·85	4·30	65·8	4·0
Levulose	10·5	50	4·87	2·05	61·1	4·4
„	10·5	50	4·31	2·00	63·7	4·3
Galactose	10·5	50	4·87	1·60	63·2	3·7
„	10·5	50	4·84	1·77	63·8	4·2
Dextrose	10·5	50	4·78	1·00	64·6	4·2
„	10·5	150	15·0	0·93	65·1	4·6
„	10·5	50	9·6	1·70	—	—
„	10·5	50	17·0	4·15	66·4	4·1
„	10·5	50	22·0	4·50	66·5	4·0

The main results of the research are (1) the amount of humus substances obtained stand in no simple relation to the formic acid, (2) the saccharoses are first inverted before a further decomposition sets in, (3) with the exception of levulose, the carbohydrates produce more humus substances with HCl than with H_2SO_4, (4) the production of humus substances is increased with the concentration of the acid, (5) levulose gives more humus substances than any other carbohydrate. (6) the humus substances contain 62—66 per cent. C., and 3·7—4·6 per cent. H.—J. W. L.

Glycyphyllin, the Sweet Principle of Smilax Glycyphylla. E. H. Rennie. J. Chem. Soc. 1886 (Trans.), 857—865.

FURTHER investigation of this substance shows that it has the formula $C_{21}H_{24}O_9+3H_2O$ when crystallised from aqueous ether, and $C_{21}H_{24}O_9+4\frac{1}{2}H_2O$ when crystallised from water. When boiled with dilute sulphuric acid it undergoes decomposition in accordance with the equation $C_{21}H_{24}O_9+2H_2O=C_{15}H_{14}O_5+C_6H_{14}O_6$, forming *phloretin* and *isodulcite*. Glycyphyllin is, therefore, closely allied to phlorizin. The phloretin was identified by analysis and by the production of phloroglucol and phloretic acid when boiled with strong caustic potash. The isodulcite was identified by analysis and by its crystalline form; assuming that 10cc. Fehling's solution are reduced by 0·0549grm. isodulcite (Will), almost the theoretical percentage of isodulcite demanded by the above equation was produced. The author suggests the possibility that in the decomposition of phlorizin by acids isodulcite is produced, which may have been mistaken by previous observers for glucose. In that case phlorizin would be identical with glycyphyllin. The relation between these two substances is being investigated.—J. M. H. M.

Raffinose or Melitose and its Quantitative Determination. R. Creydt. Ber. **19**, 3115—3119.

IN consequence of a paper by Scheibler on the above subject, (*Ber.* **19**, 2868), the author again publishes a paper which he has already communicated to a sugar trade journal. (See also this Journal, 1886, 386.) It is possible to estimate raffinose by two methods:—(1) By polarisation and inversion, and calculation of the results by the formula given below; and (2) By oxidation with nitric acid, and determination of the amount of mucic acid formed.

(1.) *Method of Inversion.*—When pure cane-sugar or raffinose was inverted with 5cc. of 38 per cent. hydrochloric acid in 100cc. of the sugar solution, the author found that for every 100 scale divisions of Schmidt and Hänsch's half-shade polariscope before inversion, there were obtained after inversion, −32·0 scale-divisions with cane-sugar, and +50·7 with raffinose, the readings being made at 20° C. From these numbers the author obtained the following formulæ:—A = direct reading, B = reading after inversion, C = difference between the readings; then

$$\text{Cane-sugar (per cent.)} \quad \frac{C-0{\cdot}493A}{0{\cdot}827}$$

$$\text{Raffinose (per cent.)} = \frac{A-\text{Cane sugar per cent.}}{1{\cdot}57}$$

These formulæ give good results provided not much already inverted sugars, invert sugar, or dextran, for instance, are present, which influence the results.

(2.) *Oxidation Method.*—A quantity of the substance for analysis, equal to at least 5grms. dry substance, is mixed with 60cc. nitric acid of 1·15 sp. gr., and evaporated on a water-bath to one-third the original volume. The raffinose is thus completely oxidised to mucic acid. The oxidised liquid is mixed with water, and the precipitated acid collected on a tared filter, washed and weighed. Experiments on pure raffinose and mixtures of pure raffinose and cane-sugar, showed that it is possible to determine the sugar within 0·3 per cent. This method is not affected by the presence of invert sugar, etc., since none of these substances yield mucic acid on oxidation. The only known constituent of molasses which gives mucic acid, is Lippmann's levulan, which is rarely present, and then only in small quantity.

Tollens maintains the opinion that the formula of raffinose is $C_{36}H_{64}O_{32}+10H_2O$ (compare this Journal, 1886, 243), and not $C_{12}H_{22}O_{11}+3H_2O$.—G. H. M.

XVI.—BREWING, WINES, SPIRITS, Etc.

New or Improved Aërated Beverages. H. R. Matthews, London, and C. G. Matthews, Burton-on-Trent. Eng. Pat. 3928, March 9, 1886. 4d.

THESE improved beverages are made by mixing wines, spirits or liqueur with water or mineral water in the desired proportions and then bottling and aërating the mixture in the usual way. The advantages gained are constancy of quality and strength and saving of time. —G. H. M.

Improvements in Aërating Brewers' Wort and other Liquids, and in Machinery or Apparatus therefor. F. Faulkner, Oldbury, and W. Adlam, Bristol. Eng. Pat. 4071, March 23, 1886. 11d.

THESE consist in aërating brewers' wort either in the copper, hop-back or cooler—preferably the former—by means of a blast of hot air, in order to render insoluble certain deleterious nitrogenous compounds. The process may also be applied to the "mash-wash" employed in the manufacture of vinegar. The aëration of worts with cold air, whilst undergoing the process of fermentation, is also included in the patent; in this case it is necessary to free the air from germs by filtering it through cotton-wool before blowing it through the fermenting liquid. Full descriptions and illustrations of the plant employed are given in the specification. —G. H. M.

Improvements in Maturing Alcoholic Liquids. W. W. Crawford, Glasgow. Eng. Pat. 4311, March 27, 1886. 6d.

THE maturing is effected by immersing pieces of wood framed together in the casks containing the alcoholic liquid—whisky, for instance. The wood is said to absorb the noxious ethers or essences, and so hasten the maturing of the spirit. This may also be done by applying permeable discs of wood or other material to the cask in such a way that the ethers, etc., rising from the alcoholic liquid, may have access to their under surface, and be able to escape from their outer surface. —G. H. M.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(*A*) CHEMISTRY OF FOODS.

The Manufacture of Dry Rennet and Process therefor. G. F. Redfern, London. From L. J. Eriksson and E. E. R. Nordling, Upsala, Sweden. Eng. Pat. 11,835, Sept. 17, 1886. 6d.

RENNET BAGS are treated with very dilute hydrochloric acid below a temperature of 40° C.; the extract is then filtered, if necessary, and neutralised with soda lye. To regulate its strength it is tested with milk known to contain both acid and alkali. Suitable gelatinous matter is then added and also some glycerin before drying, to keep it soft and prevent crumbling.—E. T.

(*B*) SANITARY CHEMISTRY.

On the Changes that occur in Suint Waters. A. Buisine. Bull. Soc. Chim. **46**, 497.

THE author finds that the percentage of potassium carbonate in suint varies greatly according to its age, degree of concentration, and so on. Microscopic organisms grow readily in suint waters when left undisturbed, and bring about important chemical changes. A final product of the fermentation, which passes through several stages, is potassium carbonate formed at the expense of the organic salts of the suint. The first change, which may take place in absence of air, is completed in a few days; it is characterised by the formation of potassium salts of carbon and volatile acids, and, simultaneously, urea is converted into ammonium carbonate, and hippuric acid into glycocoll and benzoic acid. In contact with air a second change rapidly occurs, organic substances being completely oxidised to water and carbon dioxide, of which the latter is partially retained by the potash. After this the volatile acids, together with lactic, oxalic and succinic acids, disappear: and lastly, the higher fatty acids and the nitrogenous compounds are decomposed. The benzoic acid appears to remain unaltered. The only gas evolved is carbon dioxide.—S. Y.

An Improved Process for the Softening and Purification of Liquids, and the Construction of Apparatus used therewith. P. A. Maignen, London. Eng. Pat. 2068, Feb. 12, 1886. 8d.

For the purpose of softening water the patentee uses the reagents in the liquid state, and prepares for this purpose "a single solution of the following substances: Quicklime, carbonate or silicate of soda (alum being omitted in this last case), and alum or sulphate of aluminium to suit the character of the liquid to be treated," and finds "when these reagents are mixed together in one solution they do not interfere with one another." After treatment with this solution the turbid water is passed through a "separator;" a vessel which contains shelves packed with spiral wire, sponge, charcoal, wood shavings or other absorbent material.
—C. C. H.

(C) DISINFECTANTS.

An Improved Absorbent and Antiseptic Fabric. T. Roberts, Manchester. Eng. Pat. 1200, Jan. 27, 1886. 4d.

A twilled cotton fabric with a raised or carded surface is rendered antiseptic by treatment with boric acid, carbolic acid and acetate of lead.—C. C. H.

Novel Applications of a Material or Substance produced by the Treatment of Waste Leather. W. Ross, London. Eng. Pat. 9604, July 24, 1886. 6d.

The material consists of the product resulting from the treatment of leather cuttings or waste leather according to the manner described by Newton, Eng. Pat. 1856, 1878. The material (called by the patentee "Calcerine") is to be used as a deodorant or disinfectant. Mixed with stable or similar manure, it absorbs and retains the valuable and volatile emanations. In order to form a liquid manure, calcerine is dissolved in a solution of about one part aqueous ammonia to 99 parts water. The calcerine powder can also be used as an anti-incrustator for steam boilers and for case-hardening iron and steel.—B. H.

An Improved Deodorising Material. J. Watt, South Melbourne, Victoria. Eng. Pat. 15,201, Nov. 22, 1886. 4d.

Spent tan, thoroughly dried and ground to a fine powder, is used for the purpose named. -C. C. H.

For Destroying Bad Smells and Noxious Gases in Sewers, and effectively Ventilating them by the Action of Fire in Flame, or by Heat-producing Substances. G. R. Keeting, Epsom. Eng. Pat. 11,255, Sept. 22, 1885; amended Nov. 24, 1886. 6d.

The apparatus consists of a hollow cast-iron column placed over the mouth of the sewer or drain. In the base is a chamber, fitted with an "atmospheric" gas burner placed under two annular conical cups, which are surmounted with a cap packed with asbestos. The foul air is thus consumed before its passage into the external atmosphere.—C. C. H.

XVIII.—ELECTRO-CHEMISTRY.

Improvements in Electric Batteries. J. Y. Johnson, London. From L. A. W. Desruelles, Paris, France. Eng. Pat. 2631, Feb. 23, 1886. 4d.

To diminish local action, the soluble electrodes are coated with fat or grease (preferably mineral) crushed with mercury, which may contain as amalgam a metal analogous to the soluble electrode.—E. T.

Improvements in the Treatment and Preparation of Materials used in Electric Batteries. J. Y. Johnson, London. From L. A. W. Desruelles, Paris, France. Eng. Pat. 2632, Feb. 23, 1886. 6d.

The partially spent liquids from powerful primary batteries, such as bichromate, according to this invention, are utilised in batteries for working telegraphs and similar purposes, where only a small current but a high E.M.F. are needed. To render these liquids portable, they are mixed with Kieselguhr or other porous or absorbent or acid-proof material, and dried by vaporising the water. When required for use, the addition of water is all that is necessary. The negative electrodes of batteries can be efficiently protected from corrosion by a mixture of grease and mercury.—B. T.

Improvements in Galvanic Batteries. A. Schanschieff, London. Eng. Pat. 2932, March 1, 1886. 6d.

The improved battery has an outer cell made preferably of water-proofed paper. The positive element is zinc, and the negative carbon, the latter being either in the form of a porous vessel or of a flat plate or rod in a porous vessel of some other material, such as earthenware or linen that has been dipped in collodion. Inside the porous vessel is packed peroxide of lead or manganese, mixed with carbon granules. Sometimes an agglomerated block of carbon and peroxide is used as the negative element. Mercury sulphate prepared as in Eng. Pat. 12,378, of 1885, is used as electrolyte. When the peroxide is exhausted, a strong solution of some material, such as chloride of lime (bleaching powder), which is able to restore the peroxide, is used instead of mercury sulphate. Other sulphates than that of mercury may be used but to less advantage.—E. T.

Improvements in Galvanic Batteries. A. Schanschieff and G. R. Fludder, London. Eng. Pat. 3476, March 11, 1886. 8d.

The elements of these batteries are secured to covers of insulating material, one cover serving for several cells. The upper ends of the zincs pass through slots in the cover and are held by pressure between pieces of springy brass bent twice at right angles, and the sides of the slot. The carbons may be secured in the same way or by angle-pieces of metal fastened to them. The cover, and with it the elements, are drawn up by cords wound on a drum fastened to the top of the box, and capable of being turned by hand.—E. T.

Improvements in Voltaic Piles and Accumulators. P. Haddan, London. From J. Crosse, Paris, France. Eng. Pat. 4057, March 23, 1886. 6d.

A diaphragm of cocoanut fibre or compressed powdered cork is saturated with the required chemical fluids and placed between the electrodes of an element in a voltaic battery or accumulator, instead of the exciting liquids as ordinarily used.—B. T.

A Process for Utilising the Spent Liquid from certain Voltaic Batteries. W. S. Squire, London. Eng. Pat. 4522, March 31, 1886. 4d.

The spent liquid of certain batteries in which caustic potash or soda is used, consists of potash or soda combined with oxide of zinc. By means of sulphuretted hydrogen, sulphide of zinc (impure) is precipitated, the caustic potash or soda left in the solution being decanted for use. The impure sulphide of zinc, when treated with sulphuric or hydrochloric acids, yields sulphuretted hydrogen, which may be used as above, and sulphate or chloride of zinc. These may, if desired, be converted into valuable pigments by adding barium sulphide. —E. T.

Certain New and Useful Improvements in Secondary Batteries acting as Accumulators of Electricity. E. Commetin, G. Bailhache, C. Desmazures, A. de Virloy, and L. de Bousignac, Paris, France. Eng. Pat. 7966, June 15, 1886. 6d.

In the improved secondary battery, the positive pole consists of spongy or porous copper plates, or of spongy or porous plates of other metals insoluble in soda or potash. The negative pole consists of brass or other metallic plates wrapped in a gauze of brass wire. These plates are placed horizontally in an aqueous solution of an alkaline salt with a metallic acid or a metallic oxide acting as an acid, such as zincate of soda; some chlorate of soda also is added. The plates and solution are contained in a sheet steel or iron vessel coated with a solution of indiarubber.—B. T.

An Improved Solution or Electrolyte for Primary Electric Batteries. H. Weymersch and J. Whittall, London. Eng. Pat. 9594, July 24, 1886. 6d.

The inventors claim as an efficient solution for any species of primary battery, one containing permanganate of potash, sulphate of potash, sulphate of magnesia, bichromate of soda, sulphuric acid and water in suitable proportions. To obtain a solid compound for transport, etc., chromic acid is substituted for sulphate of magnesia, the proportions being varied.—E. T.

Improvements in or relating to Batteries. A. J. Boult, London. From H. B. Cox, Cincinnati, U.S.A. Eng. Pat. 12,656, Oct. 5, 1886. 4d.

To obtain a primary battery capable of being carelessly handled and even of being inverted without damage, the inventor adds enough gelatine, or other thickening agent, to the battery liquid to bring it to the consistency of a thick jelly.—B. T.

Improvements relating to the Preparation of Metallic Magnesium by Electrolytes, and to Solutions therefor. H. H. Lake, London. From Count R. de Mongelas, Philadelphia, Penn., U.S.A. Eng. Pat. 14,760, Nov. 13, 1886. 4d.

Into a bath made up of concentrated solutions of zinc chloride and magnesium chloride dip an anode of zinc and a cathode of carbon, brass or copper. By passing an electric current through the bath, an alloy of zinc and magnesium is deposited; from this alloy magnesium may be obtained in any known way.—B. T.

Improvements in the Preparation of Organic Matter for Metallisation by Galvanic Deposit. A. J. Boult, London. From "La Société anonyme de Métallisation artistique des Animaux, Vegetaux ou autre Corps, Paris, France." Eng. Pat. 15,403, Nov. 25, 1886. 4d.

A quantity of snails or slugs are washed and placed in distilled water for a sufficient time to allow them to give off their albumen. The albumen is then filtered, boiled for an hour, and about 3 per cent. of silver nitrate added. 30grms. of this liquid are dissolved in 100grms. of distilled water, and the objects to be prepared are submerged in the solution for a few moments; they are next placed in a 20 per cent. solution of silver nitrate and afterwards submitted to the action of "hydrosulphuric gas."—B. T.

Improvements in the Method of, and Apparatus for, Desiccating the Insulating Coverings of Electrical Apparatus. N. J. Raffard, Paris. Eng. Pat. 15,462, Nov. 26, 1886. 6d.

In the improved method of desiccating an electrical conductor, the latter is passed continuously through a vessel containing any substance with which it is to be covered, and thence air-tight through the desiccator proper, which consists of a steam-jacketed vessel, kept exhausted by an air-pump. It then passes through a vessel containing paraffin or other suitable substance. Electrical apparatus is desiccated in a vessel of proper size, warmed in the most suitable and convenient manner, and exhausted by an air-pump. In certain cases the conductors are heated by passing a current of electricity through them while in the vacuum apparatus.—E. T.

Improvements in the Manufacture of Blocks, Plates, or Rods of Carbon for Electrical or other Purposes. H. H. Lake, London. From E. Shaw, Lynn, Mass., U.S.A. Eng. Pat. 15,653, Nov. 30, 1886. 4d.

Seaweed is thoroughly washed by hot water or steam, dried and carbonised; the resulting product is treated with a suitable dilute acid, leaving a pure and very soft carbon, which can be made into various articles by proper machinery. These are claimed to be more suitable, especially for electrical purposes, than those made from any other species of carbon, and to be much less expensive.—E. T.

Improvements in Electric Batteries. H. H. Harris, London. From Count R. de Montgelas, Philadelphia, U.S.A. Eng. Pat. 15,961, Dec. 6, 1886. 6d.

According to this invention, in a galvanic cell a "positive" element of aluminium is used with zinc or any other suitable "negative" element, or a positive element of some material other than aluminium is used with circuit-connections of aluminium.—B. T.

XIX.—PAPER, PASTEBOARD, Etc.

Improvements in the Construction of Boilers for Treating Wood and Other Fibre in the Manufacture of Paper and Other Pulp. J. M. Walton, Glossop. Eng Pat. 16,113, Dec. 9, 1886. 6d.

This invention relates, in the first place, to improvements on an invention made by C. C. Springer, Boston, Mass., U.S.A., Eng. Pat. 8073, July 3, 1885; the object of the present invention being to do away with inside "covering strips," and in the second place to avoid the use of lead-covered bolt heads in the interior of the boiler. The lead lining of the boiler is made in sections of such size and form as to leave an open joint between their edges, which may be packed or left open according to circumstances. Strips of lead or other compressible and acid-resisting material are laid over the joints, these strips being let into each other where the zones cross so as to break joint. These strips are held down by a series of lead-covered cast-iron blocks, which are curved to the form of the inside of the boiler and are laid with their ends touching each other so as to form circumferential rings or zones at right angles to each other or nearly so. These blocks are made thicker at the centre and gradually chamfered off. They are perforated with holes and have a lead covering cast thereon, the lead passing through the perforations and uniting the front and back parts of the covering. Each block is bored in the centre on the side next to the lining, but only extends about two-thirds through the cast iron. This hole is tapped, a corresponding hole being made through lead lining, shell and sheathing of the boiler. The blocks are secured in their places by screw bolts from outside; thus there are neither bolt heads nor nuts inside the boiler.—H. A. R.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Synthesis of Active Coniines. A. Ladenburg. Ber. **19**, 2578—2583.

THIS work is an extension of that already published (*Ber.* **19**, 439), the experiments being made on a larger scale and with chemically pure materials.

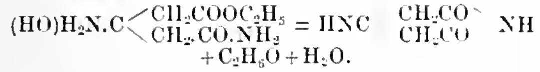
α-Picoline, purified by Lange's method (*Ber.* **18**, 3436), and boiling at 128—129°, was heated for 10 hours to 250—260° with paraldehyde in sealed tubes. The yield of α-allylpyridine was small, but was increased by recovering the α-picoline and heating it again with a fresh quantity of paraldehyde. The product was dissolved in strong acid and distilled with water; the residue was treated with excess of alkali and distilled; a clear watery liquid containing picoline came over first, and then an oil which was collected separately; the bases were separated from the distillates by means of potash, and were dried over potash. By repeated fractionation a quantity of allylpyridine, boiling between 187·5 and 192·5, was obtained. The specific gravity of the base is 0·9595. It is highly refractive, dissolves with difficulty in water, possesses an odour like conyrine, and gives a red colouration with potash. The base and the platinum (double salt) were analysed, and the gold, mercury and cadmium iodide double salts were prepared. That the allylpyridine was an α-compound was proved by converting it into picolinic acid, which melted at 133°. The reduction of α-allylpyridine to α-propylpiperidine was effected by treating the alcoholic solution at the boiling-point with sodium; the yield was almost quantitative and the product pure. The hydrochloride and the base were analysed. The base was found to be chemically and physiologically identical with coniine. The odour of both is the same; the specific gravity of α-propylpiperidine at 0° is 0·8626, and of coniine 0·8625 (*Ber.* **17**, 1679). The platinum and gold double salts, and the cadmium iodide double salts of both bases possess identical properties. As a further confirmation the propylpiperidine was converted ioto conyrine. Crude conyrine, prepared from either coniine or α-propylpiperidine, is fluorescent, but the purified products are not. The platinum double salts are identical in composition and in crystalline form, and melt at the same temperature, 159—160°. The physiological properties of coniine and of α-propylpiperidine were compared by Professor Falck, and were found to be identical. Natural coniine is, however, dextro-rotatory, while propylpiperidine is inactive. An unsuccessful attempt was made to split up the inactive base by the action of penicillium glaucum. It was found, however, that when a crystal of acid coniine dextro-tartrate was placed in a supersaturated solution of acid α-propylpiperidine tartrate, crystals separated slowly; these were removed and purified, and the base was liberated by means of potash. It was found to be optically identical with natural coniine. The mother-liquor was lævo-rotatory, but contained the dextro-rotatory modification. It was treated with cadmium iodide, and the double salt crystallised. The mother-liquor from these crystals was treated with potash to liberate the base, which proved to be nearly pure laevo-rotatory coniine, for it turned the plane of polarisation to the left to the same extent that natural coniine turns it to the right. The author states that this is the first complete synthesis of an alkaloid.—S. Y.

Synthesis of Pyridine Derivatives. H. N. Stokes and H. von Pechmann. Ber. **19**, 2694—2717.

BY the continued action of strong ammonia on ethyl-acetonedicarboxylate at the ordinary temperature, *ethyl-β-hydroxyamidoglutamate* $NH_2COCH_2 - C(OH)(NH_2)-CH_2CO.OC_2H_5$ is readily obtained. Purified by recrystallisation from water, it forms colourless long flat needles, melting at 86°, sparingly soluble in cold water and ether, readily soluble in hot water, alcohol and chloroform. Nitrite of soda added to its solution in hydrochloric acid forms a yellow precipitate of the iso-nitroso compound (?) melting with decomposition at 178°. When one part of ethyl-β-hydroxyamidoglutamate is boiled for about ten minutes with one part of sodium carbonate crystals dissolved in 3—4 parts of water, it is decomposed according to the equation: $C_7H_{14}N_2O_4 = C_5H_6N_2O_2 + C_2H_6O + H_2O$. On acidifying the cold solution with acetic acid, the new compound *glutazine* precipitates as a white powder. It forms colourless rectangular tablets, melting with decomposition at about 300°. It is tolerably soluble in hot water, almost insoluble in hot alcohol, quite insoluble in other solvents. Carbonates are decomposed by it at the boil, forming salts which are, when cold, decomposed in their turn by carbonic acid; it dissolves in cold dilute mineral acids forming the corresponding salts. Its neutral solution gives a deep red colouration with ferric chloride, which changes to dark green on warming. Its sodium, ammonium and barium salts are very soluble in water; these solutions turn green on exposure to the air. By the addition of a slight excess of bromine water to a solution of glutazine in dilute hydrochloric acid, the yellow precipitate which at first forms, is redissolved, and in a short time the liquid becomes filled with colourless crystals of *pentabromacetylacetamide* $CBr_3.CO.CBr_2.CONH_2$. This substance is readily soluble in alcohol, ether, hot benzene and chloroform. When heated with water it is converted into *dibromacetamide*, according to the equation: $CBr_3.CO.CBr_2.CONH_2 + H_2O = CHBr_3 + CO_2 + CHBr_2CONH_2$. With alcoholic ammonia it forms *dibromomalonamide* $NH_2CO.CBr_2CO.NH_2$. Glutazine reacts at 100—120° with acetyl chloride forming *mono-acetylglutazine* $C_5H_5(C_2H_3O)N_2O_2$, which crystallises in small brilliant plates melting at 285—290°. With cold ferric chloride no reaction takes place, but on warming an intense violet colouration is produced; it also does not react with hydroxylamine. Its ammonium salt forms transparent hexagonal plates. Symmetrical *trioxypyridine* [O : O : O : = 1 : 3 : 5] is formed when glutazine is boiled for 3—4 minutes with hydrochloric acid, $C_5H_6N_2O_2 + HCl + H_2O = C_5H_5O_3N + NH_4Cl$. It forms yellowish prisms, is readily soluble in hot water, the solution forming a deep red colouration with ferric chloride, whilst the trioxypyridine of Ost gives an indigo blue colour. Its ammonium salt forms thick prisms; the hydrochloride crystallises in needles. When glutazine or this trioxypyridine is condensed with hydroxylamine, an oxime is formed, probably *diketo-oximidopyridine* [CO : CO : NOH : 1 : 5 : 3], according to the equations: I. $C_5H_5NO_2(NH) + NH_3O = C_5H_5NO_2(NOH) + NH_3$. II. $C_5H_5NO_3 + NH_3O = C_5H_5NO_2(NOH) + H_2O$. This oxime is soluble in hot water, from which it crystallises as a sandy powder consisting of hexagonal tablets; it melts with evolution of gas at 194—196°. On warming its solution in dilute ammonia, a very characteristic intense purple-red colour is produced, one milligramme distinctly colouring several litres of water. Boiling hydrochloric acid regenerates hydroxylamine and trioxypyridine. Phenylhydrazine combines with glutazine, forming the compound $C_5H_5NO_2(N_2HC_6H_5)$. Trioxypyridine, heated with a large excess of ammonium acetate at 120—140°, is readily reconverted into glutazine. Boiling dilute sulphuric acid acts upon glutazine in a different manner to hydrochloric acid, forming instead of trioxypyridine the anhydride of this substance, $C_5H_4NO_2.O.NO_2C_5H_4$. This is a very stable body, slightly soluble in water, insoluble in other solvents, but dissolves in alkaline solutions, forming both acid and neutral salts; it combines also with mineral acids. It reacts neither with hydroxylamine, phenylhydrazine nor with ammonium acetate, but on evaporation of its aqueous solution trioxypyridine is formed.

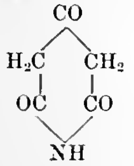
By the action of phosphorous pentachloride on glutazine, four well-characterised products are obtained. I. *Dichlorodioxyamidopyridine* [Cl : Cl : O : O : NH_2 = 2 : 4 : 1 : 5 : 3] crystallises from water in flat needles, melting at 241·5°; is sparingly soluble in hot water and alcohol, readily soluble in alkali and dilute HCl. II. *Trichloroxyamidopyridine* [Cl : Cl : Cl : O : NH_2 = 1 : 2 : 4 : 5 : 3] forms flat needles from alcohol, which melt at 282°. III. *Trichloramidopyridine* [Cl : Cl : Cl : NH_2 = 1 : 2 : 5 : 3] crystallises from water in long delicate needles. It melts at 157·5°, and sublimes without decomposition. IV. *Tetrachloroamidopyridine* [Cl : Cl : Cl : Cl : NH_2 = 1 : 2 : 4 : 5 : 3] forms colourless thin leaflets or almost cubic crystals, melting at 212°, and subliming easily. Hydriodic acid reduces it to pyridine. If this substance is boiled for about two hours with an excess of sodium ethylate and alcohol, *trichlorethoxyamidopyridine* [Cl : Cl : Cl : OC_2H_5 : NH_2 = 1 : 2 : 4 : 5 : 3] is formed, crystallising in colourless needles melting at 83°, and readily volatile with steam : concentrated hydrochloric acid splits it up into ethylchloride and trichloroxyamidopyridine, melting at 282°. But when this substance is heated with sodium ethylate and alcohol to 190°, for 3—4 hours, two new bodies are produced. I. *Dichlorodiethoxyamidopyridine* $C_5N_2H_2Cl_2(OC_2H_5)_2$, forming long needles, melting at 98°, and insoluble in water, acids and alkalis. II. *Dichlorohydroxyethoxyamidopyridine* $C_5N_2H_2Cl_2.OH.(OC_2H_5)$, which forms brittle flat needles, melting at 161·5°, and is soluble in alkalis, forming stable salts.

From the above results it appears that glutazine really is a pyridine compound, and its formation from ethyl-β-hydroxyamidoglutamate may be expressed thus :

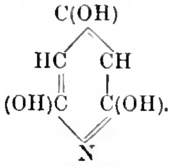


$$(HO)H_2N.C\begin{matrix}\diagup CH_2COOC_2H_5\\ \diagdown CH_2.CO.NH_2\end{matrix} = HNC\begin{matrix}CH_2CO\\ CH_2CO\end{matrix}NH + C_2H_6O + H_2O.$$

Glutazine here appears as the imide of β-imidoglutaric acid. Whether the oxygen atoms are existent in ketone or in hydroxyl form, and whether the nitrogen of the side chain is combined as amide or imide, is still undecided. It, however, may be considered as proved that the nitrogen of the pyridine ring is in the para position to the nitrogen of the side chain and ortho to the two oxygen atoms, and that therefore the above is the symmetrical trioxypyridine. The whole behaviour of this substance has much in common with that of phloroglucinol (1 : 3 : 5 trioxybenzene), which, according to v. Baeyer, seems to exist in two easily interchangeable modifications, as a triketone and as a true phenol. The authors therefore consider that this trioxypyridine does likewise exist in two isomeric modifications, corresponding to the two formulæ :



and



—T. L. B.

Ecgonine. C. E. Merck. Ber. **19**, 3002—3003.

ECGONINE, important on account of its relation to cocaine, has been recently studied by Calmets and Gossin (this Journal, 1885, 509), who found that by distilling it with baryta an oil was first obtained, which latter, by further distillation with baryta, was decomposed into an oil free from nitrogen, ethylamine, and CO_2. The formula of the platinum double salt of the oil first obtained was $(C_8H_{15}NO.HCl)_2PtCl_4$. Merck, who has also subjected ecgonine to a careful distillation with baryta, obtained methylamine, besides some tar and CO_2, the formation of other substances not having been observed. Tropine, subjected to the same process, also gives methylamine. This shows a relation to exist between tropine C_8H_{15}—NO and ecgonine $C_8H_{14}NO.CO_2H$. Merck further studied the action of reducing agents. Fuming HI, as also methyl iodide, heated with ecgonine under pressure and sodium in alcohol, produced no very satisfactory results. ½grm. ecgonine, heated in a closed tube with ½grm. PCl_5 in 5grms. chloroform for six hours, produced, after removal of the phosphorus compounds and chloroform, a crystallisable base, whose gold salt possessed the formula $C_9H_{13}NO_2HCl.AuCl_3$.

—J. W. L.

The Alkaloids of the Berberidaceæ. O. Hesse. Ber. **19**, 3190—3194.

BERBERINE is accompanied by at least four alkaloids in the root of the berberis. If the mother-liquor from berberine hydrochloride is treated with soda, a dark-coloured precipitate of an ether of *oxyacanthine* is thrown down. This, purified by conversion into the sulphate, and precipitation with ammonia, gives the pure alkaloid. The precipitated alkaloid melts at 138—150°, whilst when crystallised from ether or alcohol it has a melting-point of 214°. The amorphous substance is also more soluble in ether and alcohol than the crystalline. The author corrects the formula previously given for oxyacanthine, and now assigns to it the formula $C_{18}H_{19}NO_3$. Its solution in chloroform has the rotatory power $[\alpha]_D$ = +131·6′ (p = 4, t = 15°). It is only slightly soluble in alkalis ; strong nitric acid dissolves it with a brownish-yellow colouration ; with concentrated sulphuric acid or sulphuric acid containing molybdic acid, the solution is colourless but becomes coloured on heating. Oxyacanthine gives good crystallisable salts with acids, which are anhydrous at 100° C.

Oxyacanthine Hydrochloride, $C_{18}H_{19}NO_3.HCl + 2H_2O$, crystallises in small colourless needles, the aqueous solution of which has the rotatory power $[\alpha]_D$ = + 163·6°. Hot strong solutions are coloured green on addition of ferric chloride. It gives a double salt with platinum chloride.

Oxyacanthine Nitrate, $C_{18}H_{19}NO_3.NO_3H + 2H_2O$ crystallises in colourless needles ; the *neutral sulphate* crystallises partly in small prisms containing 6mols. water, and partly in microscopic plates with 2 mols. water. Heated with potassium hydrate and water, oxyacanthine is converted into the potassium compound of β-oxyacanthine ; this latter is easily reconverted into oxyacanthine, and is probably formed by the removal of 1mol. water from the latter. In this respect oxyacanthine behaves like narcotine.

Berbamine, the second alkaloid from berberis, soluble in ether, is thrown down from a solution of its nitrate by ammonia as a crystalline precipitate. It crystallises from alcohol in small plates, which have the formula $C_{18}H_{19}NO_3 + 2H_2O$, and melt at 156°. Its salts are readily soluble in water and are crystallisable. The platinum double salt is a yellow crystalline precipitate, only slightly soluble in water. Dried at 100°, it has the composition $(C_{15}H_{19}NO_3)_2.PtCl_6H_2$.—G. H. M.

XXI.—EXPLOSIVES, MATCHES Etc.

Improvements in Gunpowder for Ballistic Purposes. W. Hope, London. Eng. Pat. 14,914, Nov. 12, 1884. 4d.

THE improvements consist in the substitution of part or the whole of the charcoal in ordinary gunpowder by starch, sugar, flour or other like organic material consisting of carbon combined with oxygen and hydrogen, or bitumen or other like solid hydrocarbon, in order to ensure more perfect combustion.—W. D. B.

Manufacture of Granular Nitro-Cellulose. O. Imray, London. From R. Bernstein, Lind, Germany. Eng. Pat. 12,778, Oct. 24, 1885. 4d.

THIS invention relates to the manufacture of nitrocellulose in the form of fine loose and dense grains. For this purpose the solid fruits, nuts, or shells of nuts produced by various plants of the palm tribe are reduced to powder, boiled in alkaline ley, dried, and nitrated in the ordinary manner. Fragments or waste cuttings of vegetable ivory—the nut of *Phytelephas macrocarpa*—are specially suitable for the purpose. The granular nitrocellulose is very convenient in the celluloid manufacture, may be used in the loose state without being compressed or encased for explosive purposes, and can be thoroughly exploded with a comparatively small detonator.—W. D. B.

Improvements in the Manufacture of Gunpowder. O. Bowen, London. Eng. Pat. 14,052, Nov. 17, 1885. 4d.

THE improvements consist in the employment of the refuse of beech or birchwood for the preparation of charcoal, carbonisation being allowed to proceed only so far as will yield a charcoal of light brown appearance like cocoa.—W. D. B.

An Improved Manufacture of Explosive Compound, and the Preparation of Cartridges therefrom. Sir Francis Bolton, Westminster. Eng. Pat. 1955, Feb. 10, 1886. 6d.

This invention consists in the combination of a solid constituent such as chlorate of potash or other chlorate or nitrate having analogous properties with a liquid constituent such as nitrobenzene or other solvent, in which is dissolved a carbonaceous material such as resin or colophony, molasses, etc. The method of preparing cartridges by filling the solid constituent into bags or cartridge cases and then saturating the same with the liquid constituent, is also claimed.—W. B. D.

Improvements in the Manufacture of Gunpowder. A. H. Durnford, Dartford. Eng. Pat. 3578, March 13, 1886. 4d.

A charcoal very easily inflammable, of low density and only slightly hygroscopic, is prepared by subjecting cork to destructive distillation in suitable cylinders, and the improved gunpowder is prepared by incorporating 20 parts of the charcoal with 80 parts of potassium nitrate. A second variety of the improved gunpowder is prepared by the incorporation of saltpetre, cork charcoal and sulphur, the latter being in the proportion varying from 1 to 10 per cent. The gunpowder is stated to be comparatively smokeless and non-hygroscopic.
—W. D. B.

An Improvement in the Manufacture of Gunpowder. O. Bowen, London; A. S. Tomkins, and J. Cobledick, Surrey. Eng. Pat. 3953, March 13, 1886. 4d.

The inventors prepare a charcoal by the carbonisation of grains of maize and other cereals, and claim its use in the manufacture of gunpowder.—W. D. B.

Improvements in Detonators or Caps to be used with Dynamite or other Explosives. T. Johnston and G. Smith, Glasgow. Eng. Pat. 8368, June 25, 1886. 8d.

This invention relates to improvements in the manufacture of the tubes or shells forming the casing of the detonators or caps employed to start the explosion of charges of dynamite or other explosives, and consists in the longitudinal or transverse corrugation of the shells with a view of increasing the strength of the same, so that the explosive action of the fulminate is concentrated to take effect principally from the inner end and in the direction of the axis of the tube. The detonator tubes may be made of thin steel, and lacquered or otherwise coated to prevent them from rusting.—W. D. B.

Manufacture of an Explosive Compound. H. Imray, London. From H. Dulitz, Duren, Germany. Eng. Pat. 12,838, Aug. 17, 1886. 4d.

An explosive is prepared by the admixture of 20 parts of a jelly consisting of a 5 per cent. solution of gun-cotton in nitrobenzene, and 80 parts of potassium chlorate. Another oxidising agent may be substituted for the chlorate, but the amount so substituted should not exceed 10 per cent., as a larger proportion renders the explosive less sensitive.—W. D. B.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

New Reagent to show the Presence of a Hydroxyl-group. H. A. Landwehr. Ber. **19**, 2726.

As is well known, ferric chloride is a delicate reagent for mono- and di-hydric phenols, and hydroxy-acids. The author has found that bodies belonging to the fatty series, and which contain a hydroxyl-group, also give a colour reaction with very dilute solutions of the reagent. The test is made as follows:—2 drops of a 10 per cent. solution of ferric chloride are diluted to about 60cc. with water; from 10 to 20cc. of this solution are placed in a small porcelain dish, and an excess of the substance to be examined is added. The colour produced is sulphur yellow. All alcohols and carbohydrates which are soluble in water are said to give this reaction. A positive result was obtained in the case of ethyl- and propyl-alcohol, glycerol, grape, cane and milk sugar, erythrite; also glycollic, lactic, tartaric, citric, malic, saccharic and mucic acids. But neither ether, "esters," nor formic, acetic, propionic, butyric, oxalic, fumaric and malonic acids gave the reaction.—T. L. B.

A Test for Stilbene. G. Errera. Gazz. Chim. **1886**, 325.

Bade states that when an alcoholic solution of stilbene is heated with ferric chloride, a red colour is produced. The author shows that this colour is due to the water contained in the alcohol. With anhydrous alcohol the colour is not produced at all, and with aqueous alcohol the depth of colour increases with the amount of water present.—S. Y.

On the Separation of Tin and Antimony by a Volumetric Method. H. Giraud. Bull. Soc. Chim. **46**, 504.

In presence of large excess of hydrochloric acid, antimony pentachloride is completely reduced to trichloride by hydriodic acid, $SbCl_5 + 2HI = SbCl_3 + 2HCl + I_2$; but under similar conditions stannic chloride is not reduced. Tin and antimony are separated from the other metals and converted into chlorides, the solution being made acid enough to keep the antimony in solution without addition of tartaric acid. The perchlorides are formed by warming with potassium chlorate, the excess of chlorine being removed by heating. A certain quantity of the liquid is treated with an equal volume of hydrochloric acid and excess of potassium iodide; the liberated iodine is extracted with carbon bisulphide, which is then washed with water until no longer coloured, the iodine being estimated by titration with sodium thiosulphate. Two atoms of iodine correspond to one atom of antimony. In presence of small quantities of copper the method is not accurate. A strongly acid solution of antimony trichloride is not acted on by iodine, but the iodine is absorbed by stannous chloride. An attempt to estimate tin in presence of antimony by means of this reaction was unsuccessful.—S. Y.

A Direct Separation of Manganese from Iron. L. Blum. Zeits. Anal. Chem. **25**, 519.

A solution containing hydrochloric acid, ferric chloride and manganous chloride is treated with tartaric acid, until on addition of excess of ammonia, no precipitate is formed. The manganese is then precipitated with potassium ferrocyanide; nickel, cobalt and zinc are also thrown down. When filtered cold the filtrate is turbid, but after boiling, a clear filtrate is obtained; the precipitate cannot be washed, hence the reaction is only suitable for qualitative analysis. The author detected the manganese in a solution containing 0·00004grm. of manganese and 0·01grm. of iron in 1cc.
—S. Y.

On the Estimation of Ash by means of Leidenfrost's Drops. T. Salzer. Pharm. C. H. N. F., *1886*, 545.

This method was first suggested by E. Bohlig (*Chem. Zeit.* **10**, 115) for the determination of solid residue in liquids. The author employs it for solid organic substances which melt without decomposition or volatilisation. The substance—for example, oxalic acid—is placed in a platinum basin heated to dull redness; the acid forms a rolling drop which rapidly volatilises and leaves the non-volatile residue in the form of a globule. The drop preserves its shape and motion, even when the evolved gases take fire.—S. Y.

New Books.

Lauber's Handbuch des Zeugdrucks. I. Band: Dritte Auflage. Commissionsverlag von Gustav Weigel, Leipzig. H. Grevel & Co., 33, King Street, Covent Garden, London.

8vo volume, in paper cover; price 6s. Contains 122 pages of subject-matter, Table of Contents and Alphabetical Index, and a few illustrations. The work is divided into chapters—thirteen in number—and treating of the following subjects:—I. Singeing the Goods; Bleaching and Shearing. II. Preparation of Printing Colours. III. Making of the Rollers. IV. Fixing the Colours by Steam. V. Turkey-red Oil, etc. VI. Continuous Soap and Washing Machine. VII. Soaps used in the Printing Processes, &c. VIII. Water in Printworks; Investigation and Purification of Water. IX. Bleaching with Chlorine of the Prepared Goods; Dry Chlorinating and Steam Chlorinating. X. Albumen Colours, etc. XI. Reserves under Albumen Colours. XII. Steam Printing by Decomposition of metallic Salts. XIII. Colours Developed by Decompositions Involving Double Interchange, or the Volatilisation of Acids.

GAS ENGINEERS' POCKET ALMANACK AND LIGHTING TABLE FOR THE YEAR 1887. Issued by William Sugg & Co., Limited, 102, Grand Hotel Buildings, Charing Cross, London, S.W.

SMALL 8VO VOLUME in pocket-book form, bound in morocco leather, gilt, and fastened with elastic band; price 2s 6d. The book commences with a Calendar for 1887; then follows an article on the Lighting and Extinguishing of Street Lamps, etc., which contains a Table giving the Monthly Totals of Lamplight for the yearly totals of 4300, 3940, and 3836 hours. Next appears a useful Diary for Gas Managers, so that between the varieties of coals used in the mixtures for the retorts there can be entered up the makes of gas for each day of the week, the volumes in stock in the holders, and the amounts sent out. A Glossary of terms in frequent use in Gas Works, with their French and German equivalents next follows, and this is followed by the Notification of the Metropolitan Gas Referees as to the times and modes of testing for illuminating power. Well-illustrated descriptions of all the apparatus recommended by the Gas Referees, with reference tables, etc., are added. A Table is given for correcting the volumes of gases for temperature and pressure, etc. Blank pages for memoranda, divided for the months of the year, are arranged; also all the items required to be entered up and summarised each month in a Gas Works are printed and ruled off on alternate double pages, blanks being left only for the figures. The little work concludes with a few useful tables of equivalent weights, measures, and prices, &c., and finally, with some Interpolation Curve Tables, which have been calculated and arranged by Mr James T. Brown. These have the effect of rendering Sugg's Lighting Tables applicable for all parts of the world.

Trade Report.

(From the Board of Trade Journal.)

BOARD OF TRADE NOTICE.

Admission of Samples into Austria-Hungary.

A declaration, between the Governments of Great Britain and Austria-Hungary, was signed in London, on the 15th February last, for the admission duty free into Great Britain and Austria-Hungary of patterns and samples imported by commercial travellers.

TARIFF CHANGES AND CUSTOMS' REGULATIONS.

SWITZERLAND.

Classification of Articles in Customs' Tariff.

(*Note.*—Quintal = 220·4lb. avoirdupois. Franc = $9\frac{6}{10}$d.)

The following decisions affecting the classification of articles in the Swiss Customs' Tariff were given by the Swiss Customs' authorities during the months of December and January last.

"Thomasschlacke," "Thomasphosphate," deposits obtained in the dephosphorisation of iron. Category 3, duty free.

Sumac juice is no longer to be included in Category 16.

Extract of sumac, sumac juice. Category 17, duty 1 franc per quintal.

Grease for leather, in barrels. Category 25, duty 7 francs per quintal.

Phosphate of chalk (artificial manure). Category 4, duty 20 centimes per quintal.

Formic acid. Category 9A, duty 7 francs per quintal.

Chrome acetate, sulphurous acid, antiseptic oil (carbolineum), hypochlorite of potash (Javelle water), and hypochloride of soda (Labarraque water). Category 16, duty 30 centimes per quintal.

Ammoniacal chloride of tin (pink salts). Category 17, duty 1 franc per quintal.

Dregs of indigo. Category 31, duty 4 francs per quintal.

Bronze green, cinnabar green, Russian green. Category 36, duty 3 francs 50 centimes per quintal.

UNITED STATES.

Customs' Decision.

The following decision affecting the classification of articles in the Customs' Tariff, and the application of the Customs' Laws of the United States, was given by the United States Government during the month of January last:

So-called bromo-fluorescic acid, which consists of an aniline colour derived from coal-tar, and principally used in dyeing silk, wool, and cotton fabrics, is dutiable at the rate of 35 per cent. *ad valorem*, under Section 82, for "all coal-tar colours or dyes, by whatever name known," etc.

CAPE OF GOOD HOPE.

Modification in Customs' Regulations.

With reference to the statement that appeared on page 268 of No. 5 of the Journal, a notification has been received from the Agent-General for the Cape of Good Hope to the effect that the following new tariff showing the rebate to be granted, and the Customs' dues to be levied in respect of articles passing overland through the Cape Colony to any of the places or territories which have been proclaimed "free ports" has been substituted for the rates formerly levied, but the regulations under which goods may be so removed and the so-called "free ports" remain unchanged.

Articles.		Rebate to be Granted.	Duty less Rebate to be Paid.
		£ s. d.	£ s. d.
Oils of all descriptions, including mineral, imported in vessels containing not less than one imperial pint (chemical, essential, perfumed, and castor oils, and fish oils in the raw state, the produce of Africa excepted)	The gallon	0 0 6	0 0 6
Soap, common, brown, blue, yellow, or mottled	The 100lb.	0 3 0	0 1 2
Soda, caustic	For every £100 value	3 0 0	7 0 0
Turmeric	The lb.	0 0 2¾	0 0 0¼
Turpentine	The gallon	0 0 10	0 0 2
Varnish	Do.	0 2 4	0 0 8
Vinegar	Do.	0 0 5	0 0 1

CUSTOMS' TARIFF OF THE UNITED STATES OF COLOMBIA.

The following is a statement of the rates of duty now levied under the New Colombian Customs' Tariff, which came into operation on the 8th November last:—

(*Note.*—Kilogramme = 2·204lb. avoirdupois. Peso = 4s. 2d.)

Tariff Classification.	Rates of Duty.	
		Ps. Cs.
Stearine and paraffin, not manufactured	Kilog.	0·05
" " in candles, etc.........	"	0·20
Tallow, raw	"	0·01
Tallow or other candles, not otherwise mentioned	"	0·20
Stearic acid	"	0·01
Petroleum	"	0·10
Wooden matches	"	0·20
Wax matches	"	0·60
Drugs and medicines:		
Common, not otherwise mentioned	"	0·30
Sulphur and alum	"	0·20
Sulphuric acid and saltpetre	"	0·05
Potash and caustic soda, the ashes and salts of soda, pine-resin, and the subcarbonates of potash and soda	"	0·02½
Common oil soap	"	0·20
Common resin and tallow soap	"	0·05
Crucibles for smelting	"	0·05
Mineral coal	"	0·01
Pitch	"	0·05
Black tar, for shipbuilding	"	0·05
Resin	"	0·01
Glue, common	"	0·20
Varnishes	"	0·20
Paints, in powder or prepared	"	0·20

CUSTOMS' TARIFF OF PORTO RICO.

The following return shows in a comparative form the rates of Customs' Duty levied in Porto Rico on the principal articles of the produce and manufactures of the United Kingdom, according to the Convention with Spain which came into force on the 15th October last, and the duties previously applicable to British goods.

(*Note.*—Kilogramme = 2·501lb. avoirdupois. Peso = 4s. 2d. Hectogramme = 3·215oz. troy. Hectolitre = 22 Imp. gallons.)

Tariff Classification.	Old Rates of Duty.		New Rates of Duty.	
		Fs.		Fs.
Chemicals:				
Acids of every kind	100 kilos.	2·03	100 kilos.	1·26
Alum	,,	1·45	,,	0·90
Chloride of lime and potash	,,	0·87	,,	0·59
Nitrate of potash and soda....	,,	5·22	,,	3·21
Oxide of lead....	,,	3·48	,,	2·16
,, of potash and soda	,,	7·54	,,	4·68
Phosphorus....	Kilog.	0·35	Kilog.	0·22
Sulphate of iron	100 kilos.	1·74	100 kilos.	1·08
,, of soda and magnesia	,,	0·87	,,	0·59
Chemical products not enumerated	Kilog.	0·15	Kilog.	0·09
Glucose	100 kilos.	3·60	100 kilos.	2·50
Glue	,,	29·00	,,	18·00
Gunpowder....	Kilog.	0·09	Kilog.	0·05
Paraffin	100 kilos.	0·70	100 kilos.	5·40
Starch	,,	3·60	,,	2·50
Wax	,,	17·40	,,	10·80
Paints and Colours:				
Raw	,,	0·69	,,	0·48
In powder	,,	4·14	,,	2·88
In oil	,,	2·03	,,	1·26
Cochineal and indigo blue....	,,	35·00	,,	25·20
Varnish	,,	7·54	,,	4·68
Candles:				
Paraffin, sperm, and stearine....	,,	8·70	,,	5·10
Tallow	,,	5·80	,,	4·00
All other kinds....	,,	8·70	,,	5·40
Soaps:				
Common	,,	3·77	,,	2·99
Fine....	Kilog.	0·58	Kilog.	0·36
Oils:				
Animal, raw	100 kilos.	5·80	100 kilos.	4·00
,, purified	,,	5·80	,,	3·60
Mineral....	,,	2·88	,,	2·00
Vegetable	,,	6·75	,,	4·50

TRADE BETWEEN SPAIN AND THE UNITED KINGDOM.

Imports into the United Kingdom from Spain.

Articles.	Jan. 1886.	Jan. 1887.
Chemical Products unenumerated ....Value	£2,978	£1,713
Copper Ore and Regulus..Tons	2,915	3,021
Value	£61,130	£63,746
Manganese Ore ....Tons	600	900
Value	£1,200	£900
Pyrites of Iron or Copper..Tons	39,460	54,122
Value	£72,437	£102,814
Quicksilver ....lb.	300,000	600,000
Value	£24,000	£58,500
Total Value.	1886.	1887.
January	£635,256	£818,935
February	£940,906	£890,692

Exports from the United Kingdom to Spain.

ARTICLES.	Jan. 1886.	Jan. 1887.
Alkali ....Cwt.	13,617	20,501
Value	£5,011	£7,627
Caoutchouc, Manufactures of Value	£762	£808
Cement....Tons	245	293
Value	£608	£567
Coal Products, Naphtha, etc. Value	£1,657	£3,135
Soap ....Cwt.	207	291
Value	£186	£251
Total Value.	1886.	1887.
January	£240,097	£235,826
February	£241,033	£297,122

Summary Statement showing the Trade between Spain and the United Kingdom during the period subsequent to the Conclusion of the Commercial Treaty, compared with the Corresponding Period of the previous Year.

Months.	Imports into the United Kingdom from Spain.		Exports of Produce and Manufactures of United Kingdom to Spain.		Exports of Foreign and Colonial Produce to Spain.	
	1885-86.	1886-87.	1885-86.	1886-87.	1885-86.	1886-87.
	£	£	£	£	£	£
September ..	636,652	719,560	234,762	328,466	42,775	32,441
October	963,845	940,778	210,142	301,133	62,592	59,358
November ..	793,550	881,052	228,011	242,815	92,649	54,638
December ..	921,165	867,183	241,868	253,238	69,910	59,020
January	635,256	818,935	240,097	235,826	60,676	34,821
February	940,906	890,692	241,033	297,122	52,034	37,317

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

Effect of the Withdrawal of Russian Sugar Bounties.

Sir R. B. D. Morier, Her Majesty's Ambassador at St. Petersburg, in a despatch dated the 10th February last, forwards the following translation of a paragraph which appeared in the *Russian Exchange Gazette* for January 28 (February 9) last, respecting the effect of the withdrawal of the Russian Sugar Bounties on the 1st of July last:—

"Countess M. Branitsky has given orders for the closing of two of her enormous sugar manufactories, the one at Selivonsky, working out annually 250,000 berkovets (one berkovet equals about 360lb. avoirdupois) of beetroot; the other at Kojansky, requiring about 150,000 berkovets. The planters who supplied these works with beetroot have already been informed of this resolution. At the same time, news has been received in Kiev from Smiela, that Count Bobrinsky intends to close two of his sugar manufactories. Hence we see that, owing to the present crisis in the sugar trade, two of our most solid producers are going to cease work. It is evident that they do not wish to stake their last penny on one card, and that those who still mean to struggle on are the very ones that have long been doomed to die, and that conceal the sad state of their affairs."

TRADE NOTICES.

CONSUMPTION OF MINERAL OILS IN RUSSIA.

According to the *Journal de St. Pétersbourg*, of the 14th February last, mineral oils are beginning to be used as fuel on Russian locomotives. The experiment has been made on the Tambow and Saratow Railway, the result being to prove that the inflammable oil is much cheaper than wood. It is now proposed to introduce the former on the principal railways of Southern Russia.

CHILIAN GUANO AND NITRATE OF SODA BEDS.

The following information respecting the guano and nitrate of soda beds in the Chilian province of Tarapacá is extracted from the *Chilian Times* of the 27th November last:—

"The total area of the province of Tarapaca is 16,789½ square miles, and it is divided naturally into five distinct and well-defined zones. The first of these zones commences on the shores of the Pacific, and has an average width, west to east, of 18 miles. It is formed, in the first place, of the beach; and, in the second, of the coast range, which attains an altitude varying from 1125 to 5800 feet above the sea-level. This zone may be denominated the guano and mining zone. The fertiliser is found all along the coast, while the rich mineral fields of Huantajaya and Santa Rosa, and the less important ones of Cármen, Rosario, Huantaca, Paiquina, Chanavaya, and Loa, are situated in the coast sierra. The highest peaks of the sierra Morro de Punta Gorda, 2520 feet; Morro de Pisagua, 3220 feet; Huantaca Hills, 2340 feet; Morro de Tarapacá, 5785 feet; Oyarvide, lat. 20° 31′ 5″, 5800 feet; and Carrazco, 5520 feet. Punta de Lobos sierra has an altitude of 3090 feet, and the banks of the Loa have an elevation of from 1500 to 1600 feet. This belt, as already stated, has an average width of 18 miles, and as it advances eastward it becomes more and more depressed, and finally terminates in a series of pampas (open plains) having an elevation of 3500 to 3800 feet above the sea-level. Nearly all these pampas contain vast beds of salts, sulphate of soda, and sulphate of lime. They are known locally by the name of *salares*. In some parts of the desert of Atacama the beds of nitrate of soda are found under these *salares* deposits, but in Tarapacá the *caliche* (nitrate earth) is found only under a bed of conglomerate known as *costra*. It was believed, at one period, that all the *pampas* in this zone contained *caliche*, but explorations have demonstrated that they only contain traces of nitrate of soda. The true nitrate beds commence on the eastern boundary of the first zone. On the other hand, the hills in the first zone contain copper, silver, and gold, and nickel has been found in the Huantaca Hills. The guano beds, as already stated, are situated in this zone. From Camarones bay to the mouth of the Loa there is hardly a prominence or a rock on the sea-shore that does not contain some guano. This valuable fertiliser has been known from Incarial times. The aborigines of the valleys and gullies of Tarapacá, Mamina, Chiapa, Huatacondo, Camina, and Quisma were acquainted with the fertilising qualities of guano, and they conveyed it from the coast to their farms on the backs of llamas. The southern beds vary so much in aspect and colour that it frequently requires an experienced eye to make them out.

"Many of the deposits are covered with immense layers of sand, whilst others are buried beneath a solid layer of conglomerate or *costra*. Guano is also frequently found in the fissures and gullies which descend to the sea-shore. The Mejillones beds are of small extent, and the guano is of poor quality. The richest and largest beds are at Pabellon de Pica, Punta de Lobos, Huanillos, and Chipana. At the latter place the beds are horizontal and flat. From Chipana to Loa bay there are deposits of guano which have not yet been touched. The second zone of the province is the nitrate region. It commences on the edge of the Camarones gully, and extends southwards to the desert of Atacama. Up to 1858 it was believed that the nitrate beds did not extend southwards beyond the Loa gully, but in that year beds were discovered in what was then the Bolivian littoral. Explorations which were effected in 1872 proved that the nitrate beds extended northwards, beyond the Camarones gully, and that they reached as far as the Chaca gully, and even as far as the Azapa valley, in the province of Arica. The nitrate zone does not run geometrically parallel to the Tamarugal pampa, which is its eastern limit. In some places the grounds run out one or two miles farther to the east, and in some places they bend in that distance from the westward. The quantity and quality of the caliche varies very considerably, but the dimensions of the nitrate zone may be set down at 120 geographical miles in length, north to south, and two geographical miles in width, east to west. It is estimated that the nitrate beds contain the enormous quantity of 1,980,630,502 quintals, and it is stated that, with the present export duty, which is equal to $27\frac{365}{1000}$ pence per quintal, the deposits will yield a revenue of £230,809,171."

RECENT TRADE BLUE BOOKS.

Second Report of the Royal Commissioners on Technical Instruction, Vol V. Foreign Reports, Appendices, etc.

This, the fifth volume of the Second Report of the Royal Commissioners on Technical Instruction, relates chiefly to such instruction in foreign countries. Thus, letters and memoranda are given relating to French Technical Art Schools, Technical Instruction in Italy, Hand-work Instruction in Sweden, Technical Education in Wurtemburg. The programme and course of instruction of many of the principal technical and art schools on the Continent is given; amongst these the chief are the Ecole Polytechnique, Paris, the Ecole des Mines, Paris, the Ecole Commerciale, Lyons, the Ecole Nomale Superieure de Travail Manuel, Paris; the Munich Industrial Art School; Technical High School, Munich (special course for Industrial Chemists). The report contains also many other documents relating to Technical Schools of Instruction both in England, Canada, and foreign countries, the total number which are referred to in the various Appendices being no less than 40. The report, which is dated 1884, was presented on the 22nd of February, 1887."

Erratum.

The President of the Board of Trade has received the following letter from Mr. Neville Lubbock :—

"16, Leadenhall Street, E.C.,
"4th March, 1887.

"MY LORD,

"My attention has been called to the recent issue of the *Board of Trade Journal*, dated February, 1887. In that journal appears a description of the recent reports of the Royal Commission on the Depression of Trade. On the last page (170) is made the following statement :—'A minority report drawn up by the fair trade members of the Commission—viz., Lord Dunraven, Mr. Ecroyd, Mr. Lubbock, and Mr. Muntz, is also appended.' I beg respectfully to point out that it is, I believe, unusual for Departments of State, when alluding to members of Royal Commissions, to classify them by epithets descriptive of the opinions they are supposed to hold. Moreover, I hold that the views put forward in the minority report are in strict accordance with the doctrines of our highest economical authorities on free trade. I do not belong to, and never have been associated with, the Fair Trade League, and I am not even aware, except in a very general way, what principles they advocate. I object therefore to a statement being put forth in the *Board of Trade Journal* which implies that I served on the Royal Commission as a recognised advocate of particular views, and which is, therefore, calculated to mislead its readers. I respectfully request that your Lordship will be good enough to cause this letter to be published in the next number of the *Board of Trade Journal*.

"I have, etc.,
"(Signed) N. LUBBOCK."

[The words "fair trade," of which Mr. Lubbock complains, were inserted by an oversight.]

STATISTICAL TABLES.

FOREIGN TRADE OF INDIA.

Imports and Exports into and from British India.

———	Imports from Foreign Countries.		Exports to Foreign Countries.	
	Nine Months, 1st April to 31st December.		Nine Months, 1st April to 31st December.	
	1886.	*1885.*	1886.	*1885.*
	R.	R.	R.	R.
Chemicals, drugs, medicines and narcotics, and dyeing and tanning materials...........	67,26,405	*62,83,380*	10,39,10,002	*10,44,09,946*
Oila........................	1,02,81,881	*73,32,335*	33,49,023	*29,29,615*
Raw materials and unmanufactured articles....	2,25,67,070	*2,47,34,872*	23,42,86,199	*21,85,44,474*

THE TRADE OF BRITISH INDIA.

Among the publications recently "presented to Parliament by command of Her Majesty" is a statement of the trade of British India, which bristles with interesting information.

Imports.

The imports of chemicals, drugs, medicines, narcotics, dyeing, and tanning materials amounted to 8,616,601 rupees in 1885-6 against 8,739,470 rupees in 1884-5, a decrease which appears less pronounced than it would have been but for the inclusion in 1885-6, for the first time, of "dynamite and other explosives" under this heading. The import of drugs proper shows a very pronounced falling-off, but that of aniline dyes is growing fast. Some time ago we called attention in these columns to the growing employment of these dyes in the manufacture of Indian fabrics, to the great detriment of the reputation of the latter. Pressure has been brought to bear upon the Indian Government with a view to obtain its aid in discouraging the use of aniline dyes; but so far these representations have been unavailing. Five years ago only three million ounces aniline were brought into India, in 1885-6 nearly 11½ million ounces, and during the first quarter of 1886 alone no less than 4¾ million ounces. The increased consumption of aniline dyes also furnishes a clue to the diminution of the saffron exports from France to India. The imports of mineral oils amounted to 9,611,298 rupees in 1885-6, mostly kerosene, the use of which is becoming quite general. The attempts to find oil in the neighbourhood of Akyab have been abandoned, and it is as yet doubtful whether the oil-bearing region of Beluchistan will render commercial exploitation remunerative. Mineral oil has been brought from Upper Burmah, but it is valuable as a lubricant only.

Borax imports from Thibet into India are diminishing, as the cheapness of the article in Europe renders the carriage of it across the Himalayas unprofitable. Less camphor has also been received from China. Of quinine, India received 11,859 ounces in 1885-6, against 12,261 ounces in 1884-5 and 9936 ounces in 1883-4.

The total value of drugs, medicines, and chemicals imported during these periods was 5,534,070 rupees, 5,481,550 rupees, and 5,081,980 rupees; and of perfumery 557,110 rupees, 662,700 rupees, and 610,120 rupees respectively. The shipments of musk from India were as follows:—1885-6, 3816 ounces; 1884-5, 5759 ounces; 1883-4, 5864 ounces; 1883, 8452 ounces. The average value of the musk exported is put at 32s. per ounce, a convincing proof, if one were needed, that the bulk of it is of very inferior quality.—*Chemist and Druggist*, March 12, 1887.

Exports.

"Chemicals, drugs, medicines, narcotics, dyeing and tanning materials (Class IV.)" is already a sufficiently comprehensive heading in itself, and might, especially in the case of such an important drug-producing country as India, be subdivided with advantage. But when we find dynamite on the one, and tobacco on the other hand, included under its hospitable shelter, the surmise that the Indian authorities look upon this heading as a kind of convenient ash-pit in which to shoot articles unincludable in other classes grows into certainty. This class comprises opium, indigo, cutch, myrobolans, turmeric, cinchona bark, tobacco, and other articles of smaller importance, the aggregate value in 1885-6 amounting to 155,155,727 rupees, a decline of 14 per cent. since 1879-80, mainly accounted for by the diminution of the opium exports. Although still the most valuable item among the merchandise sold to China by India, the trade in opium is falling off seriously. It is to be feared that the cause of this decline must be sought less in a diminished appetite for the drug on the part of the Chinese than in the extension of opium-growing in the Chinese Empire, and the consequent gradual emancipation of that valuable customer. Considering that the opium-tax provides about one-fifth of the total Indian revenue, the decline of the trade is a serious matter to the Government. It may here be mentioned that the imports of salt into India are growing largely. There is a disgracefully heavy duty upon this article also, by which more than one eighth of the Indian revenue is procured.

The shipments of oils are declining, partly because cheaper substitutes have been found for cocoanut-oil as a soap stock, and partly, perhaps, because the depression in trade in Australia restricted the exports of castor-oil, for which that country is a large customer. Gingelly seed is largely purchased by Marseilles, where the oil expressed from it is used for soap-making.

TRADE STATISTICS FOR FEBRUARY.

The Board of Trade Returns for February show the following figures:—

Exports.

	February, 1886.		February, 1887.
Total value	£16,384,007	....	£17,255,133
Foreign and Colonial Produce (partly estimated)	4,916,377	....	5,565,708

Imports.

	February, 1886.		February, 1887.
Total value	£26,621,869	....	£28,513,991

Below are the details affecting drugs and chemicals:—

Exports.

		Feb. 1885.	Feb. 1886.	Feb. 1887.
British and Irish produce:—				
Alkali	cwt.	432,180	431,683	441,411
"	value £	128,060	136,546	125,209
Bleaching materials	cwt.	103,921	109,864	127,944
" "	value £	34,872	41,336	47,709
Drugs and medicinal preparations	"	61,572	59,898	63,321
Oil (seed)	gals.	6,305	5,797	5,759
"	value £	116,074	122,910	119,091
Soap	cwt.	32,918	35,037	38,801
"	value £	37,193	38,765	37,553
Painters' colours and materials (unenumerated)	value £	86,458	96,277	101,393
Foreign and Colonial merchandise:—				
Bark, Cinchona	cwt.	8,336	10,030	17,476
" "	value £	47,216	46,699	76,560
Chemicals (unenumerated)	"	18,978	12,463	12,280
Cochineal	cwt.	965	1,031	653
"	value £	6,793	7,698	4,511
Cutch and gambier	tons	590	773	611
" "	value £	14,741	19,405	15,481
Gum Arabic	cwt.	2,130	2,409	3,852
"	value £	8,009	10,371	17,496
Indigo	cwt.	12,050	10,793	10,008
"	value £	276,668	261,930	229,046
Lac, various kinds	cwt.	5,480	6,708	4,381
" " "	value £	18,765	19,132	12,481
Oils, cocoanut	cwt.	5,551	6,174	3,186
" "	value £	8,843	8,562	4,507
" olive	tons	248	121	130
" "	value £	11,251	6,329	5,769
" palm	cwt.	45,466	36,418	33,519
" "	value £	66,262	42,734	36,568
" petroleum	gals.	78,429	44,412	26,620
" "	value £	3,834	2,125	1,223
Quicksilver	lb.	293,517	367,964	212,380
"	value £	25,340	28,332	22,979
Nitre (nitrate of potash)	cwt.	1,829	1,155	818
Nitre (nitrate of potash)	value £	1,627	1,021	667

Imports.

		Feb. 1885.	Feb. 1886.	Feb. 1887.
Drugs, unenumerated	value £	64,700	50,712	45,080
Chemical manufactures—				
Products unenumerated	value £	105,423	113,006	91,483
Alkali	cwt.	2,582	5,607	3,449
"	value £	2,385	3,292	2,149
Brimstone	cwt.	90,782	99,053	59,519
" "	value £	21,836	23,721	13,825
Nitre (nitrate of soda)	cwt.	341,820	111,444	30,607
" "	value £	154,964	61,112	13,505
" (nitrate of potash)	cwt.	17,628	28,762	19,322
" "	value £	15,561	25,226	16,465
Quicksilver	lb.	345,225	936,600	723,085
"	value £	30,920	75,000	70,121
Bark (Cinchona)	cwt.	5,978	9,082	11,416
"	value £	48,225	61,316	56,081
Gum Arabic	cwt.	11,427	16,936	2,017
"	value £	40,591	60,817	10,320
Lac, seed, shell, stick, and dye	cwt.	4,562	11,166	7,122
Lac, seed, shell, stick, and dye	value £	11,612	33,402	20,028
Dyes and tanning materials—				
Bark (for tanners' or dyers' use)	cwt.	14,508	17,361	12,841
Bark (for tanners' or dyers' use)	value £	5,141	5,687	4,446
Aniline dyes	value £	20,424	22,471	20,866
Alizarin	value £	22,073	22,149	17,925
Other coal-tar dyes	value £	414	18	5
Cochineal	cwt.	2,044	1,720	980
"	value £	12,800	11,053	6,033
Cutch and gambier	lb.	1,159	2,805	1,563
"	value £	25,909	61,035	31,613
Indigo	cwt.	21,931	28,950	23,715
"	value £	589,691	738,150	560,472
Madder, madder root, garancine, and munjeet	cwt.	2,019	2,494	1,661
Madder, madder root, garancine, and munjeet	value £	3,040	2,821	2,231
Valonia	tons	3,025	4,380	4,489
"	value £	49,601	64,446	68,236
Oils—				
Cocoa-nut	cwt.	4,825	5,377	5,171
"	value £	7,249	6,829	8,777
Olive	tons	2,936	1,396	2,741
"	value £	118,590	55,478	100,984
Palm	cwt.	83,020	63,345	63,419
"	value £	119,125	74,319	66,734
Petroleum	gals.	4,240,145	3,503,148	8,721,788
"	value £	128,183	111,439	230,733
Seed, of all kinds	tons	1,011	1,221	965
"	value £	31,235	29,436	22,761
Train, blubber, and sperm	tons	1,307	355	592
Train, blubber, and sperm	value £	28,079	9,050	14,570
Turpentine	cwt.	23,612	32,734	25,206
"	value £	26,445	45,033	35,383

GERMAN ETHER AND PICRIC ACID EXPORTS.

Last year, 376 tons of ether and collodion were exported by Germany, against 704 tons in 1885. Of this total France was the recipient last year of 158 tons, against only 4 tons in 1885, or an increase of 154 tons. Picric acid was exported during 1886 to the extent of 53 tons, against 23 tons in the previous year, an increase of 20 tons. For January, 1887, the export of ether shows an increase of 18 tons, and that of picric acid about 7½ tons. This increase is mainly due to the development of the export trade with France in these materials, as in January, 23 tons ether and 10 tons picric acid were exported to that country. In January, 1886, no picric acid whatever was sent to France from Germany, and only 627lb. ether.—*Chem and Drug.*, 19th March, 1887.

New Openings for Trade.

Germany—Chemical and Pharmaceutical Commodities.—The British Consul at Dresden, writing at the close of last year, says that the exports of chemical and pharmaceutical commodities look well in the German official returns. Much of the foreign business, like the domestic, he says, gives a very low rate of profit, owing to the enormous fall in the value of chemical, pharmaceutical, and technical products. The overproduction is immense, but the price of some important articles has been kept up by trade coalitions, and the dividends of a certain fraction of the seventy or eighty German companies, though not up to the old level, are fairly satisfactory. As in other branches of manufacture, makers of specialties and holders of patents are obtaining very large returns—*e.g.*, the Berlin Company "Schering" has given 18 per cent., and the shares have lately jumped from 120 to 515. As of particular concern for ourselves, he mentions that the ammonia-soda movement is in active progress, to the detriment, as the German Custom-House statistics show, of the import of British "Leblanc" soda. According to some newspaper figures (which he has been unable to verify) the sales of one great German chemical staple—the chloride of potassium of the Stassfurth Carnallite Works—have been the most extensive effected for some years.

Roumelia—Drugs and Dyes.—Drugs and dyes, we learn from consular reports, are among the articles of first necessity imported into Roumelia from this country. There appears to be good reason to believe that we shall be able to hold our own with these articles.

Turkey—Chemicals, Drugs, &c.—According to the British Consul at Salonica there is a growing demand in Macedonia for chemicals. There has been a sustained demand for drugs, and Austrian imports have accordingly steadily increased. Sulphurous oils and drugs figure among the chief imports from Italy.

Bulgaria—Opening for Toilet Soaps.—There is said to be an opening for toilet soaps in Bulgaria. The Austrians have hitherto done a very good trade by offering cheap imitations of English articles. The bulk of the common soap used is the white Turkish or Cretan, made from olive oil.—*Brit. and Col. Drug.*, 19th March, 1887.

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

1886.

2599 W. Fäger, Liverpool. Improvement in centrifugal machine filters. Complete specification. February 19

2622 W. T. Ramsden and T. Moy, London. Improvements in the method of, and in apparatus for, cooling and freezing. February 19

2654 C. W. Crossley, London. Improvements in the construction, arrangement, and combination of apparatus for the propulsion, suction, and movement of air for ventilating, blowing, and other purposes; applicable also for the movement of fluids and gases. February 21

2678 T. Gautreau, London. Improvements in tubes for steam generators or condensers, and other heating or cooling apparatus. February 21

2710 J. A. Crocker, London. Improvements in filtering machines. Complete specification. February 22

2711 J. A. Crocker, London. Improvements in filtering machines. Complete specification. February 22

2747 J. Gray, Glasgow. Improvements in centrifugal machines for separating fluids of different specific gravity. February 22

2766 J. Y. Johnson—From La Société G. Boone and J. Nory, France. Improvements in decantation apparatus for clarifying and purifying water and other liquids. Complete specification. February 22

2782 H. H. Lake—From W. W. Batchelder, United States. Improvements relating to vapour burners or similar heating apparatus. Complete specification. February 22

2881 B. J. B. Mills—From J. Rétif, France. A new or improved filter for water and other liquids. Complete specification. February 24

2909 A. MacLaine, Belfast. An improved feed-water heater and air extractor in connection with steam engines. February 25

2910 J. C. Thresh, Manchester. Improvements in the manufacture of filtering materials. February 25

2915 J. Critchlow, T. Forester, W. Forester, H. Forester, and L. Forester, Longport. Improvements in filter-presses. February 25

2918. A. T. Winn and W. E. Hainsworth, Dewsbury. Self-acting, self-feeding carbonising and vapour-distributing kiln. February 25

2920 D. Rylands and R. Potter, Barnsley. Improvements in regenerative gas furnaces. February 25

3016 R. R. Evans, London. Improvements in the construction of centrifugal pumps and fans for blast and exhaust purposes. Complete specification. February 26

3023 W. A. Keay, Westerham Hill. Improvements in apparatus for evaporating and condensing liquids. February 26

3024 M. Schwab, London. New or improved apparatus for the intermittent supply of liquid to chemical plant, steam boilers, or other vessels under pressure or otherwise. February 26

3030 F. Weldon, London. Improvements in compressing apparatus. February 26

3045 G. F. Belling, London. High-pressure tap. Feb. 28

3052 R. Hallewell, Manchester. Improvements in the manufacture of water-heating apparatus. February 28

3055 T. Cook and G. Bryant, London. Improved fire-bar for furnaces, etc. February 28

3148 E. Luck, London. Improvements in distillatory apparatus. March 1

3151 A. G. Brookes—From M. Greeven & Co., Germany. Improvements in steam vacuum pumping apparatus. March 1

3210 R. Fraser, Liverpool. Improvements in or appertaining to feed-heating and water-circulating apparatus for steam-boiler furnaces. March 2

3221 H. E. Newton—From E. Theisen, Germany. Improvements in condensing apparatus. March 2

3301 T. Lockerbie, London. Improvements in pipes for conducting liquids, such as acids, alkalis, beer, paraffin oils, and the like. March 4

3364 W. Williams, London. Improvements in fusible plugs for steam boilers, feed-water heaters, and other appliances connected with steam boilers. March 4

3443 E. Wilson, London. Improved disintegrator. Mar. 7

3499 J. P. Jackson, Liverpool. Improvements in apparatus for filtering water and other liquids. March 8

3571 W. P. Thompson—From J. D. Smead. See Class II.

3647 C. H. Roeckner, F. L. Roeckner, and R. L. Roeckner, Tynemouth. Separating solids from liquids; and for filtering liquids. Complete specification. March 10

3701 A. MacLaine, Belfast. Improvements in heating feed-water, and extracting oil and air therefrom, in connection with steam engines. March 11

3729 A. Mayhew, London. A new or improved apparatus for supplying liquid to steam boilers, and other vessels, as and when required, either automatically or otherwise. March 11

3749 M. Kotyra. See Class XVIII.

3793 J. Imray—From La Compagnie Générale pour la Production du Froid Procédes, E. Fixary, France. An improvement in refrigerating apparatus. March 12

3804 J. Howes, Liverpool. Improvements in filtering apparatus. March 14

3839 W. S. Tomkins, London. Improvements in injectors for feeding steam boilers or generators, and raising and forcing liquids for other purposes. March 14

3841 J. Cumming, F. N. Fennell, and G. F. Fennell, London. Improvements in apparatus for heating water or other fluids. March 14

3843 G. Downing—From H. T. Baeschlin, France. Improvements in the manufacture of refrigerating materials. Mar. 14

3848 C. J. Buhring, London. Improvements in and relating to filtering apparatus. March 14

3862 W. A. G. Schönheyder, London. An improved method and apparatus for distilling. March 14

3961 H. J. West, London. Improvements in ice-making and refrigerating machines. March 16

3999 E. Albin, London. Improvements in heating and feeding air to boiler furnaces and the like. March 16

4021 W. P. Thompson, Liverpool—From D. D. Smead, United States. Improvements in apparatus for heating air. March 17

*COMPLETE SPECIFICATIONS ACCEPTED.**

1886.

16,589 E. L. Marsden and P. H. S. Nicklin. Steam blast apparatus. February 26

2864 F. Windhausen. Apparatus for refrigerating. Feb. 26

5669 C. W. Rabitz, London. Filtering apparatus. Feb. 26

6051 J. R. Fothergill. Furnaces for effecting combustion of fuel with air under pressure. March 19

6072 P. A. Maignen. Filtering apparatus. March 16

6282 F. N. Mackay. Apparatus for effecting the absorption of gases by liquids. March 16

6502 A. M. Clark—From M. M. Bair. Construction of furnaces, muffles, and other heating apparatus. March 16

6510 H. J. Worssam and H. Hunt. Preventing the deposit of solid matter in the tubes of apparatus for heating or cooling liquids. March 16

6628 H. E. Newton—From A. L. G. Dehne. Filter presses for use under high pressures. March 19

7202 A. M. Clark—From M. M. Bair. Reverberatory furnaces. March 19

7850 E. G. B. Barlow and C. W. Poole. Apparatus for regulating the supply of compressed gas. March 5

1887.

832 H. J. P. Jolly—From G. Richmond. Method and apparatus for artificial cooling. February 23

1035 H. H. Lake—From V. Collian. Steam generators. Feb. 23

1114 H. J. Allison—From the De la Vergne Refrigerating Machine Company. Buffers for gas compressor valves. February 26

1582 A. J. Boult—From S. W. Merryman. Boiler-cleaning compounds. March 2

2192 H. D. Cooper. Washer especially suitable for the joints of tubes and fittings lined with glass. March 12

2237 H. D. Cooper. Fittings for tubes lined with glass or other material. March 16

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* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

2623 T. Lishman, London. Improvements in and in apparatus for treating the waste products from the manufacture of gas, coke, and the like. February 19

2674 W. H. Luther and G. Rose, Glasgow. Improvements in and connected with oleaginous vapour or gas and air lamps for lighting and heating purposes. February 21

2708 T. G. Marsh, Lytham. Improvements in gas lighting. February 22

2749 A. J. Boult—From H. W. Brooks, United States. Improvements in the manufacture of steam and oil gas for fuel and for illuminating purposes. Complete specification. February 22

2752 H. J. Siebel, jun., London. Improvements in apparatus for enriching gas. Complete specification. February 22

2870 J. A. Eaton, London—From S. H. Shaw, India. Apparatus for heating air to a high temperature. February 24

2945 G. E. Saville, Manchester. Improvements relating to the manufacture of hydrocarbon gas from coal. February 25

2948 J. Yelland, London. A pot and tank gas furnace combined. February 25

3267 C. W. Watts, London. Improvements in the purification of coal gas, and apparatus therefor. March 3

3271 J. Gilchrist, Glasgow. The burning of solid hydrocarbon (or paraffin wax) in miners' lamps and for keeping the same in a liquid condition, also from being blown out easily. March 3

3291 J. Howard and E T. Bousfield, London. Improvements in the manufacture of gas and in apparatus therefor. March 3

3335 J. Smith and A. Emley, Newcastle-on-Tyne. Improvements in burners for regenerative gas-lighting apparatus. Complete specification. March 4

3367 J. W. Newall, London. Improved method of heating furnaces with liquid fuel. March 5

3388 A. Lentz, Liverpool. Improvements in charging retorts and apparatus therefor. Complete specification. March 5

3396 S. Chandler, jun., and J. Chandler, London. An improved device for checking and regulating the flow of gas. March 5

3418 J. A. Marsh, Cleveland, Ohio, U.S.A. Improvements in apparatus for producing gas or vapour from hydrocarbons, and for utilising such gas or vapour for lighting or heating. Complete specification. March 5

3450 J. J. Lundy, A. G. Christiansen, and F. G. C. Lundy, London. Applications of and improvements in the treatment of the products of combustion. March 7

3571 W. P. Thompson, Liverpool—From J. D. Smead, United States. Improvements in burning liquid fuel, and in apparatus and furnaces therefor. March 9

3617 A. F. Craig, A. Neilson, and J. Snodgrass, Glasgow. Improvements in apparatus for separating mineral or other oils from oils or substances of different specific gravities. March 10

3781 G. E. Darman, Stafford. Improvements in thermopiles relating to those heated and cooled by means of the circulation of liquids. March 12

3978 G. Anderson, London. Improvements in apparatus to be used for the purification of coal gas by ammonia. March 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

5522 T. F. V. C. Otto, C. Otto & Co., and The Hibernia and Shamrock Mining Co. Coke ovens. March 5

5858 J. Hepworth and E. Marriott. Removal of ammonia from coal gas, and manufacture of ammoniacal salts therefrom; and apparatus therefor. March 9

5915 W. S. Sutherland. Apparatus for producing heating and illuminating gas. March 2

7733 T. Drake. Manufacturing gas from benzoline or other oil, and apparatus therefor. March 2

8822 M. H. Dement—From G. W. Le Vin. Heating and ventilating apparatus. March 2

8895 H. Williams. Obtaining illuminating and heating gas, and apparatus therefor. March 2

15902 H. H. Lake—From J. J. Johnston. Manufacture of gas for lighting and heating. March 12

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

COMPLETE SPECIFICATION ACCEPTED.

1886.

2720 R. J. Lee. Promoting and effecting combustion, especially of medicinal and chemical agents. February 26

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

2863 R. H. W. Biggs—From C. M. de Lahorie, Paris. A new or improved method of manufacturing dyes, disinfectants, artificial stone, artificial ivory, and other similar substances. February 21

2985 O. Imray—From The Farbwerke vormals Meister, Lucius and Bruning, Germany. Improved manufacture of a methylene-blue specially adapted for printing on textile fibres. February 25

3028 F. Raschig, London. A process for the production of hydroxylamin. February 26

3039 J. Hickisson (trading as J. Bond & Co.) and A. Layland, London. Improvements in ink for marking linen and other materials. February 26

3280 R. Chadwick and J. Consterdine-Chadwick, London. Improved colouring matter for dyeing, painting, staining, or printing. March 3

3304 R. Reid, Glasgow. Improvements in separating solid matter from alizarin or other colouring matters or starch. March 4

3859 J. W. Lovibond, London. Apparatus for use in estimating, measuring or comparing colour, texture, and appearance of liquid or solid bodies, materials, or fabrics viewed by transmitted or by reflected light. March 14

3991 H. H. Lake—From A. Leonardt & Co, Germany. Improvements in the manufacture of colouring matters. March 16

4036 C. C. Horsley, London. An improved method of, and apparatus for, extracting tannin from bark. March 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

5846 J. Y. Johnson—From The Farbenfabriken vormals F. Bayer & Co. Producing a new sulpho-acid, and obtaining azo dyes therefrom. March 2

6000 H. Baum. Production of para-rosanilin and its homologues, and mono-di-tri-alkalised, phenylised, or naphthylised derivatives thereof. March 5

6413 J. H. Johnson—From The Badische Aniline and Soda Fabrik. The preparation from gallic acid of a yellow colouring matter suitable for dyeing and printing. March 16

6631 J. H. Johnson—From The Badische Aniline and Soda Fabrik. Preparing printing colours and solutions of colouring matters suitable for printing and fixing aniline colours on cotton or other similar fibres. March 19

7281 C. A. Martius. Production of azo colours from the paradiamines of stilbene and fluorine. March 19

V.—TEXTILES, COTTON, WOOL, SILK, ETC.

APPLICATIONS.

2695 A. M. Clark—From M. P. E. Gérard, France. An improved process of manufacturing textile threads from viscous or pasty matters. February 21

3662 W. Baxter, Bradford. A machine for finishing and polishing certain textile fabrics. March 10

3715 J. Longmore and W. L. Watson, London. Improvements in the treatment of exogenous plants, flax, jute, rhea, and the like. March 11

3719 P. Parsy, London. Improvements in steeping flax and similar matters. March 11

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

5790 P. Parsy. Steeping flax and other textile matters. February 23

7278 F. Mollet-Fontaino. Treatment of vegetable textile materials, and of threads and fabrics made therefrom. March 9

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

2811 J. A. Berly—From G. Lombard et Cie., France. Improvements in apparatus for cleansing, bleaching, burling, scalding, and dyeing spun textiles. February 23

3389 F. Towlson and E. Weldon, Manchester. Improvements in dyeing and printing aniline blacks. March 5

3541 W. Walker and J. Drenchfield, London. Improvements in machinery or apparatus for treating fibrous materials and fabrics for bleaching, dyeing, and other analogous purposes. March 8

3561 A. Birch, Manchester. Improved rollers for dyeing, washing, soaping, and bleaching fabrics, etc. March 9

3680 H. E. Ludbrook, London. An improved machine for dressing or separating and cleaning piassava and other vegetable fibres. March 10

3753 J. Burn, Bradford. Improvements in the method of, and apparatus for, dyeing warp and other threads. March 12

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

2561 A. M. Clark—From M. Honigmann, Germany. An improved method for preventing vessels of copper and its alloys being attacked when used for the evaporation of soda and potash leys, and for working soda steam boilers. February 18

2597 R. Fullarton, London. Improvements in means and apparatus for concentration and clarification of sulphuric acid. February 19

2680 A. A. Croll, London. Improvements in the treatment of ammoniacal liquor to obtain salts therefrom, and means or apparatus employed therein. February 21

2762 H. E. Newton—From A. Miller, United States. Improvements relating to the evaporation of salt and other substances in closed vessels. February 22

2963 A. Brin and L. Q. Brin, London. Improvements in the production of chlorine. February 25

2966 J. J. Hood and A. G. Salamon, London. Improvements in the manufacture of sulphate of alumina. February 25

3144 H. L. Pattinson, jun., London. Improvements in the manufacture of hydrates of barium and strontium. March 1

3583 A. A. Croll, London. Improvements in the treatment of sulphate of alumina. March 9

3704 J. Hargreaves, T. Robinson, and J Hargreaves, Liverpool. Improvements in the treatment of cupreous pyrites to separate gold, silver, copper, and sulphur, and to obtain oxide of iron, and in apparatus employed therein. March 11

4002 C. Humfrey. See Class X.

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

4388 T. Capper—From S. Pick. Apparatus used in the manufacture of ammonia soda. March 2

5456 T. T. Mathieson and J. Hawliczek. Purifying black ash, and recovering ammonia therefrom. February 23

5673 J. Hargreaves, T. Robinson, and J. Hargreaves. Treating hydrochloric acid to obtain chlorine, and using the said chlorine in the manufacture of bleaching powder, and apparatus therefor. March 2

5682 J. Hargreaves, T. Robinson, and J. Hargreaves. Manufacture of sulphates of soda and potash, and apparatus therefor. March 2

6468 W. Simon. Manufacture of bichromate of potash. March 2

5681 J. Hargreaves, T. Robinson, and J. Hargreaves. Treating pyrites, and apparatus therefor. March 9

7157 A. M. Clark—From M. Honigmann. Protecting copper vessels used for soda, steam boilers, and for evaporating potash and soda leys. March 16

16491 J. M. Walton. Manufacture of sulphurous acid, and other sulphur compounds, and apparatus therefor. March 16

1887.

1998 A. M. Clark—From J. Brown, F. Herreshoff, W. H. Nichols, and G. H. Nichols. Making pure sulphuric acid and strong sulphuric acid in one continuous operation. March 9

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

2821 W. H. Turner, London. Improvements in or relating to the printing of tiles, and the like. February 23

3205 W. A. O'Sullivan, Dublin. Mechanical glass-bottle blowing. March 2

3258 R. E. Donovan, F. Hazlett, and J. Johnston, Dublin. Improved apparatus for blowing glass by mechanical means. March 3

3431 H. M. Ashley, Ferrybridge. Improvements in the manufacture of bottles and other hollowware in glass, and in the machinery for the same. March 7

3518 A. D. Brogan and A. M. Malloch, Glasgow. An improved method of producing rippled, chequered or other patterns or designs upon rolled plate and sheet glass, and apparatus therefor. March 8

3519 A. D. Brogan and A. M. Malloch, Glasgow. An improved method of producing rippled, chequered or other patterns or designs upon rolled plate and sheet glass, and apparatus therefor. March 8

3671 J. Breeden, London. Improvements in illuminating glass and other transparencies. March 10

3689 W. H. Beck—From La Société F. Benoist et L. Berthiot, France. New or improved machine for surfacing cylindrical and other curved glasses. March 11

3794 T. Garton, London. A novel transparent protective enamel. Complete specification. March 12

3907 T. E. Halford and R. Morant. See Class X.

4005 A. Fielding, Longport. Improvements in the manufacture of artistic pottery. March 17

4062 C. D. Barker and F. C. Hills, London. Improvements in the shape and manufacture of porous pots. March 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

5748 W. W. Pilkington. Apparatus for use in the manufacture of plate glass. March 19

6114 R. Young and R. Jex-Long. Manufacture of fire-clay tuyeres, and apparatus therefor. March 5

6150 J. G. Sowerby. Improvement of apparatus used in the fire polishing of glassware. March 9

8559 J. R. Pratt. Potters' lathes. March 16

8957 R. Skeoch and W. G. Wodson. Case kiln for burning bricks and other clay goods. March 2

14979 W. H. Blessley. Manufacture of stoneware. March 19

15009 J. D. Watson. Annealing glass or articles made therefrom. March 5

15552 H. W. Lowden. Tiles for roofing and other purposes. February 23

1887.

178 J. Van de Loo. Presses for the embellishment of ceramic products, and method of applying enamel. March 2

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

2531 J. W. T. Stephens and R. Clark, Cardiff. The manufacture of Portland, Roman and other cements. February 18

2573 P. Jochum, London. An improved manufacture of blocks or slabs formed of combined argillaceous and ferruginous matter suitable for paving and other purposes, and apparatus therefor, such apparatus being also applicable for mixing pulverulent materials generally. Complete specification. February 18

2863 R. H. W. Biggs—From C. M. de Laborie. See Class IV.

2911 C. S. Lumley and J. Northrop, London. Improvements in the method of paving by the employment of concrete blocks or sets, and in apparatus therefor. February 25

3168 S. Trickett and J. Noad, London. Improvements in the manufacture of hydraulic cements, limes, mortars or concretes. March 1

3507 J. Pope, Folkestone. Improvements in construction of walls of houses, buildings, and the like. March 8

3568 G. G. Girling, Lenham, Kent. Making artificial stone, to be called "Petrean stone." March 9

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

3832 W. E. Constable. Manufacture of artificial ashphalt. February 23

5578 J. D. Gibbins. Method of constructing footways, etc., and producing and laying composition. February 23

5843 C. J. Howe. Manufacture of cement or plaster. March 9

5975 A. J. Boult—From A. Grasset and A. C. Mallat. Manufacture of cement. March 5

6221 C. S. Williams. Construction of fireproof floors. March 2

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

2530 H. Hibbert and W. Horsfield, Nottingham. Improvements in machinery or apparatus used in mines, called "Prop-for Mines." February 18

2541 G. Thew, Farnworth. The prevention of explosions in collieries, named "The Perfect Safety Lamp." February 18

2565 A. M. Clark—From H. A. Brustlein, France. Improvements in the method of cooling ingots, and in moulds therefor. February 18

2602 C. A. Burghardt and W. J. Twining. See Class XVIII.

2681 W. F. Richards and J. Roberts, London. Improvements in the manufacture of iron. February 21

2697 E. Patterson and W. H. Strype, London. Improvements in miners' safety lamps. February 21

2720 J. A. Maskrey, London. Improvements in apparatus for use in the manufacture of tin plates. February 22

2722 J. Banham and S. W. Wilkinson, Sheffield. Improvements in the method of making castings. February 22

2740 M. Constable and J. R. Bingle, London. An improved process for the extraction of gold, silver, and other metals from ferriferous ores containing same. Complete specification. February 22

2774 A. E. Outerbridge, jun., London. Moulds for metal castings. Complete specification. February 22

2780 J. Dahl, London. Improvements in annealing steel. February 22

2834 H. Gardner—From R. J. Henderson, United States. A special treatment of iron ores, and apparatus for that purpose. February 23

2935 J. Dickson, Sheffield. An improved method of preparing steel for roller bars and bed-plate bars used in the manufacture of paper and paper pulp. February 25

2945 E. Robertshaw, London. Improvements in apparatus for preventing accidents in mines or other shafts by overwinding. February 25

2999 L. A. Brode, Glasgow. Improvements in preparing briquettes of ironstone, waste, or dust, or other ferruginous materials for smelting. February 26

3259 J. Ronson, Walsall. Regulating the expansion and contraction of chill rolls, which he calls a "Chill-roll Regulator." March 3

3271 J. Gilchrist. See Class II.

3291 S. Alley and J. A. MacLellan, Glasgow. Improvements in apparatus for making moulds for casting. March 4

3340 J. H. Wicksteed, London. Improved arrangement of shearing machines for cutting hot blooms or cogged ingots. March 4

3356 H. J. Kirkman, London. Improvements in the manufacture of tin and terne plates and galvanised iron sheeta, and other galvanised goods. March 4

3362 J. W. Swan, London. Improved apparatus for the detection of explosive gases in mines or other places. March 4

3109 F. R. Schweizer and C. F. Muhlmann, London. Improvements relating to the casting of metals and alloys. March 5

3115 G. J. Goodhue, London. Timber structures for mines. March 7

3531 T. Shaw, London. Improved method of and apparatus for testing gases drawn from mines, and signalling or indicating the result thereof. March 8

3573 J. L. Parker, Longport. An improved shield for miners' safety lamp. March 9

3669 C. B. Schultze, London. A new or improved process for the extraction and recovery of metals, and especially for the recovery of tin from tinned iron plate. March 10

3670 F. H. Lloyd and H. White, London. Improvements in the manufacture of cast steel, and in apparatus used in the said manufacture. March 10

3696 C. B. Phillips, Chester. The dephosphorating and refining iron, steel, alloys of iron or steel, and other metals and alloys. March 11

3704 J. Hargreaves, T. Robinson, and J. Hargreaves, Liverpool. Treatment of cupreous pyrites to separate gold, silver, copper and sulphur, and to obtain oxide of iron; and in apparatus employed therein. March 11

3738 P. M. Justice—From H. T. Rode, Germany. Improvements in the manufacture of steel and ingot iron. Complete specification. March 11

3741 O. Hehner and T. H. Cobley, London. Improvements in the recovery or extraction of tin, or oxide or salts of tin, from waste tinned iron or tin scrap. March 11

3821 H. W. Martin and J. Turnbull, London. An improved method of damping dust in collieries and mines. March 11

3907 T. E. Halford and R. Morant. An improved method of making glass-lined metal articles. March 15

3974 S. Siemang, London. Compound chilled casting for armour plates. March 16

3975 S. Siemang. Improvements in the manufacture of cast iron. March 16

4002 C. Humfrey, Liverpool. Improvements in or appertaining to the manufacture of sodium. March 17

4006 D. McCorkindale, Mossend. Improvements in preparing malleable iron for making tubes and other articles. March 17

4009 B. E. Clarke, Sheffield. Improvements in miners' safety lamps. March 17

4053 E. Fisher and J. P. Cramp, London. Improved methods of smelting in blast furnaces. March 17

4054 F. Elmore, London. Improvements in the means of and apparatus for the coating of pieces of metal. March 17

4064 J. W. Clewhall and F. Clench, London. Improvements in crushing mills for ore and other materials. March 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

2865 F. Bosshardt—From S. Montagne. Method and means for extracting tin from tinned metal cuttings by means of hydrochloric acid gas. February 26

2870 R. Stone. Manufacture of iron and steel. March 2

3393 J Lysaght and J. Lysaght, Limited. Annealing apparatus. March 12

4177 J. W. Wailes. Furnaces and regenerators for production of steel. March 16

4536 W. Penrose and W. Hackney. Manufacture of open hearth steel. February 26

4812 R. Thompson. Implements for breaking down stone or coal. March 2

5681 J. Hargreaves, T. Robinson and J. Hargreaves. Treating pyrites, and apparatus therefor.

6217 A. Johnson. Apparatus for preventing blown-out shots in blasting and tunnelling, and preventing ignition of explosive gas in blasting. March 2

6300 J. M. Bennett. Smelting and refining gold, silver, copper, zinc, lead, and tin ores, and furnaces therefor. March 19.

6180 W. Paterson. Miners' safety lamps. March 2

6550 T. Slater. Manufacture of metallic alloys. March 9

7920 H. Johnson. Apparatus for breaking down minerals. (Previously included in No. 6217.) March 2

16419 W. A. Barlow—From J. Bulliat. Manufacture of fine steel from coarse grain steel, and regeneration of burnt steel. March 9

16523 J. E. Bott, S. J. Hackney and W. Craven. Production of steel for steel castings, and apparatus therefor; applicable also for melting other metals.

1887.

163 H. H. Lake—From W. White. Amalgamating apparatus for separating metals from their ores. March 9

1166 S. B. Stine. Coal-mining machines. February 26

1721 J. Laidler. Safety lamps. March 5

1750 H. H. Lake—From Count R. de Muntgelas. The electrodeposition of aluminium, and apparatus therefor. March 16

1918 A. H. Reed—From H. G. Hicks. Welding compounds. March 9

2117 C. Sheibler. Manufacturing steel and iron, and obtaining by-products therefrom. March 19

XI.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

2615 W. Buttner, J. G. Haller and J. G. Magnus, London. Improved apparatus and means for extracting, washing, and condensing fat, grease, glue, oil or other substances from bones, wool, organic or inorganic substances; for drying the same, and recovering the solvent employed. Complete specification. February 19

2887 C. Wilkins, London. Improvements in marking soap. February 24

2904 D. G. Joy, Kingston-upon-Hull. Improvements in refining oils, fats, and their residues. February 24

3031 A. G. Wass, London. An improved lubricant. February 26

3110 A. Smith, London. A process for deodorising cocoa nut oil. March 5

3592 H. N. Hillman, and G. B. Kleinpass, London. Improvements relating to the manufacture of margarine, oleomargarine, and similar substances. March 9

3617 A. F. Craig, A. Neilson and J. Snodgrass. Improvements in apparatus for separating mineral or other oils from oils or substances of different specific gravities. March 10

3832 A. G. Wass, London. An improved lubricant. Complete specification. March 11

3833 A. G. Wass, London. An improved lubricant. Complete specification. March 11

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

5792 A. J. Boult—From E. Oppelt. Apparatus for extraction of oils or other vegetable juices. March 2

6210 H. W. Langbeck and R. E. Ritsert. Separating cholesterine fats from commercial wool fats, and from lyes of wool-washing works. March 9

1887.

16 R. Wright. Toilet and washing soap. March 12

XII.—PAINTS, VARNISHES, AND RESINS.

APPLICATIONS.

2691 A. M. Clark—From M. P. E. Gerard, France. A new composition capable of being formed into threads, films, sheets, slabs, or moulded articles, or used as a varnish. February 21

3209 W. F. Hurndall, Liverpool. Improvements in paints applicable for painting iron or steel work, the insides and outsides of boilers, and other structures. March 2

3869 W. R. Hutton, E. Fischer, W. Struthers, and T. J. Smillie, Glasgow. Improvements in anti-corrosive or preservative coatings for metallic surfaces. March 15

3987 J. A. Bigsby, Deptford. Improved method of preparing a gummy varnish, coloured or otherwise, for general use or decorative purposes. March 16

4008 W. D. Weissenburg, London. A new way of manufacturing white lead. March 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

5820 J. Warwick. Manufacture of white lead. February 23

6370 R. Lavender. Manufacture of oxide of iron pigment. March 12

1887.

2198 W. Dick. Protective varnish. March 19

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

3027 E. Tuteur and W. J. Goulborne, London. Improvements in leather compositions applicable to various useful purposes. February 28

3623 J. Pickup, E. Pickup, and J. Pickup, Manchester. Improvements in apparatus for boiling size in size boxes of sizing machines; applicable also to other machines or apparatus where an injection of steam is used to obtain boiling. Complete specification. March 10

3860 H. Golding, London. Improvements in treating leather. March 14

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

13283 A. M. Clark—From J. B. West. Tanning and stuffing leather. March 16

1887.

1163 J. H. G. Langenhagen. Dressing for leather. Feb. 26

XIV.—AGRICULTURE, MANURES, Etc.

APPLICATIONS.

3088 H. Stevenson and J. T. Hazeldine, London. The manufacture or making improved artificial manures. February 28

3179 J. Hardwick and J. R. Shearer, London. Improvements in the manufacture of hygienic manure by the treatment of excreta and sewage, and in the methods of its application to land and plants; suitable also as a destroyer of noxious insects, aa a disinfectant, and for other purposes. March 2

3292 T. McMurray, Glasgow. New or improved compounds to be used for deodorising, filtering, and manuring purposes. March 4

COMPLETE SPECIFICATION ACCEPTED.

1886.

6732 T. H. Cobley. Treatment of sewage sludge, and preparation of a manure therefrom. March 19

XV.—SUGAR, GUMS, STARCHES, Etc.

APPLICATIONS.

2572 C. D. Abel—From T. Roussélot, The Antilles. Improvements in multiple three-roll sugar-cane mills. February 18

2905 H. H. Lake—From La Compagnie de Fives-Lille, France. Improvements relating to diffusing apparatus for use in the treatment of beetroot, sugar-cane, and other substances. February 24

2983 G. F. Marshall, London. The manufacture of an improved carbon for filtering and decolourising purposes. February 25

3526 A. E. Major, Wandsworth. Improvements in the manufacture of sugar. March 8

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

5562 T. M. Aitken and J. McNeil. Machines for cutting sugar canes. February 23

5792 A. J. Boult—From E. Oppelt. See Class XI.

1887.

1931 M. A. Perret. Apparatus for extracting the saccharine or other soluble matter from sugar cane, etc. March 19

2138 H. L. Sulman and E. E. Berry. Treatment of grain for the manufacture of starch or glucose. March 19

XVI.—BREWING, WINES, and SPIRITS.

APPLICATIONS.

2936 G. Epstein, London. Improvements in the treatment of brewers' and distillers' grain. February 25

3187 J. Klein, London. Improvements in apparatus for filtering beer and other liquids. March 2

3240 G. Epstein, London. Improvements in the treatment of coffee, porter, and other drinks, and apparatus therefor. March 3

4013 C. Lesne, London. The cure of musty and otherwise stinking brewers' casks. March 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

4168 W. Spencer and J. Jones. Treatment of brewers' wort. March 16

5457 W. S. Squire. Manufacture of yeast. February 23

5772 F. Faulkner and W. Adlam. Treating brewers' wort. March 2

6112 G. F. Redfern—From P. Lauth. Apparatus for drying and germinating barley, etc. March 9

6401 H. Schaarwachter. Apparatus for pasteurising beer, wine, etc. March 5

8420 A. Boake and F. G. A. Roberts. Application of an improved antiseptic salt in brewing. March 5

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

APPLICATIONS.

A.—Chemistry of Foods.

1886.

17165 C. A. Wahlin, A. Forssell, and F. L. Enguist, London—From A. T. Pfeiff, Sweden. Improvements in the treatment of milk. August 19, 1886. Received 18th February, 1887, and ante-dated under International Convention.

1887.

2937 G. Epstein, London. Improvements in the treatment of coffee, and apparatus therefor. February 25

3128 G. Grout and G. Shenton, London. An improved addition to farinaceous substances for making bread, biscuits, cakes, and other articles of food usually made therefrom. March 1

3284 C. A. Sahlstrom, Aberdeen. Improvements in preserving, and apparatus for the same. March 3

3461 G. Bischof, London. A process of, and apparatus for, purifying water. March 7

3471 H. Kochert, London. Improved preserved food. March 7

3597 T. Rickett, Southampton. Improvements in the process of bread raising and baking in ovens. Complete specification. March 9

4063 W. L. Wise—From C. A. Wahlin, A. Forssell, and F. L. Enguist, Sweden. Improvements in the treatment of milk. March 17

B.—Sanitary Chemistry.

2553 A. Angell, London. Improvements in the manufacture of precipitants, and in the treatment of sewage. February 18

2860 H. Davey, Leeds. A method of automatically raising sewage. Complete specification. February 24

3179 J. Hardwick and J. R. Shearer. See Class XIV.

3292 T. McMurray, Glasgow. New or improved compounds to be used for deodorising, filtering, and manuring purposes. March 4

3338 E. Crutchloe, London. Improvements in furnaces for securing the complete reduction of any organic matter to ashes, and rendering innocuous and inoffensive the gases escaping therefrom. March 4

3352 G. Gehring, London. Process and apparatus for the separation and disinfection of fœcal and other matters, March 4

C.—Disinfectants.

2831 J. H. Harford and W. W. Reeves, London. An improved disinfecting and curative device, and composition or powder to be used therewith. February 23

2863 R. H. W. Biggs—From C. M. de Lahoric. See Class IV.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1886.

4114 A. S. Krueger. A preparation for a new beverage similar to coffee. February 23

9518 C. Millen. Preparation and preservation of cocoanuts for use as food. March 16

17087 A. B. Imrie. Refrigerating machinery applicable to freezing machines for preserving meat and other perishable substances. March 19

1887.

1996 J. Carnrick. Process and apparatus for manufacture of powdered milk. March 9

B.—Sanitary Chemistry.

1886.

3973 J. W. Slater, S. K. Page, W. Stevens, and the Native Guano Company, Limited. Preparation of materials for use in the treatment of sewage and foul water. February 23

4203 L. G. G. Daudenart. Purification and utilisation of sewage, and apparatus. March 9

6732 T. H. Cobley. See Class XIV.

13829 F. Candy. Manufacture of materials for use in the treatment of sewage, to effect the separation of matters in suspension and solution in the water thereof, and the clarification and purification of other polluted water, and certain other liquids. March 19

1887.

278 J. Wohanka and K. Kocian. Purification of sewage. March 9

C.—Disinfectants.

1886.

6191 W. D. Borland. Manufacture of bromine preparations for sanitary purposes. March 9

6966 H. M. Caldwell. Improved deodorant and disinfectant. March 16

11011 J. W. Knights and W. D. Gall. Disinfecting powder. March 12

XVIII.—ELECTRO-CHEMISTRY.

APPLICATIONS.

2588 L. Hanson, Halifax. An improved construction of armature for dynamos or electric motors. February 19

2602 C. A. Burghardt and W. J. Twining, Manchester. Improvements in the production of aluminium, and of alloys of aluminium and copper by electro-deposition. February 19

2641 G. W. Rhodes—From L. Lambotte, Brussels. A new hydro-electric battery. February 21

2721 C. G. Curtis, F. B. Crocker, and S. S. Wheeler, London. Electric batteries. Complete specification. February 22

2825 J. G. Statter, London. Improvements in or applicable to dynamo-electric machines. February 23

2835 G. V. Lagarde, London. Improvements relating to electric batteries, and to means for putting the same into and out of action. Complete specification. February 23

3056 H. Aylesbury and J. Milne, Bristol. An alternating current sparkless commutator for an electric dynamo. Feb. 28

3057 H. Aylesbury and J. Milne. A brushless and sparkless commutator for an electric dynamo. February 28

3087 E. Wilson, Hanover. The improvement of dynamo-electric machines. February 28

3098 B. J. B. Mills—From A. Million, France. Improvements in electric candles. February 28

3197 Sir D. L. Salomons, Bart., T. Parker, and P. B. Elwell, Wolverhampton. An improved means of separating the plates in secondary batteries. March 2

3323 C. L. Tweedale, Manchester. Improvements in primary batteries. March 4

3342 W. E. Ayrton and J. Perry, London. Apparatus for measuring the coefficients of self-induction or of mutual induction. March 4

3588 G. Tangye and T. Jefferies, London. Improvements in machinery or apparatus for driving dynamo-electric and magneto-electric machines. March 9

3608 J. D. F. Andrews, London. An improvement in dynamo-electric machines. March 9

3609 D. Halpin and J. A. Timmis, London. Improvements in dynamo-electric or magneto-electric machines and motors. March 9

3749 M. Kotyra, London. Improvements in electrical apparatus for the prevention of corrosion and formation of scale in steam boilers. March 11

3796 G. C. Fricker, Putney. Generating electricity by the direct combustion of carbon fuels. March 12

3811 T. R. Weston, London. A new method for obtaining electricity. March 14

3856 T. V. Hughes, London. An improved process for making filaments of carbonisable material suitable for conversion into conductors for use in electric glow lamps. March 14

4032 M. Immisch, London. Improved holder for brushes of electro-motors and dynamo-machines. March 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

4663 F. F. Stögermayr and V. Glassner. Electric generators. March 9

4884 J. Platt, J. Hopkinson, and E. Hopkinson. Dynamo-electric machines. March 2

5479 S. C. C. Currie. Gauging electric currents, and apparatus therefor. February 23

5588 W. M. Mordey. Dynamo-electric machines. March 9

5971 A. W. Armstrong. Electrical batteries and appliances. March 2

9518 R. Applegarth. Carbon electrodes. March 2

9582 J. P. Hall. Dynamo-electric machines. March 2

10502 E. Frankland. Electrical storage batteries. March 5

13592 M. Bailey and J. Warner. Primary batteries. March 2

11937 M. Bailey and J. Warner. Preventing escape of noxious fumes from batteries. March 2

1887.

111 W. C. Quinby. Electrolyte and depolarising solution for voltaic batteries. March 9

1656 M. Bailey and J. Warner. Preventing escape of noxious fumes from electric batteries. March 5

1750 H. H. Lake—From Count R. de Montgelas. The electro-deposition of aluminium, and apparatus therefor. March 16

1752 H. H. Lake—From Count R. de Montgelas. Electric batteries. March 5

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

3029 J. B. Spence, London. Improved mode of preparing fibres for use in paper making and other purposes. Feb. 26

3100 P. Cook, Glasgow. Improvements in and connected with the manufacture of papier-mâché hollow vessels, and in mechanism therefor. February 28

3122 H. J. Shawcross and B. H. Thwaite, Liverpool. Improvements in the method of manufacture and subsequent treatment of paper-tissue fabrics, wood, and like material for the production of writings, prints, designs, or other impressions in ink black and in colours. March 1

3891 T. Worth, Droylsden. An improvement in the waterproofing of paper for packing and other purposes. March 15

3927 C. Russell and P. H. Craigin, London. Improvements in paper-pulp screens. Complete specification. March 15

3937 A. Wilkinson, London. The treatment of fibres for pulp, and the manufacture of paper therefrom. March 15

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

1076 A. Schlumberger. Manufacture of cheques and other papers so as to prevent fraudulent alterations therein. Feb. 26

5563 W. E. Heys—From E. G. H. Ladewig. Manufacture of fire- and waterproof paper, millboard, etc. March 2

6585 J. G. Dunbar and A. Mackenzie. Apparatus for regulating the supply of pulp to paper-making machines. March 9

1887.

517 H. H. Lake—From E. R. Wiggin. Manufacture of corrugated paper and similar fabrics. March 2

523 H. H. Lake—From E. R. Wiggin. Machinery for use in the manufacture of corrugated paper. March 2

1443 R. Eisentraut. Manufacturing composition from cellulose or ground wood, which can be moulded by heat and pressure. March 2

1808 H. H. Lake—F. J. Marshall. Machinery for the manuacture of paper pulp. March 5.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATION.

3678 S. H. Levi, London. A process of treating the seeds of the fruit of a certain tree to render the same fit for industrial or commercial purposes. March 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

5936 E. Edwards—From E. A. Viteau. Process for complete purification of perfumes, in the manufacture of which sulphuret of carbon has been used. March 2

6259 C. D. Abel—From La Société Anonyme des Parfums Naturels de Caones. Extraction of perfume essences. Mar. 9

XXI.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

2628 H. S. Maxim, London. Improvements relating to the manufacture and treatment of dynamite, blasting gelatine, and similar explosive compounds, and to apparatus therefor. February 19

2679 C. Roth, London. Improvements in the manufacture of explosives. Complete specification. February 21

3173 S. H. Nealy and L. Hutchins, London. Improvements in marine torpedoes. Complete specification. March 1

3245 H. Jephson, Derby. Improved fog-signal detonator. March 2

3176 E. L. Sheldon, London. An improved match or cigarette light. March 7

3550 J. P. Gibbins, London. A land mine or torpedo for the discharge of grenades, small shell, or other missiles, over a large area. Complete specification. March 8

3551 J. P. Gibbins, London. A floating electro contact or automatic mine. Complete specification. March 8

3554 J. Fraser, London. Improvements in the method of, and apparatus for, manufacturing lucifer matches. March 8

3675 A. V. Newton—From A. Nobel, France. Improvements in explosive compounds. March 10

3676 A. V. Newton—From A. Nobel. Improvements in detonators. March 10

3778 W. W. Walker and E. A. McAdam, Liverpool. Improvements in matches, wax-vestas, tapers, and the like. March 12

3872 E. St. John Christophers and B. Dunk. The improvement of explosive shells. March 15

3887 G. P. Lemprière, Birmingham. Improvements in exploders or detonators for fog signals, torpedoes, artillery, fire-arms, blasting cartridges, and other articles of a like nature. March 15

3920 A. J. Boult—From L. Bagger, United States. Improvements in, or relating to, the igniting of explosive charges. Complete specification. March 15

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

4525 G. A. Sweetser. Improvements in the manufacture of cigar lights, fusees, or vesuvians, and apparatus therefor. March 2

6258 C. D. Abel—From F. Gaens. Explosive compound for blasting. March 5

5494 H. von Schenk. Manufacture of substances for igniting matches. March 16

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NOTICES.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those members of Council whose names are placed in italics in the annexed list, will retire from their respective offices at the forthcoming Annual General Meeting.

Professor James Dewar, F.R.S., has been nominated to the office of President, and Mr. David Howard has been nominated Vice-President under Rule 11.

Professor Clowes, Mr. J. Neilson Cuthbertson, Mr. Ivan Levinstein, and Professor W. A. Tilden, F.R.S., have been nominated Vice-Presidents under Rule 8; and Mr. B. S. Proctor has been nominated Ordinary Member of Council under Rule 17, in the place of Mr. Levinstein, nominated Vice-President.

The Treasurer and Foreign Secretary have been nominated for re-election.

Members are hereby invited to nominate fit and proper persons to fill four vacancies among the Ordinary Members of Council under Rule 18. Special nomination forms for this purpose can be obtained from the General Secretary upon application.

Extract from Rule 18:—"No such nomination shall be valid, unless it be signed by at least ten members of the Society, who are not in arrear with their subscriptions, nor unless it be received by the General Secretary, at the Society's Office, at least one month before the date of the commencement of the Annual General Meeting, to the election to take place at which it refers. Nor shall any such nomination be valid if the person nominated be ineligible for election under Rules 12 or 15. No member shall sign more than one nomination form."

Notice is hereby given, that the next Annual General Meeting will be held in Manchester on Wednesday, Thursday, and Friday, the 13th, 14th, and 15th of July next. Detailed arrangements and the programme of proceedings will appear as soon as complete.

The supply of copies of the Journal for January, 1882, and January, 1883, being now exhausted, the Secretary would be glad to receive communications from members possessing extra copies of those numbers, in good condition, with a view to purchase.

Should sufficient applications for complete sets be received, the numbers will be reprinted.

Authors of communications read before the Society or any of its Local Sections are requested to take notice that, under Bye-Law 43, they cannot receive the prescribed 50 copies of their communications unless they comply with the condition laid down in that Bye-Law—viz., that they give notice of their desire to receive such copies upon their manuscript before sending it to the Editor. Mention should also be made as to whether the Discussion is to be included in the reprint.

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W. Johnston Saint, l/o Munich; 11, Queen's Road, Aberdeen.

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R. Wightwick Roberts, l/o Valparaiso, Chili.

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Jas. Armour, c/o Clippens Oil Co., 16, Bothwell Street, Glasgow, clerk.

T. F. Barbour, Chemical Laboratory, University of Edinburgh, assistant.

Alex. Barr, 42, Bath Street, Glasgow, asphalte and waterproof cloth manufacturer.

R. Bloomfield, Thurma Factory, viâ Darbhunga, Tirhoot, India, indigo planter.

Thos. Fletcher, 99, Great Hampton Street, Birmingham, master baker.

Jas. Hardman, Whitwood Chemical Works, Normanton, manager.

Jno. Harrison, 35th and Gray's Ferry Road, Philadelphia, Pa., U.S.A., chemical manufacturer.

A. Frederick Jones, 15, Dawson Place, Bayswater, W., sodium nitrate manufacturer.

J. West Knights, County Laboratory, Cambridge, public analyst.

Alex. L. Lineff, 12, Buckingham Street, Adelphi, W.C., consulting engineer.

Harvey M. Mansfield, Fairfield, Somerset Co., Maine, U.S.A., chemist to Wood Fibre Company.

Frank Moul, Aldersgate Chemical Works, Southball, chemist.

Thos. C. Palmer, 121, Adelaide Road, Haverstock Hill, N.W., engineer.

E. Cheshire Patchitt, 128, Derby Road, Nottingham.

Dr. W. H. Perkin, jun., 33, Central Road, Withington, Manchester, chemist.

Chas. E. Pickard, Phœnix, Oswego Co., New York, U.S.A., student in applied chemistry.

Herb. Pilkington, Tipton Green Furnaces, South Staffordshire, blast furnace manager.

Edw. Ramsden, Holly Bank, Great Horton, Bradford, Yorks., spinner.

Alex. J. J. Ross, Battlefield Cottage, Falkirk, N.B., chemist.

C. J. Thompson, 11, Bentley Road, Prince's Park, Liverpool, pharmacist and analyst.

Jas. Totton, 150, Shaw Heath, Stockport, chemist.

Death.

E. Addenbrooke, 18, Cawley Road, South Hackney, E.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

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Hon. Local Sec. and Treasurer: Thos. Tyrer, Garden Wharf, Church Road, Battersea, S.W.

The meetings of the London Section will be held on the first Monday in each month.

SESSION 1886–87.

Prospective Arrangements.

May 2.—Dr. P. F. Frankland, "Recent Bacteriological Research in connection with Water Supply."
,, Dr. C. R. A. Wright, "The Action of Zinc Chloride on Castor Oil."
,, 16.—Messrs. Cross & Bevan, "Pictet's Wood Pulp System."
,, Mr. John Ruffle, "The Estimation of Moisture in Superphosphates and similar Fertilisers."
June 6.—Dr. H. E. Armstrong, "The Alkaloids—the Present State of Knowledge concerning them, and the Method employed in their Investigation."
,, Mr. Boverton Redwood, "Notes of a Recent Visit to some of the Petroleum-producing Territories of the United States and Canada."
July.—Annual Meeting in Manchester.

Notices of Meetings and Papers will be found in the Scientific Journals.

Notices of papers and communications to be made to the Local Secretary.

Meeting held April 4, 1887.

THE PRESIDENT IN THE CHAIR.

THE Triennial Election of Officers and Committee of the Section was made. Thanks to the Chairman and Committee were proposed and replied to by the Secretary. The new Committee takes office after June next.

FURTHER NOTES AND EXPERIMENTS ON THE COMPOSITION AND MANURIAL VALUE OF SEWAGE SLUDGE.

BY J. M. H. MUNRO, D.SC., F.C.S., ETC.,
Professor of Chemistry in the College of Agriculture, Downton, Salisbury.

In January, 1885, I had the honour of reading a paper before this Society, giving the results of field experiments with filter-pressed sewage sludge upon crops of turnips; I showed that, weight for weight, partially air-dried sludge exercised rather more immediate effect than farmyard manure, and good crops were grown with all three of the sludges tried, whereas on the unmanured plots scarcely any crop could be obtained. Since, however, 5 tons of the sludges contained a considerably greater weight of phosphoric acid and nitrogen than 5 tons of the farmyard manure, I considered that I had by no means obtained the maximum effect, which I attributed to the fact that the sludges were used in tenacious clods not readily pulverised by the harrow so as to mix with the soil. I expressed my intention of experimenting with some dried and ground sludges, anticipating that from them much better duty per unit of nitrogen and of phosphoric acid would be obtained.

These trials were duly made, with all the care I could bestow on them, but circumstances beyond my control interfered greatly with the results. Thirty-five plots of rape were grown in 1885, and some experiments were made on potatoes also; nothing was wanting to success but suitable weather, and unfortunately the summer of 1885 is too well remembered as one of exceptional drought. Root crops failed almost entirely over the whole of the south of England, winter keep was consequently exceedingly scarce, and the price of sheep fell alarmingly at the autumn fairs. My experimental plots of rape and swedes were really the best specimens of those crops to be seen on the farm, but that is not saying much; the weather was far too dry to favour the action of any manures, and even Peruvian guano, superphosphate, and nitrate of soda, produced only a fraction of their usual effect.

In consequence of this, I postponed publication of the results, and laid out another series of thirty-five plots in 1886, on which a mixture of rape and turnips was grown; these also were sacrificed to a misadventure, for which science provides no remedy. The farm manager, caring nothing for sewage sludge, and a good deal for the exigencies of his daily work, cast a greedy eye upon my crops as they approached maturity, and finally folded a flock of sheep upon them without allowing me any opportunity of weighing up the produce. I cannot, therefore, pretend to offer in this paper anything very new or very conclusive; as the title indicates, I have, really in response to the invitation of your Hon. Secretary, put together such notes and observations as may furnish a record of the work I have been able to devote to the subject during the past two years. The very full and recent discussion on the disposal of sewage sludge following the reading of Mr. Dibdin's and Mr. Crimp's papers at the Institution of Civil Engineers, proves the interest and importance of the subject, but at the same time, perhaps, rather discourages any individual effort to add to the existing information.

I will first dispose of the field experiments with ordinary sewage sludges, and with a novel one, and then consider the composition of sludge, and how sewage can best be precipitated and the sludge pressed *with the view* of utilising the pressed cakes as manure; and this, I may be allowed to point out, is not quite the same thing as precipitation and pressing with the sole view of clarifying sewage and avoiding a nuisance.

The ordinary sludges tried as manures in 1885 were Coventry sludge (lime and alumina), Leyton sludge (Hanson's process, lime and alkali waste), native guano (A B C process): all air-dried and ground. Wimbledon sludge (lime) partially air-dried and in lumps. Besides these, I tried also a sludge precipitated *not* from sewage, but from the waste liquor of a hide-cleansing factory. In its dry state it contained 1·20 per cent. nitrogen, and only 0·80 per cent. phosphoric acid.

The plots receiving these sludges were compared with unmanured plots, and with plots receiving standard manures, such as nitrate of soda, mineral superphosphate, Peruvian guano, and fish guano.

The detailed analyses of these sludges (together with others) are given in Table A, and will be commented on after the manurial results have been given.

From this table we find that eight samples of sewage sludge tried as manures, prepared in six different towns, by lime or alumina precipitation, or both, contained on the average in 100 parts of dry matter 2·20 per cent. of phosphoric acid, equivalent to 4·80 per cent. of phosphate of lime, and 1·40 per cent. of nitrogen equivalent to 1·71 per cent. of ammonia. Mr. Dibdin gives as the average composition of the (dried) sludge obtained at Crossness 1·57 per cent. of phosphoric acid, =3·42 per cent. of phosphate of lime, and 2·08 per cent. of nitrogen, =2·53 per cent. of ammonia. In bone manures, some of which contain about the same percentage of nitrogen as dried sludge, 13s. per unit of nitrogen reckoned as ammonia is not considered a high valuation; and as to precipitated phosphate, it may be put at 2s. per unit. I mean that farmers should be well content to pay these prices at industrial centres for manure in the condition of dried and ground sludge, free on rail, but exclusive of carriage; they generally pay very considerably higher figures, because they buy inferior manures in small lots through local dealers on credit. For example, many so-called samples of bone superphosphate contain not more than 0·6 per cent. of nitrogen reckoned as ammonia, and even this small quantity is generally paid for at more than 13s. per unit. Again, by getting close quotations from London makers a farmer could no doubt buy 10 or 20 tons of mineral superphosphate at 1s. 9d. per unit of "soluble phosphate," exclusive of bags, carriage, and credit; but farmers generally pay 2s. 6d. to 3s. per unit, and an educated farmer, in talking to me, refused to believe that this manure could be of good quality under £4 10s. per ton, that is 3s. 6d. per unit of soluble phosphate. On the basis given above we get 31s. 9d. on my analysis, and 36s. on Mr. Dibdin's, as about the value of the manurial constituents of one ton of dried and ground sewage sludge. I contended that there is nothing to prevent this valuation being justified, when the ground sludge is applied to crops and property mixed with the soil, side by side with well-known artificials bought at market rates. I am aware that these figures give nearly 15s. per ton as the value of the wet pressed sludge containing 55 per cent. water; but I have never contended that sludge from the presses is worth 15s. per ton. Its unsuitable physical condition was fully dwelt on in my previous paper. At Salisbury, during the last few months, 1000 tons of this stuff have been sold at nearly 4s. per ton on the spot; the railway company would deliver stable manure from London for about 6s. 6d. per ton at this distance. Bearing in mind that under favourable circumstances these two manures will in the first year produce nearly similar crops, weight for weight, a much higher price than 4s. cannot be expected; at the same time, the farmer using good sludge leaves in the soil a much larger residue of phosphoric acid and nitrogen, to be partly utilised in future years, than is left by an equal weight of farmyard dung.

So long as Local Boards can get anything for the sludge, or even give it away, they will probably not trouble about any further preparation of it. But where other manures are cheap, and the sewage works not in the midst of an agricultural district, 4s. cannot be obtained; at Coventry, 2s. 6d. is all that can be had; at Wimbledon, where stable manure competes with it, 1s. per ton is obtained; at Leyton it is given away; at Tottenham it is partly given and partly *delivered to* the farmers; and at Crossness, where it would be produced in very large quantities, quite away from the country, competing with stall manure, fish waste, and other refuse requiring to be sold, and close to the spot where artificial manures can be bought cheaper than anywhere else, it would seem as if no mode of disposal or of utilisation can save sewage sludge, pressed or unpressed, from being a burden to the rates. What will eventually be done with the London sludge I leave to others to discuss. My present object is to point out that in smaller towns, where the pressed sludge is not easily disposed of, but is not produced in too great a quantity, or too far from an agricultural district, a manure can be produced by drying and grinding, which, at all events, should more than repay the cost of these two processes.

Let us see now how my estimate of 30s. per ton dry, is justified by trials against other manures, first remarking that in field experiments of this kind negative results are of no value. A manure *cannot* under the most favourable circumstances do more than yield up a certain fraction of its fertilising ingredients to a crop, but, on the other hand, many circumstances may prevent even the best manure from producing any appreciable benefit in particular cases. To ensure success, the soil must be in poor condition, otherwise the unmanured plots will yield too highly; the crop must be one which will respond to the "dominant constituent" of the manure—root crops for phosphates, gramineous crops for nitrogen, potatoes or clover for potash, etc.; the manure must be in proper condition (*i.e.*, generally in powder), and properly applied at the right time; a uniform plant must exist over the plots; the soil must be uniform in character; *and there must be sufficient rainfall to render the manure available to the plant.* Lack of the last condition was fatal to many of the plots of rape in 1885; for want of rain just after sowing the plant failed in patches, most over the unmanured plots, and next over those receiving the weakest and most insoluble manures. The six unmanured plots produced an average of 153lb. green rape; the *best* plots, those receiving farmyard-manure and enriched sludges only produced about 450lb.—three times this quantity would have been a fair crop had there been sufficient rainfall. Owing to the patchy nature of the plant, the plots receiving—

4cwt. per acre, herring and potash guano
1½ tons ,, hide cleansing factory sludge
3 tons ,, native guano
1½ tons ,, nativo guano
3 tons ,, Coventry sludge

showed either insignificant increases over the unmanured plots (the herring and potash guano showed a *decrease*), or increases so irregular that no conclusions can be drawn. Coming to the plots on which a more uniform plant was secured, the following averages were obtained:—

	Increase. lb.
Unmanured, 153lb.	0
1½ tons per acre, Wimbledon sludge, 254lb.	101
1½ tons ,, Coventry sludge, 261lb.	108
4cwt. ,, superphosphate, 278lb.	125
8cwt. per acre, superphosphate, 328lb.	175
4cwt. ,, codfish guano and potash, 295lb.	112
1½ tons ,, dried and ground Leyton sludgo (moisture 27 per cent., nitrogen 1·05 per cent., phosphoric acid 1·28 per cent.), 345lb.	192
10 tons per acre, farmyard manure, 449lb.	296

Taking the four best results, the 8cwt. superphosphates, costing us 24s., and the 4cwt. codfish guano, costing 32s., were both inferior to the 1½ ton dried and ground Leyton sludge, worth, according to my valuation, 28s. 6d.; the 10 tons farmyard manure, which if bought would cost in our district perhaps 65s., produced about as great an increase over the Leyton sludge crop as would be expected from the difference in the price at which they are valued.

The ground Leyton sludge (precipitated by Hanson's process) was of a peculiar light feathery texture, different to what I have seen in any other sludges. I do not know the reason of this, but perhaps it partly accounts for the good result obtained with it.

Experiments made in the same year (1885) on potatoes, grown in a different soil, and in a different locality, show that dried Coventry sludge and Native Guano (the only sludges tried) justify the value here assigned to them, in comparison with fish-potash Guano and Peruvian guano. In this case the potato sets were a yard apart each way, and a carefully-weighed quantity of the manure was incorporated with the soil above each set at the time of planting, experiments reported by me elsewhere (*Agricultural Gazette*, September, 1884), having shown that the yield of tubers could be more than doubled according to the mode of applying the manures, and that this mode was the best of those tried. In 1885 the results were:—

39 sets of potatoes unmanured, produced on an average	61lb. tubers.
39 sets, each manured with 4oz. dried and ground Coventry sludge, @ 13½% moisture, 1·06% nitrogen, and 1·25% phosphoric acid, produced on an average	76lb. ,,
39 sets, with 8oz. each of the same sludge	86lb. ,,
39 sets, with 8oz. each Native Guano, at 29% moisture, 1·50% nitrogen, and 1·42% phosphoric acid	74lb. ,,
39 sets, each with 1oz. fish guano, containing 8% nitrogen, 7½% phosphoric acid, and potash salts	78lb. ,,
39 sets, each with 2oz. of the fish guano	102lb. ,,
39 sets, each with 3oz. Peruvian guano, containing 8% nitrogen, and 11% phosphoric acid	114½lb. ,,

The Peruvian guano cost £10 per ton, the fish guano £8; the native guano comes, on my valuation, to 29s. 6d. per ton, the Coventry sludge to 22s. 6d. Applying these figures, we find that—

4oz. per set Coventry sludge gave an increase of 12lb. potatoes, at a cost of	1d.
8oz. per set Coventry sludge gave an increase of 22lb. potatoes, at a cost of	2¼d.
8oz. per set Native Guano gave an increase of 10lb. potatoes, at a cost of	3d.
1oz. per set Fish potash guano gave an increase of 14lb. potatoes, at a cost of	2d.
2oz. per set Fish potash guano gave an increase of 38lb. potatoes, at a cost of	4¼d.
3oz. per set Peruvian guano gave an increase of 50¾lb. potatoes, at a cost of	7¾d.

Without analysing these numbers more minutely, it is evident the comparison is by no means unfavourable to Coventry sludge at the value affixed to it.

The only other manurial results I have to bring forward are those obtained with specially prepared sludges, enriched by the use of phosphatic material in treating the sewage.

The idea of precipitating sewage by dissolved phosphates is very old, and is associated with the names of Herapath, Blythe, the Phosphate Sewage Co., Dugald Campbell, and Whitthread. The novelties in the present experiments are two, and refer to the phosphatic material employed, and the time of introducing it into the sewage. In 1884 and 1885 I was employed in demonstrating the manurial value of the phosphates contained in basic cinder, or Thomas phosphate slag, and it was while this work was on hand that the idea occurred to Mr. C. C. Hutchinson and myself of utilising this substance for sewage treatment. Thomas slag was then a waste product, and consequently by far the cheapest phosphatic material to be bought; it is still considerably cheaper than other phosphates, but as the experiments made in 1885 by Professor Wrightson and myself, and a number of experiments made in Germany by Dr. Paul Wagner and others, have demonstrated the high manurial value of this slag, when simply ground to a very fine powder, it can no longer be obtained at a waste product price.

Thomas phosphate slag now contains on an average 17 or 18 per cent. of phosphoric acid, equivalent to 37 or 38 per cent. phosphate of lime. It is distinguished from other phosphatic materials by the presence of 12—18 per cent. of protoxide of iron, together with some peroxide.

When this slag is ground and treated with sulphuric acid, there is obtained a "superphosphate" of a peculiar character; in addition to the soluble phosphate, it contains a considerable proportion of ferrous sulphate, some ferric sulphate, and a large excess of sulphate of lime. The manurial efficacy of this "dissolved slag" appears to be to some extent interfered with by the sulphate of iron, and is at present eclipsed by the superior results shown by the undissolved slag when finely ground. As a sewage precipitant, however, the sulphate of iron is an advantage. The soluble phosphate has also precipitating power, and the phosphoric acid is recovered in the sludge. The drawback to the process is the large percentage of lime contained in the slag—about 20 per cent. in excess of the phosphoric acid, and the consequent large proportion of sulphuric acid required to dissolve it. Could a phosphatic slag be produced, with this excess of lime nearly replaced by protoxide of iron and phosphoric acid, it would be very suitable for this method of sewage treatment.

In June, 1885, some experiments were made by Messrs. S. H. Johnson, C. C. Hutchinson, and myself, at the West Ham Sewage Works, with the view of obtaining a highly phosphatic sludge to be dried and ground for manure; and the manure produced was tried against the other sludges in the field trials already cited. I will summarise very briefly these experiments, which disclose some points of interest. The West Ham sewage is notorious for being very foul, very much contaminated by manufacturing refuse, and liable to vary in composition with great suddenness; hence it has always been found difficult to treat by chemical processes. A preliminary series of precipitation experiments in gallon jars was therefore made, from which we learned—

I. That dissolved cinder alone tried successively in quantities of 3, 5, 10, 16, 20, and 40grs. per gallon, produced no satisfactory precipitation. The dissolved cinder was of course precipitated by the ammonia of the sewage, as is the case with the sulphate of alumina in the A B C process, but the precipitate so produced failed to clarify the liquid, and bring about speedy settlement. All the mixtures remained alkaline after standing for half-an-hour.

II. 40grs. dissolved cinder per gallon, followed by the successive addition of 1½, 1½, and 3grs. of lime (as milk of lime), produced a more satisfactory effluent, but the effect was much better when the 6grs. of lime were added in one dose, directly after the dissolved cinder, instead of in instalments.

III. Adding the lime *before* the dissolved cinder produced a still better precipitation. This is known to be the case also when lime is used in conjunction with sulphate of alumina.

IV. 8, 6, 28, 14, and 10grs. lime were then tried, followed by 16, 24, 168, 70, and 30grs. dissolved cinder. Less than 10grs. of lime gave an unsatisfactory precipitation with this sample of sewage, but by using 10grs. with 30grs. dissolved cinder, as good a clarification was obtained as with larger quantities. These quantities gave a nearly neutral effluent, in which phosphoric acid could not be detected.

V. Raw ground basic cinder, although containing free lime, was found to have little or no precipitating power.

VI. 10grs. of lime and 10grs. sulphate of alumina gave a better precipitation than 10grs. lime alone, but 10grs. lime and 30grs. dissolved cinder gave the best of all. When the sulphate of alumina was increased to 20grs., however, it showed a superiority over the dissolved cinder.

All the above experiments were made with the same sample of sewage. The next morning a fresh sample was taken, and the trials continued. Only 5grs. of lime were found necessary to produce a satisfactory clearance, and the best result was obtained with 5grs. lime and 20grs. dissolved cinder. Another sample of sewage, taken *only half-an-hour after the preceding*, however, did not clear well with 2, 3 or 5grs. of lime, followed by dissolved cinder or sulphate of alumina, and required 10grs. lime and 20grs. dissolved cinder to produce a satisfactory clearance. In a manufacturing district like West Ham the changes in the character of the sewage are sometimes very sudden.

On the third day also of the precipitation trials the sewage required 10grs. lime and 30grs. dissolved cinder, and the effluent was not improved by substituting 10grs. of sulphate of alumina for 10 of the dissolved cinder.

Our object being to produce a sludge rich in phosphoric acid, we determined to use 10grs. lime and 30grs. dissolved cinder on the large scale, and accordingly we precipitated the contents of two tanks (about 525,000gals.) of sewage with 7cwt. lime and 19cwt. dissolved cinder. The milk of lime was added before pumping and the dissolved cinder after.

With the sludge produced in these operations a series of pressing experiments was conducted with a hand-power filter-press, in order to ascertain the minimum quantity of lime required to render the sludge pressable. The necessity for adding lime again at this stage considerably increases the quantity of lime consumed, diminishes the nominal value of the sludge, and gives rise to the very alkaline and badly-smelling press-liquor complained of by Dr. Tidy and others. (See Table B, analyses of the Wimbledon, Leyton and Salisbury press-liquors.)

The untreated sludge was, of course, found to be unpressable, and only when 1½ per cent. of lime was added could a good pressing be obtained, the time taken (in the hand-press) being half-an-hour, and the pressure rising from 60 to 100lb. per square inch.

The first large pressing was, therefore, made with this proportion, 2cwt. lime (1½ per cent.) being added as milk of lime to the 14,680lb. sludge measured in the well. It will be noticed that this is more than half the quantity used (3½cwt.) for the actual precipitation of this first tank of sludge. Good cakes were obtained, which easily came to pieces (A).

It was found by a small trial pressing that the quantity of lime required to make the sludge pressable could be diminished by employing it in conjunction with dissolved cinder. With ¾ per cent., or half the lime formerly used, perfect cakes were obtained, when 5 per cent. of dissolved cinder was added after the lime; this quantity of dissolved cinder being more than sufficient to neutralise the sludge, but not sufficient to neutralise the sludge and lime. The press-liquor obtained in this way differed much from that obtained by the use of lime alone: it was much lighter in colour and less offensive, formed no scum of carbonate of lime on standing, and was much more free from foul matter, giving slight light-coloured precipitates with a little sulphate of alumina and dissolved cinder instead of the dark green and black precipitates given by the limed press liquor.

A small pressing with ½ per cent. lime and 10 per cent. dissolved cinder also gave good cakes (C), but the press liquor, although good in quality, was acid.

Another small pressing was made with ½ per cent. lime and 10 per cent. dissolved cinder, and a further quantity of lime to neutralisation: this also yielded good cakes (D).

The large pressing of sludge from the second tank was made with ¾ per cent. lime (1cwt.) and 5 per cent. dissolved cinder (6·6cwt.) to the 233 cubic feet of sludge in the well: in one hour first-rate cakes were obtained with a good press liquor.

All the sludges, from both large and small pressings, were dried, ground, and analysed. Field experiments were made with the sludges A and B from the large pressings.

Detailed analyses of these sludges are given in Table A; here it is only necessary to give the percentages of nitrogen and phosphate of lime in the dried material:—

	$N=NH_3$		$Ca_3P_2O_8$.
Sludge A, precipitated with 10grs. lime and 30grs. dissolved cinder per gallon, and pressed with lime 1½ per cent. of sludge, contained	2·23	....	6·81
B, precipitated like A, and pressed with lime ¾ per cent. and dissolved cinder 5 per cent. of sludge, contained	1·97	....	10·57
C, precipitated like A, and pressed with ½ per cent. and dissolved cinder 10 per cent. of sludge, contained	1·26	....	14·54
D, like C, but more lime added to neutralise the sludge	1·03	....	13·10

In addition to the large percentages of phosphates these sludges differ from ordinary sludges in having the carbonate of lime partly or wholly replaced by sulphate; thus, A contained only 10 per cent. carbonate of lime, and B none at all, but 25–30 per cent. of sulphate. There is no doubt this is an advantage from a manurial point of view. Notwithstanding the considerable proportion of precipitating materials used the A and B sludges are above the average in nitrogen; this partly arises from the solubility of the sulphate of lime into which the carbonate is converted. All these sludges of course contained protoxide of iron, and were very dark in colour as they came from the press; very speedily a fine reddish-purple tint appeared on the surface, and the colour gradually penetrated through the cakes; the complete conversion of protoxide of iron into peroxide, however, was not finished when the cakes were dry and ground, but continued to go on for a week or two in the bags of ground sludge. In addition to this oxidation the ground sludge in the bags underwent a gradual oxidation of the organic matter, which kept the sludges quite warm for two or three weeks after they were stored in the manure shed at Downton.

Here I may say that, admitting the utility of ferrous salts as precipitating agents, I can by no means agree with Mr. Dibdin's theory of their action—the idea of precipitated ferrous hydrate acting as a carrier of oxygen to the organic matter of sewage appears to me fanciful in the extreme. Mr. Dibdin says "it is rapidly converted into ferric hydrate by the oxygen dissolved in the water." But sewage, as has been shown in the experiments of Angus Smith, in my own, and in Gayon and Dupetit's, is the special habitat of *denitrifying bacteria*—organisms so greedy of oxygen that, in presence of organic matter capable of oxidation, they will take oxygen from *nitrates* in solution, when they cannot get it from the air, and hand it over to the organic matter. Hence sewage never contains nitrates until these bacteria have died down, and hence it contains no dissolved oxygen either—what was there has been used up long before. It is *these* bacteria that are the active agents in burning up the organic matter by transference of atmospheric oxygen, and they are followed by an organism of a totally different stamp, the nitrifying organism, which oxidises the ammonia to nitrate, and so completes the purification. Ferrous hydrate under the surface of the liquid remains ferrous hydrate (if it does not become ferrous sulphide); exposed to the air it quickly becomes ferric hydrate, as in the sludge cake now being considered, and then *remains* ferric hydrate unless the cakes should be again submerged. At any rate I have seen no proof that it acts otherwise.

The sludge A, pressed with 1½ per cent. of lime, has always given off a strong odour of ammonia; the sludge B, with half this quantity of lime, and this neutralised by the dissolved cinder, has never smelt of ammonia.

Now, as to the manurial results obtained with A and B.

It will be remembered that the unmanured plots of rape produced on an average 153lb. rape, and that the best of the ordinary dried sludges—that from Leyton—gave 345lb., or an increase of 192lb. when applied at the rate of 1½ tons per acre. As compared with these results—

1½ tons per acre of A gave 350lb. rape, or an increase of 197lb.
1¼ „ B „ 450lb. „ „ 297lb.

the latter crop being identical with that obtained by the dressing of 10 tons per acre farmyard manure, the best of the series. If the 10 tons farmyard manure cost, as I have said, at least 60s., the B sludge must be worth 40s. per ton; valued on the scale I have already given (2s. per unit of phosphate of lime, and 13s. per unit of ammonia), we get for the B sludge (with 10 per cent. moisture, as used) 42s. per ton, and for the A sludge (with 15 per cent. moisture, as used) 38s. 6d. With the remainder of the A and B sludges, mixed together, an entire acre of swedes was grown in another field, 8cwt. per acre of the dried sludge being drilled in with the seed. The remainder of the field was dressed with 4cwt. superphosphate per acre. The strip dressed with the dried sludge was the best in the field; on this portion the crop was fairly uniform, and roots of a fair size were obtained; on the rest of the field the crop was very patchy, as was generally the case in our district. Taking into account the very exceptional dryness of the season, I think it may be said that the manurial results obtained with these sludges were very fairly successful.

On the whole, although not altogether prepared to recommend the dissolved cinder as a precipitating agent, it appears to be a very good substance with which to press the sludge—effecting an economy of lime, greatly improving the press liquor, and conferring additional manurial value on the sludge. As regards the presence of sulphate of lime in the press liquor and effluent, Warington has shown that this substance greatly accelerates the nitrification of ammoniacal solutions; hence it appears to be desirable rather than otherwise, at any rate when the effluent is to be used for irrigation—the best way of disposing of it.

As the average composition of the dry matter of ordinary sewage sludge we get (from Table A):—

Organic and volatile matter	30·95,	containing nitrogen	1·42,	equal to ammonia	1·72.
Ash	69·05	„	P_2O_5 .... 2·20,	„	$Ca_3P_2O_8$ 4·81.
	100·00				

Of this ash 21·22 consists of clay and sand, and in the four samples analysed 29·72 consists of carbonate of lime.

Mr. Dibdin's average analysis of a number of samples of pressed sludge obtained at Crossness gives, when calculated out in the same way—

Organic and volatile matter .... 39·80, containing N .. 2·08 = NH_3 .... 2·53.
Ash................. .. 60·20 „ P_2O_5 .. 1·57 = $Ca_3P_2O_8$ .. 3·43.
100·00

The sludge analysed by Mr. Dibdin, was, it is to be supposed, produced with a minimum quantity of precipitating material—the 3·7 grains lime, and 1 grain sulphate of iron per gallon recommended for the treatment of the Metropolitan sewage. Where lime is used, as it is a cheap precipitant, and when used in sufficient quantity always produces a clear though not pure effluent, there is a tendency to use it in excessive quantities: the necessity of adding lime to the sludge to make it pressable increases the waste. The sample of Salisbury sludge (Table A) thus contains as much as 65 per cent. of its dry weight of carbonate of lime, and is, of course, correspondingly poor in nitrogen and phosphates. In considering the manurial value of sludge, its variability of composition is an important factor. In my own analyses the nitrogen per cent. of dry sludge varies from ·88 in Salisbury sludge and ·96 in Wimbledon sludge with the lime process, to 2·16 in "Native Guano" (A B C process), and 2·28 in West Ham sludge (lime and alumina). The phosphate of lime is still more variable; 1·44 per cent. in the Salisbury sludge, about 5 per cent. in several others, and as much as 9·75 per cent. in one sample of Wimbledon sludge.

From Dr. Wallace's analyses of twelve different makes of sludge (not pressed sludge, and therefore not calculated out in full for comparison with the preceding), I find an average of 27·96 organic and volatile matter, containing 0·90 nitrogen, equal to 1·10 ammonia.

The percentage of nitrogen contained in the organic and volatile matter of sewage sludge appears, from Dr. Wallace's analyses, to be 3·22, from Mr. Dibdin's, 5·22, and from my own, 4·58. Five per cent. of nitrogen, therefore, is the limit to which dry sewage sludge would tend to approach, could we obtain it free from road detritus, and precipitating material. In actual practice, 2 per cent. is a maximum which is rarely obtained.

It would be a great advantage, if, as Major-General Scott proposed, the road detritus could be separated from the sewage in a separate tank before the sludge proper is allowed to subside. When the precipitant is added first of all, it appears that the precipitate in this first tank is richest in nitrogen; but if the road detritus be allowed to deposit in a first small tank, and the precipitating agents added between the first and second tank, a different result ought to be obtained. Perhaps, on an average, not less than 50 per cent. of dry sludge consists of road detritus, and if this could be removed by a preliminary settling, the manurial value of the second sludge would be nearly doubled. The road detritus sludge could be burnt in destructors, and only the second sludge sold as manure.

Next to the adoption of this measure, which I should like to see tested practically, economy of precipitating materials is the chief means by which a rich sludge can be produced. Theoretically, the quantity of precipitants ought to be adapted to every charge of sewage in the tanks; this, however, is impossible, and the plan of automatically regulating the supply of lime by the flow of sewage falls very far short of the requirements of the case. The difficulty can best be met by habitual observation of the sewage on the part of the manager, and an avoidance of the tendency to work up to the maximum quantity of lime and stick to it. When sulphate of alumina is used as well as lime, more economy is observed, and a richer sludge produced. There is no doubt that, as Mr. Dibdin says, the lime ought to be applied in solution (as it is in the press liquor), and this is to be accomplished by preliminary agitation of the milk of lime with a sufficient volume of sewage to dissolve the whole of it. When we come to pressing the sludge, the practice of shovelling in lime wholesale is also to be discouraged; if the preparation of sludge manure is undertaken seriously, the lime added at this stage ought to be neutralised by superphosphate or dissolved basic slag, as I show in another part of this paper. By doing this, lime is economised, the manure enriched (of course the soluble phosphate is recovered), the press cloths last longer, and the press liquor is much less offensive. The dried sludge also does not part with ammonia. In the late discussion at the Institution of Civil Engineers, an agricultural chemist doubted whether the nitrogen of sewage sludge has any manurial efficacy. If Mr. Lloyd had observed the strong ammoniacal odour continually given off from limed sludge, he would not be sceptical on this point. Mr. Sillar, the champion of a limeless process, went to the opposite extreme. "By the addition of lime to manure," he says, "the whole of the ammonia is discharged into the air, rendering the manure comparatively worthless for agricultural purposes." Somewhere between these two extremes lies the truth. Ammonia is certainly given off continuously, but the process is gradual, and in the mere drying of a limed sludge, very little is lost. To test this point, I dried 20grms. of limed (Wimbledon) sludge, containing 56 per cent. water, in a Liebig's tube plunged in boiling water; a current of air was aspirated through the tube, and the evolved ammonia received in standard acid and determined. The original sludge contained 0·4195 per cent. of nitrogen, and ·0095 or $\frac{1}{44}$ of the whole amount, was given off as ammonia in drying.

Amongst all the ordinary sludges which I have tried as manures, Native Guano, on the dried sample, contained most nitrogen, = 2·62 per cent. of ammonia; and the phosphate of lime was also good—viz., 4·37 per cent. The lot actually sent me for experiment, however, contained no less than 29½ per cent. water—quite 15 or 20 per cent. more than there ought to be in a sludge dried for transit to any distance. Perhaps the reasons why this company produces a very fairly rich sludge, are that at Aylesbury they have to deal with sewage precipitable with a small proportion of reagents, and that great attention is bestowed by the management there on proportioning the precipitants to the sewage to be treated. Much has been heard about the action of the clay and charcoal in carrying down ammonia, and even the alumina has had this action claimed for it. I do not know of any published experiments actually proving this, and I doubt if experience on the large scale has confirmed it. At any rate, as Mr. Dibdin has shown, the "Native Guano" produced at Crossness (where, perhaps, they found a much larger quantity of precipitants necessary than at Aylesbury), was actually poorer in ammonia than Mr. Dibdin's limed sludge. During the last few days, I have made a few experiments to test for myself any precipitating action for ammonia possessed by the A B C materials.

A solution of ammonia containing 11grs. NH_3 per gallon, was divided into lots of 500cc. each, in glass jars covered with ground glass plates. The following precipitants were then added to the various jars :—

I. 14grs. per gallon China clay made into an emulsion with water.
II. 140grs. per gallon China clay made into an emulsion with water.
III. 140grs. per gallon China clay made into an emulsion with water; 280grs. per gallon common salt being previously added to the solution to promote coagulation of the clay.
IV. 28grs. clay per gallon, followed by 28grs. alum in solution.
V. 112grs. clay per gallon, followed by 112grs. alum in solution.
VI. 28grs. alum per gallon in solution.
VII. 112grs. alum per gallon in solution.
VIII. 28grs. per gallon freshly-burnt animal charcoal (bone black).
IX. 112grs. per gallon freshly-burnt animal charcoal (bone black).
X. No addition.

After standing for two days, 250cc. of the clear liquid were pipetted off from each jar, and the ammonia still in solution distilled off into standard acid and determined. The distillate of No. X. (nothing added), required 7·8cc. standard acid for neutralisation, agreeing with the calculated quantity; and the distillate from every other jar came within 0·1cc., more or less, of this amount. Caustic soda was, of course, added to the alumed solutions before distillation, to liberate the ammonia fixed by the sulphuric acid. It appears, from these experiments, that neither alum, clay, nor charcoal, nor the first two together, carried down any appreciable quantity of ammonia, even when used in the proportion of 140grs. per gallon. The value of the clay as a weighing material was, however, very evident; the precipitate of alumina and clay settled into a much smaller space, and in much less time than the precipitate of alumina alone; and, conversely, the clay was carried down by the alumina far quicker than it settled by itself.

Grains per Gallon.	Wimbledon Press Liquor.	Leyton Press Liquor.	Salisbury Press Liquor.
Total solid matter	237·6	470·1	354·6
Ash	174·6	293·6	238·1
Less on ignition	63·0	176·5	116·5
Ammonia by distillation	8·0	22·5	19·5
Remaining alkalinity reckoned as lime CaO	106·8	87·4	86·5
Sodium chloride......	8·36	8·07	3·85
Oxygen taken from $KMnO_4$ in fifteen minutes	—	5·6	—
Oxygen taken from $KMnO_4$ in four hours	—	9·4	—

Incineration of Sludge.—This has been tried at Leyton during the year, the pressed cake being partly dried, and then burnt with the aid of coal. Mr. Dawson, to whom I am indebted for these particulars, says that although the sludge could be burnt without creating a nuisance, the plan has been abandoned on account of expense. Six tons of pressed sludge furnished one ton of ash, and if this could be sold at 10s. per ton it would have paid expenses. A sample of this ash was analysed by me, last July, with the following result :—Calcium carbonate (with a little sulphide), 20·23; quicklime, 26·33; oxide of iron, etc., 13·6; sand and insoluble matter, 28·8; phosphoric acid, 1·60, equivalent to phosphate of lime, 3·50. On account of the considerable proportion of caustic lime the sludge ash was tried as a precipitant of sewage, and for pressing the sludge,—it failed in both capacities. As a manure the phosphate of lime would make it worth from 3s. to 7s. a ton, according to its observed efficacy. Two-thirds of the calculated manurial value of dried sludge is due to nitrogen. If the expense of drying sludge be undertaken at all, it can hardly be worth while to burn off two-thirds of its manurial value for the sake of reducing the weight of the dried material by one-third or less (dried sludge generally gives over 70 per cent ash).

Press Liquor.—I have procured samples of press liquor from Mr. Crimp, of Wimbledon, Mr. Dawson, of Leyton, and Mr. Bothams, of Salisbury. They yielded, on analysis, the results given in table on previous column.

Of these press liquors, that from Wimbledon was by far the best—light in colour, quite bright, and of less evil odour than the other two. Analysis showed it to contain very much less organic matter. These liquors are saturated solutions of lime in the organic liquid, and, as observed by Mr. Crimp and others, when added to crude sewage they very readily precipitate it. Since press liquor contains nearly 100 grains lime per gallon, 1 gallon added to 20 gallons sewage supplies 5 grains per gallon of lime in the form recommended by Mr. Dibdin—viz., in solution. I agree with Mr. Crimp that this is, perhaps, the best way to dispose of the press liquor. According to Mr. Crimp it only amounts to 1 per cent. of the sewage treated daily, and there is no accumulation. At any rate, when the effluent is used for irrigation this is the proper way to dispose of it. Probably the very bad odour of press liquor is due not so much to products of putrefaction as to products of the action of the caustic lime on the nitrogenous matter of the sludge. The sample of Wimbledon liquor shown has remained perfectly bright for some weeks in the bottle. There seems to be too much lime present to allow of bacterial decompositions. That the liquor is really saturated with lime I proved by shaking it with finely powdered slaked lime for some days. The alkalinity was increased by only 2 grains per gallon. No precipitation of dissolved organic matter takes place when the liquor is neutralised by an acid. The quantity of permanganate decolourised by it is very large (the Leyton press liquor speedily decolourises half its volume of the solution generally used in water analysis), and the odour only disappears in proportion to the completion of this oxidation.

To sum up the main conclusions of this paper, sewage sludge is certainly possessed of manurial value to the extent indicated in the experiments described in this paper and my previous one.

By drying and grinding the weight of the sludge is halved, and its manurial richness doubled; on account of the improved texture the manurial *efficacy* is probably more than quadrupled. In districts where the pressed sludge cannot be distributed on farms close at hand, drying and grinding are *necessary* to the disposal of it as manure. I must leave estimates to others, but it certainly appears that with sludge worth using at all, the increased value must repay the cost of these two operations.

When the preparation of manure is undertaken seriously, the following circumstances are desirable :—

I.—Preliminary settlement of road detritus.
II.—Economy of precipitants.
III.—Neutralisation of sludge by some form of superphosphate before pressing.
IV.—Drying and grinding.
V.—Perhaps enrichment with cheap nitrogenous superphosphatic material.

TABLE A.

COMPOSITION OF THE DRY MATTER OF DIFFERENT SAMPLES OF SEWAGE SLUDGE.

	Coventry, 1884. Alumina, iron, and lime.	Leyton, 1884. Alumina, iron, and lime.	West Ham, 1884. Alumina and lime.	Wimbledon, 1885.	Wimbledon, 1886.	Coventry, 1885.	Leyton, 1885. Hanson's process.	"Native Guano," 1885. A B C process.	Salisbury, 1887. Lime process.	Mean of first eight tried as manures.	West Ham, 1885. Precipitated and pressed with lime and dissolved phosphatic slag.			
											A	B	C	D
Organic matter	26·11	26·08	40·32	25·90	25·86	26·07	29·96	45·68	15·00	30·75	42·03	33·32	22·81	21·80
Containing nitrogen........	1·36	1·35	1·82	0·96	0·98	1·26	1·14	2·16	0·88	1·42	1·84	1·62	1·01	0·85
Equal to ammonia	1·65	1·64	2·21	1·17	1·19	1·53	1·75	2·62	1·07	1·72	2·23	1·97	1·26	1·03
Mineral matter	73·86	73·92	59·68	71·10	74·14	73·93	70·04	51·32	85·00	69·25	57·97	66·68	77·19	78·20
Containing $CaCO_3$	39·07	26·36	23·72	—	—	—	—	—	65·01	—	10·68	—	—	--
Insoluble in HCl (sand)	22·84	26·21	18·30	16·19	14·01	20·25	14·89	37·08	14·42	21·22	11·69	18·73	10·60	10·51
Oxide of iron, etc..	8·70	15·21	10·02	—	—	—	—	—	—	—	12·96	23·00	—	—
S_2O_5	2·43	2·04	2·57	4·17	0·88	1·48	1·75	2·00	0·66	2·20	3·12	4·81	6·66	6·00
Equal to $Ca_3P_2O_8$	5·30	4·15	5·61	9·75	1·92	3·23	3·82	4·37	1·44	4·81	6·81	10·57	11·51	13·10
Sulphate of lime ($CaSO_4$) ..	—	—	—	—	—	—	—	—	—	—	14·27	30·02	44·71	47·95

DISCUSSION.

Mr. **Sillar** said this was a question to which he had devoted close attention for many years. Dr. Munro deserved the gratitude of the public for the pains he had taken to solve a problem which must be admitted to be of vast importance, especially at this crisis, when everyone was complaining of the depression of agriculture. It was a settled conviction in his mind that, following the course of nature, the waste of the animal and vegetable life of the world should go to replenish the earth, if the earth was to continue to afford nourishment for the animal and vegetable creation. He could not conceive a more wasteful and suicidal course than to take the strength and richness of the land, after its use by nature, and throw it to pollute our rivers and destroy our sea coasts. Dr. Munro had taken the rational course of testing the value of these things agriculturally, and it was to be much regretted that his experiments with the "native guano" had been so interfered with by a bad season. It was only to be expected, however, that a manure which is prepared in a perfectly dry state should suffer disadvantage when put upon barren land in such a season as last year. It had been said that in order to make sludge useful in agriculture it should be fortified by the addition of ammoniacal manures or those rich in phosphates. Some crops, such as turnips, required a larger amount of phosphates than others; but he would himself rather apply sludge to those crops which were not so dependent upon phosphoric acid. Some people insisted that native guano had its richness increased by other manures; but that was not the case. Dr. Tidy, in his exhaustive report, had distinctly said that native guano was nothing more than the produce of sewage, plus, of course, the materials used for precipitating it; but those materials being clay, charcoal, and lime, they could have no manurial effect. During his experience four official trials had been made of this "native guano." The first was at Crossness, and was made under the supervision of the Metropolitan Board of Works. The land was divided into three parts, upon one of which no manure was put, on the second part 10cwt. per acre, and on the third 15cwt. per acre. The result showed that a dressing of 10cwt. per acre more than doubled the crop, and 15cwt. did very little more. This satisfied them that 10cwt. was a sufficient dose. But, strange to say, the benefit of the manure was by no means exhausted the first year. And the reason was that the supply to the earth of its natural food would not only produce a good crop, but leave the land stronger than it found it; thus contrasting strongly with the action of those ammoniacal manures which stimulate the land, acting not as bread but as brandy, and scourging a little more out of an almost exhausted soil. The character of the sludge naturally depended upon the process by which it was taken out of the sewage. Precipitation must be the means employed; but sludge which resulted from simple subsidence was almost worthless. Our best chemists had declared that the manurial value of human excreta was almost wholly contained in the urine. Liebig had estimated the value at 8s. 7d. per ton, of which he credited the 7d. to the dung and the 8s. to the urine. If one took the mixed matter from the sewers and allowed it to settle, one got the solid portion, but none of the matter in solution. It was, however, the experience of farmers that the solid deposit was almost worthless; the part which had valuable manurial properties—the urine—having been run off with the effluent water. And this dissolved matter was not only that part of the sewage which had the highest manurial value, but it was also the principal cause of the pollution of our streams. Therefore, it was now recognised that in any treatment of sewage the dissolved impurities must be taken out as well as the suspended impurities, if the manure was to be worth having. Precipitation processes were divided into those in which lime was used and those in which lime was not used. He might be thought to exaggerate when he said that lime caused serious loss of ammonia. But it was so. By adding sufficient lime all the ammonia would be got out. At Aylesbury the use of lime had been abjured for the double reason that by driving away the ammonia it injured the manure and rendered the effluent water alkaline and dangerous to fish. Sulphate of alumina, charcoal, clay and blood as used there, attached themselves to the dissolved impurities, bringing them into the condition of suspension, and then upon the addition of the sulphate of alumina all the impurities were thrown down together—at any rate sufficient of them were precipitated to render the effluent water admissible into any running river. He did not know whether he had exactly caught Dr. Munro's meaning when he said that he had made the experiment of mixing ammonia and water, and trying the mixture by the A B C process. But he knew that Dr. Tidy had reported that he found the percentage of combined nitrogen in the manure to be remarkably constant, averaging 3·8 per cent., reckoned as ammonia, while the phosphoric acid was 5 per cent., reckoned as tricalcium phosphate. These 3 per cent. of ammonia and 5 per cent. of phosphates must have been carried down by the precipitants, for they were not to be found in either the clay, the charcoal, the blood, or the sulphate of alumina. The effluent water from this process was clear and inoffensive; but if lime were added to the sludge it became horribly offensive. Some farmers, however, hardly cared for a manure that was not offensive. Still they had to bear in mind that they had not only to produce a manure to please the farmers, but they had also to purify the water and avoid distressing the neighbourhood. With respect to the agricultural value of the manure, he (the speaker) had collected evidence which he believed would satisfy the most sceptical. They had put it to the test of chemical analysis, and to exhaustive field tests at Crossness. It had been tried against farmyard manure and Peruvian guano, etc., and, value for value, it was better than them; for at £3 10s. per ton it beat them all. Then at Berkshire Colonel Milne Holme and Sir James Jepson had put it upon the fields and published the results, and in each case the "native guano" had beaten every other manure. They had sold thousands of tons, and never at less than 70s. per ton. He thought he had shown that sewage could be treated so as to preserve the manure in an inoffensive condition, and suitable for conveyance to any distance. Everyone wished that this question should be thoroughly understood, and that the country should no longer be guilty of waste, and of the pollution of our rivers with the strength of the land.

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DISCUSSION ON MESSRS. CROSS AND BEVAN'S PAPER ON HERMITE'S METHOD OF ELECTROLYTIC BLEACHING.

The Chairman said he had been much interested by this paper. Success in such fields depended on a right estimation of the value of any given process, and on its proper application. Whether one used chlorine in the ordinary form of bleaching powder, or the chlorine compounds produced by electrolysis, or ozonised air, the real question was how to get the largest amount of available oxygen with the least possible expenditure of force.

Professor Armstrong considered it would have been of much advantage to the Society if the authors of the paper had given some account of the process to which it referred. As it was, he was not quite sure what was the real claim of the inventor—whether it was simply for the production of a solution which would bleach, or for the use of a certain solution in a particular way. The process seemed to him to be merely one for the preparation of a bleaching solution. The authors, however, had expressed themselves in language so difficult to follow, that he had failed to realise the meaning of some of their statements. Their results were put forward in such a form that it was practically impossible to pass any judgment on the efficiency of the process from a mere study of the paper. The paper was unnecessarily full of expressions altogether special to the authors and difficult for others to understand. For instance, in the first part of the paper it was stated that "the chlorine in bleaching powder may be regarded as an accumulator of oxygen." The term "accumulator," as used by electricians, was convenient, but was often misleading, and such a term was not desirable in chemistry. Later on, it was said that the solution contained a large amount of bleaching compounds at a very high tension: and when one tried to find the meaning of this statement, it turned out that these bleaching compounds were soluble in ether, and would evaporate with it. That was not the usual way of describing bodies of high tension. The important part of the paper was, he supposed, contained in the passages beginning, "What we may call the primary interpretation of an electrolysis, according to Faraday's law, presupposes a complete separation of the ions. When this does not occur, and where, by electrochemical substitution, the anode and cathode are brought into relationship peculiar to a peculiar balance of the products of analysis, the law requires a modified interpretation. We shall revert subsequently to this point, as affecting the particular case under consideration." He did not understand the meaning of that passage, but it appeared to be regarded as an important one, as it was referred to by the authors later on. He thought, too, that the authors should further explain their statement that "the *bleaching* efficiency of the electrolysed solution is considerably in excess of that of a solution of calcium hypochlorite of the same *oxidising* efficiency, measured—*i.e.*, in terms of the usual standard—an alkaline solution of arsenious acid." If this meant anything at all, it meant that the solution had a higher oxidising power than ordinary bleaching-powder solution. But then it was said that "the oxidising efficiency—*i.e.*, free or active oxygen—thus measured and expressed in terms of the current, is in excess of that calculated on the basis of the electrolytic law, as directly interpreted." These statements were more or less contradictory. It was important to observe that the efficiency of this new solution was measured by means of a solution of arsenious acid—the authors had not ascertained the real efficiency of the solution. They had adopted a bad standard—one which gave a measure of only part of what was present. Later on, it was said that a certain amount of available chlorine was obtained per ampère hour, but it was not stated how that available chlorine was determined by arsenious acid. He could not understand the authors' statement that the oxidising efficiency of the solution was in excess, not only of that of a bleaching-powder solution, but of the theoretical efficiency obtainable according to the electrolytic law, except upon the supposition that the authors believed in perpetual motion. Something must be wrong, and the only possible conclusion was that the authors' interpretation of the electrolytic law was incorrect. After such a statement, it appeared to him unnecessary to analyse the figures given as proving the efficiency of the process. No data had been given as to the composition of the solution. It was said to be altogether peculiar and different from a bleaching powder solution—which was very probable—but the authors seemed to have made no attempt to determine what amount either of oxygen, or of chlorine capable of producing oxidation directly, or of oxygen-chlorine compounds, were present. They had employed merely the conventional standard—arsenious acid. Taking all the circumstances into account, the paper did not seem to advance our knowledge of the subject under discussion. No data has been given from which it was possible to determine the actual efficiency of the bleaching solution, and to arrive at such a determination, numerous and definite data were necessary. It was to be regretted that the paper had not been drawn up as scientific papers usually were, and that the authors had not given a clear statement of the methods they had employed to arrive at their facts.

Mr. **Mactear** was inclined to agree with much that Prof. Armstrong had said, but would like to start from a different basis, and say a few words on the process as he had seen it in operation recently at the Antwerp Exhibition. The process was at work there on a considerable scale, and was, of course, one which deeply interested himself. He had spent some hours in watching it at work, and had been highly delighted by the results he had seen. The employment of an electrolysed solution of this class was not new; it had been known for many years, and was, he believed, the subject of many patents. But the special apparatus designed by M. Hermite for the process was extremely ingenious, though he feared it would also prove to be exceedingly expensive. There could be no doubt, however, that M. Hermite had shown at Antwerp a perfectly practicable installation for bleaching flax yarns. He was under the impression that the figures given to him showed that the results were hardly as yet satisfactory from a commercial point of view. No doubt the authors would be able later on to bring forward further results, which would enable one more fully to compare the new process with the old. At present this new process seemed to him to be very interesting and very promising, though hardly yet in its most practicable form.

Mr. **Cross**, in reply, said that as Prof. Armstrong had brought a rather heavy indictment against the exposition of the Hermite process, he would endeavour to make a few explanations. He had closely studied the process for some months, and in doing so had had the advantage of intercourse with a distinguished physicist—Prof. Pictet. They had jointly endeavoured to work out the problems which the process presented, and any statements made in the paper represented Prof. Pictet's views on the subject as well as his own. If Prof. Armstrong told him that he could not understand the language of the paper, he could only reply that there was no possible ground for discussion between them. The subject was a difficult one, and was complicated on a variety of issues. They had brought it before this society first because, there being an installation actually at work on a large scale, the matter might be considered, from an industrial and commercial point of view, as fairly elucidated. At any rate, it was sufficiently matured to permit practical men to come to the laboratory to make their own trials and calculations, and to order apparatus for their own works based on those trials and measurements. To a certain extent the scientific and commercial sides of a question were separable, and it was a frequent experience for science to come after industry rather than before it. They had laid the industrial side of the matter before this Society; at the same time they wished to indicate the lines upon which the scientific investigation would follow. That investigation would probably be long and laborious, and the results would in due time be laid before the Society to which it properly belonged. For the end they had in view the arsenious acid standard was a good one; and it had this advantage: that the reaction involved was so simple that if the acid were destroyed it could only be in one way, by oxidation to arsenic acid; it might not measure the whole of the oxygen, but it could not err the other way. The point to be determined was the comparative bleaching effects of two solutions. One might take the time standard, but that was not the most important element. The best standard was the amount of oxygen consumed in bringing a certain weight of pulp or yarn to a particular condition. Those comparisons were given in the paper in language which, he thought, could not be misunderstood; and the numbers given had been verified, in regard to the solution, on every scale from 1 litre up to 850 litres. With regard to the important question of the electrolytic law, and the apparently excessive yield of oxygen, all he could say was, that they had taken a certain measure (arsenious acid) of the oxidising efficiency of their solution, and the numbers thus obtained, in terms of oxygen or its equivalent of chlorine, were in excess of the so-called theoretical equivalent. That was the dilemma they were presented with, and they saw no escape from it. They were bound to explain, and the explanation did not appear to be strained. The maximum error of their instruments was 1 per cent. Doubtless there were errors of language in the paper. The authors had, however, used such terms as seemed to them to convey a lucid meaning; and if they appeared to others to be nonsense, they could only express regret. He would state, in conclusion, that the results given had been obtained in various ways, and that the experiments had been conducted with all the care that men could use who had an important matter in hand. No pains had been spared by the inventor, who had, moreover, shown himself anxious to have the results obtained fully and freely criticised; and the testimony they had obtained to the correctness of those results had been so unanimous that they had felt justified in laying them before the Society. In reference to Mr. Mactear's allusion to the Antwerp Exhibition, it might be mentioned that M. Hermite had been awarded a gold medal by the Technical Jury. Since then the process and apparatus had been considerably improved.

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DISCUSSION ON MR. MACTEAR'S PAPER ON CASTNER'S SODIUM PROCESS.

In inviting discussion on this paper, the **Chairman** observed that its main interest lay in the fact that it opened up the possibility of obtaining aluminium at a much cheaper rate than at present. As the late Mr. Weldon had shown in one of the papers he had read before the Section, the production of aluminium by direct reduction by heat and carbon was utterly impossible—the very principle of thermo-chemistry forbidding it. Therefore, any process which gave cheap sodium, and thus rendered possible the production of cheap aluminium by Deville's process would prove of immense advantage to industry.

Mr. **Mactear** said: At the last meeting, after the reading of the paper, a gentleman had asked him what was the difference between this process and the Thompson process. He was not acquainted with the latter process at the time, but he had taken the trouble to ascertain its nature since, in case the question should be again raised. He did not know whether it was proposed to use a Bessemer converter in the Thompson process for the manufacture of sodium; but the idea was that by having a bath of molten iron they would get a decomposition of their soda salt and so obtain their sodium. The difference between these two processes was therefore very marked. In the one case molten iron was used, requiring an enormously high temperature and a special lining for the apparatus; whereas the Castner process required no molten metal, the temperature was always under 1000C., and the apparatus was extremely simple. He had had a long experience of processes, chemical and physical, and he usually found that the best proof of the difference between two processes with the same object was that one was successful and the other was not.

Mr. Johnson inquired whether there were any circumstances limiting the quantity of materials to be worked. The apparatus as described seemed enormous for so small a charge.

Mr. Mactear replied that it was evident that this was the first furnace, and that it had been built upon calculations made entirely in the dark. On that account it was hardly fair to criticise either the dimensions of the apparatus or the quantity of material worked in it.

Mr. Johnson said that was a question which would affect its commercial use.

Mr. Mactear admitted that; but a child must creep before it ran; and this was the creeping. It was intended to largely increase the charges treated. Up to the present they had been feeling their way; many points had had to be elucidated, and the results had surpassed their utmost expectations. The next furnace would be modified accordingly in construction and dimensions. No doubt much could be done in the way of cheapening the process; but, all things considered, he thought the meeting would agree with him that Mr. Castner deserved high praise for the results already obtained.

The Chairman said it seemed to him that if the process would work and give promising results on this small scale, it was almost certain to work well and develop better results on a much larger scale. It opened up a prospect of really cheap aluminium, and that would revolutionise engineering.

Mr. Mactear here exhibited a piece of bronze made from aluminium produced from the sodium process. He said it was remarkable as having been forged out cold from a *first* casting, whereas such bronzes usually required repeated meltings before they were clean enough to be forged.

Mr. C. von Buch said there was a process called the Cowles' process for producing aluminium bronze in an electric furnace. The bronze thus produced seemed to him to vary much in composition. He supposed that a bronze made like the one they had just seen would be much better than that made by the Cowles' system.

Mr. Lant Carpenter had no personal experience of bronze, but had read accounts from America with regard to its production by the Cowles' system, and those accounts certainly bore out the criticism just passed upon it. Bronze thus made must necessarily be very indefinite in composition.

DISCUSSION ON MR. MACTEAR'S PAPER ON RAISING ACIDS.

The Chairman said this was another instance of the inversion of a well-known principle, the discovery of which we owed to Dr. Sprengel. That inventor had revolutionised our ideas of physics by the discovery of his vacuum pump; and the reversal of its principle enabled one to work a siphon at a much higher level than was theoretically possible. Most practical men had had experience of a leak in a siphon, and of the wonderful power of the long leg for losing its weight. In the case of a small siphon, if the long leg were full of air, one could let a little air into the short leg; but to find this principle carried out successfully on so large a scale was extremely interesting. Of course it remained to be seen how the method would compare in point of economy with the ordinary montejus which was now generally used. For his own part he had tried many pumps, but had not yet found one which would pump acids satisfactorily.

Liverpool Section.

Chairman: Prof. J. Campbell Brown.

Vice-Chairman: Dr. F. Hurter.

Committee:

J. Affleck.
E. G. Ballard.
Ernest Bibby.
H. Brunner.
J. C. Gamble.
D. Herman.
J. W. Kynaston.
E. K. Muspratt.
Jas. Simpson.
A. Norman Tate.
A. Watt.

Local Sec. and Treasurer: W. P. Thompson, 6, Lord Street, Liverpool.

A meeting will be held at University College Laboratory, Brownlow Street, on May 4, and the following paper has been promised:—

Mr. J. W. Macdonald, "On the Manufacture of Arrowroot in St. Vincent, West Indies; its Uses and Adulterants."

May 4.—Discussion on Mr. Westmoreland's paper "On the Estimation of Sulphur in Pyrites."

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

The Chairman (Dr. Brown) showed a novel apparatus for the production of chlorine in proportion as it is required for experimental purposes, in which compressed balls of hypochlorite of calcium and gypsum were treated with hydrochloric acid, the supply of acid being regulated by the pressure of gas in the generator.

Dr. Hamburger mentioned another apparatus for making chlorine, which he had now used for several years. It consisted of a large flask filled with hot and strong hydrochloric acid, into which a solution of sodium chlorate was allowed to drop by means of a capillary syphon. If chlorine-oxygen compounds were objectionable, the gas must be passed once or twice through strong hydrochloric acid, by which means pure chlorine was obtained. The apparatus would work for 24 hours without any attention whatever. The evolution of the gas could be regulated by the use of a weak or strong solution of sodium chlorate.

Dr. John asked the last speaker whether from his apparatus the current could be shut off very readily.

Dr. Hamburger replied that it could be shut off readily enough by simply breaking the capillary tube, when the evolution of gas ceased in a short time.

Mr. Longuet Higgins then read his paper on the Manufacture of Chlorates.

ON THE MANUFACTURE OF POTASSIUM CHLORATE BY MEANS OF MAGNESIA.

C. LONGUET HIGGINS, A.R.S.M.

The process for the manufacture of chlorate of potassium which is now carried on at James Muspratt & Son's works in Widnes was worked out in 1883 by Dr. G. Eschellmann, who at that time was chemist there. It is patented in the names of E. K. Muspratt and G. Eschellmann.

The idea of substituting magnesia in the place of lime for absorbing chlorine was not new, for Weldon had made many experiments with it on the small scale with a view to recover the chlorine and magnesia for further use. Up to the present time, however, magnesium chloride has resisted profitable decomposition. Dr. Eschellmann's objects in using magnesia were the production of more chlorate of potassium from a given quantity of muriates than would be obtained when employing lime and also chloride of magnesium, which, instead of being run to waste, like calcium chloride, could be concentrated in aqueous solution till it formed a hard mass on cooling, in which condition it is bought by cotton sizers. The magnesia used is obtained in the form of the natural carbonate, magnesite, which is found in three forms hard, soft, and earthy, the specific gravity varying from 2·8—3·08. This, besides carbonate of magnesia, contains varying quantities of $CaCO_3$, AL_2O_3, Fe_2O_3, silicate of magnesia, sand, and traces of copper and manganese.

MAGNESITE.

$MgCO_3$.	$CaCO_3$.	Insol. Fe_2O_3, etc.	H_2O.
93·40	3·40	2·70	....
97·10	1·20	1·50	...
93·00	2·25	4·20	0·40

MAGNESIA.

MgO.	CaO.	CO_2.	SiO_2, etc.
89·20	4·6	4·5	1·7
91·99	4·71	1·0	2·3
90·56	4·54	3·3	1·6
92·764	4·036	2·3	0·9
92·70	4·60	0·7	2·0

Magnesite at a lower temperature than in the case of limestone gives off its carbonic acid, leaving about half its weight of magnesia.

When well burnt the resulting magnesia is very light, quite soft like chalk, and often has a beautiful radiating columnar structure, not unlike starch. Magnesia is easily overburnt, when it becomes very hard, dense, and somewhat crystalline, the specific gravity increasing from 3·07 to 3·61. In this condition it is useless for chlorine absorption.

The Mn in the magnesite is often present in the form of dendritic MnO_2, and is converted by the burning into Mn_3O_4, which gives the magnesia a cream or rose pink colour, according to the quantity present.

Magnesia is very slightly soluble in water, and does not slake; it must, therefore, be very finely ground and suspended in water for treatment with chlorine. As may be expected, it does not absorb chlorine so readily as lime, and the temperature caused by the reaction under the same circumstances does not rise so high. The temperature of a magnesia octagon when finishing is about 110° Fahr., but of course it varies with the bulk of the liquor, strength of the chlorine, and rate of absorption. With a large quantity of liquor and strong chlorine the highest temperature ever observed is 140° Fahr. Lime liquor treated in a similar way rises to a much higher temperature.

The mass of the liquor, strength of the gas, and temperature within certain limits do not seem to vary the finished product; an octagon finished in one day with strong gas shows the same proportion of chlorate to chloride as one which with weak gas takes a much longer time to finish, and finishes at a lower temperature.

It may be here mentioned that, as Dr. Lunge has pointed out, in his paper on the conversion of calcium hypochlorite into calcium chlorate, calcium chlorate will form at the ordinary temperature, provided the treatment with chlorine is carried on long enough; 70 per cent. are converted readily, the other 30 per cent. slowly. Magnesium chlorate will also form readily at ordinary temperatures. At Widnes two octagons have been used to absorb the residual gas from the other octagons of a series, and never had strong gas. If they were allowed to finish, more than a week was required, and consequently their temperature was very low, yet in the end the reaction was as complete in these as in the others. At one time the attempt was made to hasten the absorption in a magnesia octagon by heating with steam, but in this case an undue amount of $MgCl_2$ was formed.

Damp Cl has next to no action on dry magnesia or on the precipitated hydrate dried at 212°. On the freshly precipitated hydrate suspended in water, Cl acts rapidly.

If the hydrate is dried before suspension in water, Cl does not act so rapidly on it as when it is freshly precipitated.

With lime, when the liquor turns pink, it is a sure sign that, at any rate, the finishing point is nearly reached; but it is not so when magnesia is used, for pink liquor can be obtained which contains a very large quantity of undissolved magnesia, and which will, therefore, still take up a great deal of chlorine.

It would seem as if any hypochlorite formed was converted into chlorate before the chlorine attacks fresh magnesia. With lime the reactions are $2CaO + 4Cl = CaCl_2 + CaCl_2O_2$; then in the presence of more Cl, $3CaCl_2O_2 = CaCl_2O_6 + 2CaCl_2$.

The first reaction must be very transient in the case of magnesia, for a bleach liquor cannot be made at ordinary temperatures by treating magnesia suspended in water with Cl. A sample of octagon liquor taken during some very cold weather, and which, on account of exposure and the dilution of the gas passed over it, had been always very near the freezing-point, on filtering was found to be very strongly pink-coloured, and yielded only a very slight quantity of hypochlorite to arsenious acid. In this case the reaction was complete near the freezing-point.

The proportion of chlorate to chloride in well-finished magnesia octagon liquor, usually approaches very near to the theoretical 1—5—viz., 1—5·1 or less, so that, as the Cl nearly always contains a small amount of hydrochloric acid, the loss of oxygen from hypochlorite must be very small. With regard to strength, liquors of all densities up to 1·25 have been produced, the proportion remaining the same. With lime liquors the proportion varies from 5·3—5·6, and the work is not considered bad if it averages 1—5·4. The smaller amount of chloride in magnesia liquors constitutes an important advantage of this process, about 7 per cent. less chloride being obtained with magnesia than with lime.

A very awkward phenomenon, occasionally manifested in treating magnesia with chlorine, is that the contents of the octagon will assume a semi-solid or party state at a certain stage of the reaction. This is probably due to the magnesium chloride formed combining with magnesia as an oxychloride. These octagons in the end finish as well as the others, but require rather different treatment.

With regard to the pink colour of the finished liquor, it is caused by the Mn_3O_4 in the magnesia: the more pink the magnesia the higher the colour of the finished liquor. With very pure magnesia the liquors are nearly colourless. The finished octagon liquor bleaches litmus on account of its containing a trace of free Cl. When this is boiled off, it has an alkaline reaction due to a little dissolved magnesia.

Magnesium chlorate does not decompose on boiling any more than calcium chlorate, so the octagon liquor is boiled down till about 50 per cent. of the chloride will crystallise out on cooling as $MgCl_2 6H_2O$ containing about 44 per cent. $MgCl_2$. It is not safe to concentrate any further, as the temperature rises too high and the liquor, when cool, sets so hard in the vats that there is great difficulty in emptying them. The proportion of chlorate to chloride in the concentrated liquor will then be about 1—2·8. Any calcium chloride present remains in the liquor.

The crystals of $MgCl_2$ can be readily freed from the $MgCl_2O_6$ liquor. Chloride of potassium is then added to the strong chlorate liquor, and the $KClO_3$ crystallised out. Great care has to be exercised in adding the chloride of potassium to such strong liquor, or the greater part of it will be found undissolved. As nearly as possible the theoretical quantity of potassium chloride must be added, for any $MgCl_2O_6$ left is lost, and any excess of potassium chloride combines with magnesium chloride and crystallises as the double chloride carnallite ($MgCl_2,KCl6H_2O$) along with the $KClO^3$, and is afterwards difficult to wash out. This also renders you unable to estimate the excess added by testing the mother-liquor.

On account of having such an enormous quantity of chloride in so small a volume of liquid it crystallises at first very rapidly indeed in the form of very small thin laminæ; afterwards, as the liquor cools, the crystals build themselves up into fragile needles composed of small crystals superimposed on one another, something like the carnallite needles, and quite different from the long acicular crystals obtained by the lime process. They are beautifully clean, as the chlorate boil is made in a few hours, thus having only a short time in which to get contaminated with iron from the pan. As $KClO_3$ is less soluble in $MgCl_2$ than in $CaCl_2$, the magnesium mother-liquors contain very much less chlorate per litre than lime mother-liquor, besides being very much less in quantity; consequently, the yield of chlorate is greater, 90 per cent. of the total $KClO_3$ being obtained. The lowest magnesium mother-liquor obtained contains 10grms. of chlorate per litre, the average being about 19, whereas calcium mother-liquors will not average under 30grms. per litre. Operations in the finishing-house are carried on very much as with the lime process. The liquors stand very well and seldom require renewal. The mother-liquor now contains $MgCl_2$,$CaCl_2$,$KClO_3$ and some gypsum derived from the sulphate in the muriates; a little $MgHo_2$ is also present, rendering the liquor alkaline. It is run into a still, together with a solution of the $MgCl_2$ crystals obtained from the concentrated octagon liquor, and the chlorate is destroyed by HCl, of which an excess is necessary or all the chlorate will not be decomposed. The Cl given off is sent back to the octagons.

When the still gets to a temperature of about 140° Fahr. the evolution of the gas is attended by phosphorescence, due to the decomposition of O_2Cl. Unless due care is exercised an explosion may occur, attended by a flash of light with deleterious effect on the top of the still.

Almost the last trace of Cl is steamed out, so that the liquor running off does not smell of Cl, but rather of hydrochloric acid.

The still liquor is now neutralised with magnesia, when it gives off a very strong, sweet smell, much stronger than that given off on neutralising Weldon still liquor. Metallic iron must be kept out of the neutralising well, as the hydrogen from it reduces the ferric chloride in the liquor to ferrous chloride, which is very incompletely precipitated by the magnesia as green ferrous hydrate leaving liquors which turn reddish, and go on depositing iron for some time after.

A measured quantity of a strong solution of Stassfurt kieserite ($MgSO_4 H_2O$) is then run in according to the calcium present, and the contents of the well are pumped into a settler where the iron and a great part of the gypsum settle out leaving the liquor of a beautiful green colour and very clear. Some of the gypsum is thrown down slowly in a dense crystalline form, coating the settlers and giving great inconvenience if pipes are used to convey the liquor to its destination.

The chloride of magnesium is now concentrated; formerly wrought-iron pans were used for this purpose, but were found to be so strongly acted on that they had to be abandoned, and cast-iron pots are substituted in their place.

A great deal of time and trouble has been expended in trying to stop the action of this liquor on iron, even in the case of cast-iron, but without success, as it does not seem possible to stop the evolution of a small quantity of hydrochloric acid, and consequent action on the iron at the temperature to which the liquor is raised—viz., considerably over 300° F. Magnesium chloride also acts on iron, especially wrought iron, according to the equation, $MgCl_2 + Fe + 2OH_2 = MgH_2O_2 + FeCl_2 + H_2$.

This reaction takes place even at ordinary temperatures, and is the one which renders $MgCl_2$ so destructive to boiler plates.

A higher temperature and voltaic action are favourable to the reaction. If a bright wrought-iron vessel is filled with a strong solution of $MgCl_2$, rendered slightly alkaline with magnesia and left for some time, a green precipitate of ferrous hydrate, which afterwards oxidises and turns red, shows that action has taken place. Zinc and lead are acted on in a similar manner, only more strongly. A zinc and platinum couple placed in a solution of $MgCl_2$ and warmed, gives off hydrogen abundantly.

The quantity of iron taken off when cast pots are used is very slight, but is sufficient to give the magnesium chloride a very high colour.

Clear at first, the liquor on boiling soon becomes muddy and whitish, owing to precipitated gypsum, which is soluble to a considerable extent in a weak solution of magnesium chloride. Any iron dissolved is not oxidised during the boiling, or precipitated by the magnesia present in the liquor, which retains its alkalinity throughout, or by excess of magnesia added at the end of the operation, but remains in solution as ferrous chloride which, when the magnesium chloride is cool, is converted into hydrated oxide, which oxidises and imparts to it a series of colours well known to chemical manufacturers. A violet or pink colour has often been obtained which is destroyed on the addition of water; what this is due to has not been ascertained, but may be to a double chloride of ferrous iron and potassium or magnesium.

To remove iron dissolved by the liquor the quantity is kept as small as possible by the employment of cast iron for the vessel, and it is oxidised to the ferric state when magnesia will precipitate it completely.

For this purpose the liquor is boiled up to near the finishing point and the iron oxidised, when the colour of the magnesium chloride changes from muddy white to bright yellow; the steam at this stage smells slightly acid.

Magnesia is now added and the fire dropped. The liquor settles rapidly, is very clear, and of a greenish colour. When cold enough it is packed into barrels, where it soon sets very hard.

The sediment at the bottom of the pot consists of oxide of iron, gypsum, magnesia, and about 30 per cent. of magnesium chloride. The magnesium chloride is very white, free from iron and chloride of calcium and contains 47 per cent. of $MgCl_2$.

DISCUSSION.

Dr. HAMBURGER asked what was the strength of the octagon liquor that was obtained by the magnesia process—*i.e.*, how many grammes of magnesium chlorate per litre?

Mr. HIGGINS said it varied from 1·20 sp. gr., but sometimes ran as high as 50° Tw.

Dr. HAMBURGER said with regard to magnesium hypochlorite, he had found on passing chlorine into milk of magnesia the same thing which Mr. Higgins had mentioned—namely, that a pure magnesium hypochlorite could not be obtained by the action of chlorine on magnesia. A large portion of the magnesium hypochlorite was converted at common temperatures into magnesium chlorate and chloride. The only way of obtaining a magnesium hypochlorite solution, tolerably free from magnesium chlorate, was by the decomposition of the analogous lime compound He was sorry to differ from Mr. Higgins in another case. The lecturer had mentioned that the proportion of chlorine as magnesium chlorate to chlorine as magnesium chloride was nearly the theoretical—viz., 1 to 5. That was not his experience. In fact, his best experiments yielded liquors in which the proportion was 1 to 6, and in many cases the proportion was far more unfavourable, showing that the magnesium chlorate had decomposed into chloride and free oxygen. He had previously mentioned that the magnesium hypochlorite was readily converted into chlorate and chloride. On the other hand, he had often experienced a difficulty in converting the last traces of hypochlorite in spite of using a great excess of chlorine. His experiments were made on the small scale, and he should like to ask the lecturer, whether, in working on the large scale, he had noticed the same difficulty.

Mr. CAREY said he would make no remark, except that the process was a very interesting one to the Society, and to ask with regard to the roasted magnesite, that Mr. Higgins would be good enough to forward some specimens to the Geological Society of Liverpool, as that Society, no doubt, would be much interested in them, seeing that these specimens form a new example of a natural process, of which they had all seen the results in the columnar basalt at Fingall's Cave and other similar places, whereby material ordinarily amorphous had been induced to assume a columnar structure. The magnesite before them seemed to be an example of the same kind of action, it goes into the kiln entirely amorphous, and comes out with the columnar structure very distinctly marked; and as in the case of columnar basalt, the columns are in the main at right angles to the cooling surfaces. They were all very much obliged to Mr. Higgins for having explained this new and excellent chlorate process in so clear a manner.

Dr. HURTER said there were a great many points of interest which Mr. Higgins had mentioned. In the first place, he mentioned that hypochlorite of magnesia very readily transformed itself into magnesium chlorate. That might be of some little interest to bleachers who intended to use Hermite's process for preparing bleaching liquor. This process consisted in electrolysing a solution of magnesium chloride, whereby magnesium hypochlorite was produced, which, however, very readily turned into chlorate, even during the electrolysis. He did not know whether the bleachers would be desirous of having the chlorine in the form of chlorate. Another point was the over-burning of magnesia. It was very peculiar how greatly the sp. gr. of magnesia altered on over-burning; and how difficult it was to dissolve. At first when Messrs. Muspratt began the new process, Messrs. Gaskell, Deacon and Co. burnt the magnesia for them. Dr. Eschellmann then complained about one batch that it was not burnt at all, and was simply magnesite. On investigation this turned out to be erroneous, and the magnesia contained no carbonate at all. It was intensely hard and heavy, and absolutely inert to chlorine gas. There was another point. They were told that the advantages of the process were, in the first instance, that the by-product magnesium chloride was saleable in limited quantities: and secondly, that potassium chlorate was much less soluble in magnesium chloride than in calcium chloride solutions. He should like to know to what extent this solubility differed. He thought they owed some thanks to Messrs. Muspratt for permitting Mr. Higgins to bring such an elaborate report of the new process before the section.

Mr. W. P. THOMPSON asked where the magnesite was obtained, and whether it was a sedimentary deposit, or an igneous one. He had met with it in small quantity in Serpentine, so supposed the latter.

Mr. E. K. MUSPRATT said he had not lately given so much personal attention to the process as Dr. Eschellmann and Mr. Higgins, although he had followed it, and in the initiative he took some steps with Dr Eschellman to bring about a perfect process. With regard to what Dr. Hamburger said as to the proportion obtained when absorbing chlorine by magnesia and lime, it was certainly their experience the proportion was very much more favourable with magnesia than with lime. They never got an octagon liquor exceeding the proportion of 1 to 5·2. Now, Dr. Hamburger acknowledged that the average of their octagon liquor with lime was 1 to 5·4 or 5·6, and he thought if Dr. Hamburger had made chlorate of potash some 20 years ago, when the workmen were not so skilled or careful as at the present day, he would have found sometimes with lime that the proportion of these liquors ran up from 1 to 6 and 7 and even 8. That was frequently caused owing to the carelessness of the workmen. Now, as Mr. Higgins had already told them, even with the most concentrated liquors they got a proportion of 1·0 to 5·1 and 5·2. He did not know why Dr. Hamburger's experiments on the small scale should have given him a different result. They knew perfectly well that the results were sometimes very different when carried out on a large scale. As regards the measure of the solubility, all he could say was that with the mother liquors in the lime process they very seldom (certainly in warm weather), had less than about 30 or 35grms. of chlorate of potassium per litre. With the magnesia process they had as low as 10grms. per litre, and even in warm weather it ran to 19 or 20grms. only, which showed that the chlorate of potassium is very much less soluble in the magnesium liquor than in the calcium liquor. As regards the treatment of the residue of the chloride of magnesium of course that had been one of the difficulties they had to contend with to get this chloride of magnesium in a soluble form. It was very curious that Dr. Eschellmann, who went to Strassfurt to examine the treatment of the $MgCl_2$ there, on his return advised them to put up wrought-iron pans, and they put up exactly the same pans in their works that they found by experience to be useful and desirable in Strassfurt, but much to their astonishment there was something in the liquors that they dealt with that acted upon the iron to a far greater extent than the Strassfurt liquors, and they were obliged to take refuge in the cast-iron instead of wrought-iron for the purpose of concentrating the liquor. He thought that what Mr. Higgins had read threw some light upon an observation that was made on the action of water in boilers. It was well known that when water contained chloride of magnesium it acted very rapidly on steam boilers. Apparently from their experience it had a direct action, and they got hydrate of magnesia and hydrochloric acid. When it was proposed in the year 1871 by Mr. Weldon to use magnesia in place of lime for the chlorate of potash process, Mr. Weldon's idea was to recover the chlorine or the hydrochloric acid from the chloride of magnesium, and to use the magnesia over and over again. That, he very soon found was impracticable. He thought Messrs. Gamble's had also some experience, and they knew how very difficult it was to obtain all the chlorine or hydrochloric acid from the chloride of magnesium calcination. Therefore, to really carry out this process, and make it a commercial one, it was necessary to make this chloride of magnesium in a saleable form, and in that they had succeeded. They would see from the sample that the chlorate of magnesium that was now produced was quite white and pure, purer than the German, and gave satisfaction in every way to consumers of it.

The Chairman said that the heat of neutralisation of $HClO_3$ by magnesium was probably about 15,000, whereas that by calcium was about 27,000 or 28,000. This might partly account for the increased yield of potassium chlorate, because magnesium chlorate would be more readily converted into potassium chlorate than calcium chlorate would. He also suggested that the more rapid formation of $MgClO_3$ as compared with $CaClO_3$ might be accounted for in the same way. It would be interesting to know whether at a higher temperature the $CaClO_3$ is formed as readily as $MgClO_3$, and whether calcium or magnesium would combine with the chlorine first if it were presented to both simultaneously.

Mr. Higgins, in reply to Dr. Hurter, said with regard to the difference of solubility of potassium chlorate in magnesium chloride and calcium chloride, he had made no quantitative experiments. What he judged from were results obtained in practice. In reply to Mr. Thompson, the magnesite was found in the island of Eubœa (Greece), associated with Serpentine. With regard to Dr. Hamburger's proportion of 1·00 to 5·6,* they had got nothing like that, even in the case where an octagon was heated with steam, when he did not think it was over 1·00 to 5·5. As to the last traces of hypochlorite, the hypochlorite was converted into chlorate as fast as formed, and there was no difficulty in making the conversion into chlorate complete.

Manchester Section.

Chairman: Sir H. E. Roscoe, M.P.

Vice-Chairman: I. Levinstein.

Committee:

Dr. Bowman.
R. F. Carpenter.
C. Estcourt.
H. Grimshaw.
Peter Hart.
Dr. Gerland.
C. Schorlemmer.
Dr. Schunck.
Dr. Watson.
Wm. Thomson.
L. Siebold.
Dr. Hewitt.

Local Secretary:
J. Carter-Bell, Bankfield, The Cliff, Higher Broughton, Manchester.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

REFRIGERATION AND ICE MAKING.

BY GEORGE E. DAVIS.

Our Journal already contains two valuable papers upon this subject, one read by Mr. J. J. Coleman, before the members of the Glasgow and West of Scotland Section, in May, 1884, and the other by Mr. T. B. Lightfoot, before the London Section, in March, 1886. Both these papers have largely extended the knowledge relating to ice machines, and I have carefully gone over the papers in question to avoid repetition, and, if possible, to put my remarks into a different groove, and as I have now had two years' experience of the compression system for refrigerating purposes, and also for the actual manufacture of ice, my remarks may be of use to those manufacturers who contemplate carrying on chemical processes by means of refrigeration, or commencing the manufacture of ice for sale.

Refrigerating machines have, roughly speaking, been constructed on two distinct principles; and here I deviate from the usual classification—the one, in which the expanded and cold gas is absorbed in water and is re-introduced in solution into the system; the other, in which the expanded gas, after it has done its work, is re-introduced into the system by means of a compression pump. The former we will call the absorption system, while the latter we will style the compression system.

I am not taking into account any apparatus for the production of cold by means of the melting of a solid; as, although such a one has been constructed to work with nitrate of ammonia as the active agent, yet such an apparatus could never expect to compete successfully with either the absorption or the compression system—at least so far as cost is concerned.

Carré's original machine, introduced in 1860, may be considered the type of all absorbing machines; it may be found described in most treatises on elementary chemistry published since that date. Ordinary liquid ammonia was placed in one vessel, which was connected with another destined to become the refrigerator. In use, heat was applied to the vessel containing liquid ammonia (aqua ammonia) while the refrigerator was immersed in cold water. When sufficient ammonia had passed over, mixed of course with a certain quantity of the vapour of water, the source of heat was removed and both vessels plunged simultaneously into receptacles holding cold water. Re-absorption of anhydrous ammonia by the contents of the previously heated vessel then took place, and the extremely rapid evaporation of ammonia from the second vessel lowered the temperature of the surrounding water to such an extent that it was slowly converted into ice.

The original machine was hardly one capable of finding extensive use, as the operation was not continuous; but Carré himself improved upon it, and various other improvements and modifications have been later introduced by other inventors and manufacturers. At present there are two forms of this system working in England—the "Carré Reece," made by Pontifex and Wood; and the "Kropff" system, which is of Continental manufacture. I saw both systems at work about two years ago, and was favourably impressed with the simplicity of their combinations, though it seemed to me at the time that the absorption system was not the best; why, I will describe later on.

In order to make the action of this apparatus and this system plain to you, I have prepared the diagram on opposite page (Fig. 1), which will show the principal parts of an absorption machine.

The generator A contains a strong solution of ammonia, where it is heated by means of a steam coil through which steam is constantly passed; the heat thus applied causes the ammonia to be driven out of its aqueous solution (and with the ammonia there is simultaneously a certain amount of ordinary steam developed); this mixture rises up through the analyser

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* Dr. Hamburger said 1—6.

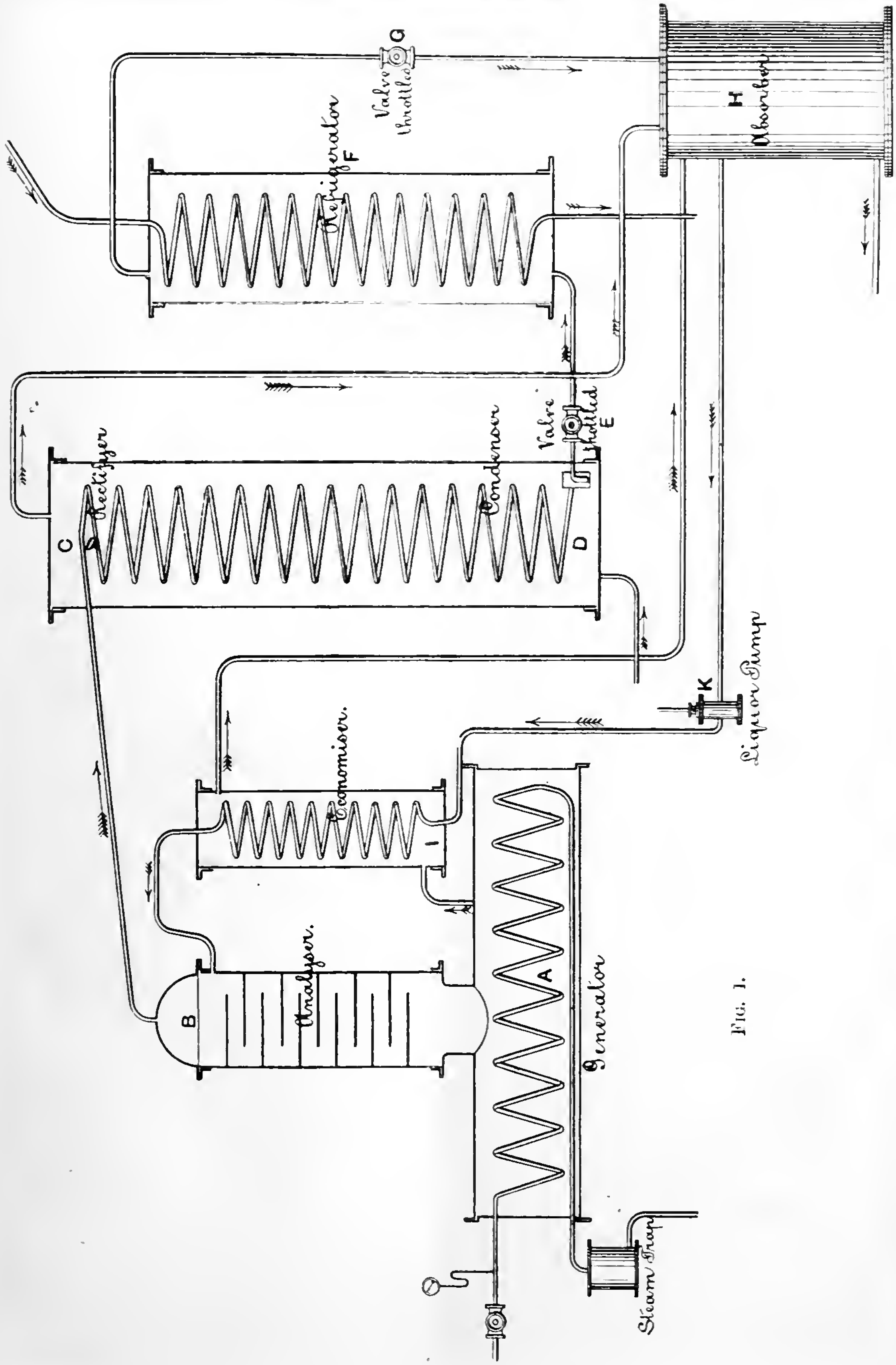
Valve throttled
G
Refrigerator
F
H
Absorber
Rectifyer
C
Condenser
D
Valve throttled
E
Economiser.
I
Analyser.
B
Generator
A
Liquor Pump
K
Steam Trap

Fig. 1.

B. This analyser separates (more or less perfectly) the aqueous vapour, which condenses and falls back into the generator A. From the analyser the ammonia passes into the rectifier C, where the vapour gives up its property of being superheated, and reaching the condenser D, if the plant is properly constructed, it gives up its latent heat of condensation and becomes converted into liquid anhydrous ammonia.

The two quantities of heat mentioned are taken away by cooling water. The liquefied ammonia flows from the condenser through a regulating valve E into the refrigerator F, which it should fill to a certain height, evaporating constantly and abstracting the necessary heat from the brine or water passing through a system of coils placed within the refrigerator. From the refrigerator the ammonia vapours flow through a throttling valve G into the absorber H, where they are absorbed by weak ammoniacal liquor, which is forced by the excess pressure in the generator through the body of the economiser I into the absorber. When this spent liquor has been converted into strong liquor, it is pumped by means of the liquor pump K back through the economiser coil into the analyser and generator, where the entire process just described is again repeated.

This short sketch shows clearly the action of machines made on the absorption system, and it shows also that there is much room for the introduction of modifications without altering the principle of the apparatus. In these machines ammonia is always used on account of its great solubility in water, and also because it is easy to cause its evolution by the application of heat.

We may now turn our attention to the compression system, which is at once much more simple in its arrangements than the one we have already described. Yet it is one which demands much more careful workmanship in the construction of the machinery than is the case with that working on the absorption system. I have prepared the diagram Fig. 2 to show you the principal parts of a refrigerator working on the compression system. To start with, the apparatus is charged with nearly anhydrous ammonia. The pump A receives the expanded vapour from the refrigerator coils C, and compresses it into the coils of the condenser B, in which the vapours are liquefied, from whence it escapes into the refrigerator by means of the regulating cock D, evaporating again in the refrigerator. This cycle of operations is continually going on, the vapour is being compressed and liquefied in the condenser, and re-evaporated in the refrigerator, where it is cooling the liquid which surrounds the coils.

On the compression system there are several and varying forms of machine, each one specially suited to the liquid or vapour to be employed therein. In Raoul Pictet's machine the liquid employed is anhydrous sulphur dioxide; then we have the various ether machines, and lastly anhydrous ammonia machines. I do not intend to single out these various machines, though later on I shall have to say something about the Linde ammonia machine, with which I have gained most of my experience. It stands to reason that the substance of the machine must be constructed of materials capable of resisting the medium employed. It would not do to use ammonia in Pictet's compressor any more than it would to use Pictet's liquid in a Linde machine, though ether or air may be used in either, if the condensing and refrigerating space be alike suitable.

The action of the compression machine is very simple, yet it is often misunderstood, and much irrelevant matter has been written respecting it. So lately as in September last an article appeared in *Industries* on the manufacture of ice, in which the following words occur:—

"When a body changes its condition from the liquid to the gaseous form, heat is absorbed to increase the energy of the molecules, although there need not necessarily be an increase in temperature. The heat thus absorbed without change of sensible temperature is called the latent heat of vaporisation. The quantity of this heat varies according to the liquid employed and the pressure at which vaporisation takes place. Economically the best liquid to employ will be that which has the highest latent heat, because the

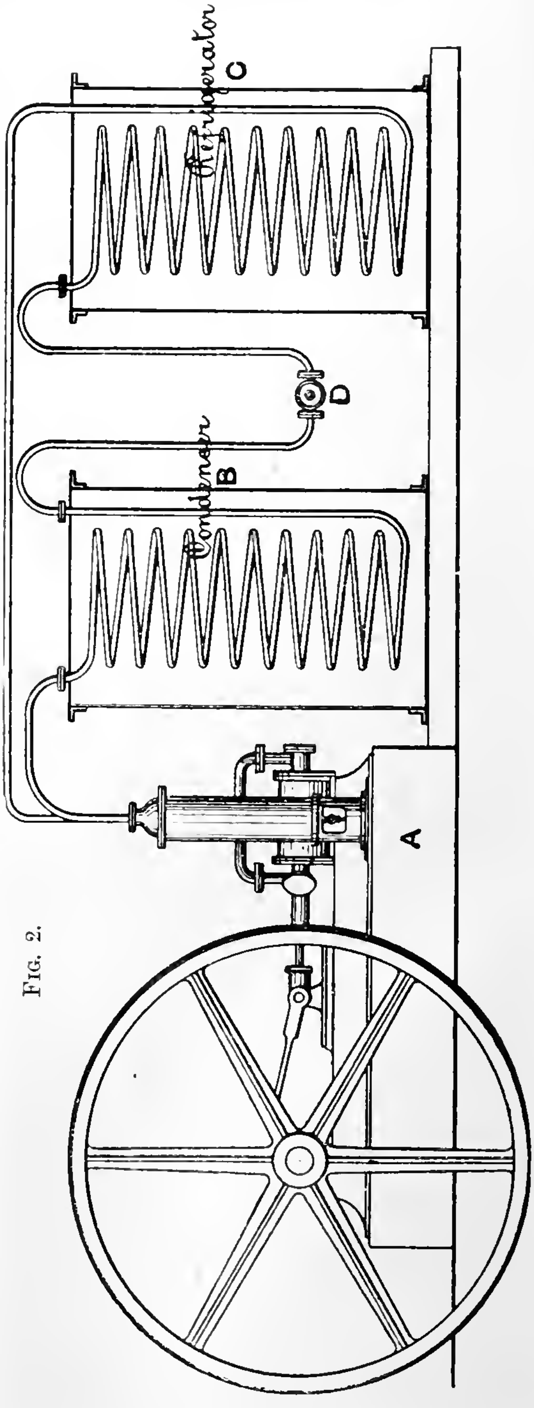

Fig. 2.

smallest bulk will suffice to absorb a given amount of heat, and consequently the least power will be used." This is wrong, theoretically; from a physical point of view, it is of no consequence whatever what compressible vapours are employed; they may be water, sulphurous acid, carbonic acid, hydrogen, oxygen, or simply a mixture of any of them, such as air. The effect of employing various media is shown however in the size of the machinery, the compressor, the condenser coils, or those of the refrigerator. For a given weight of ice to be produced a carbonic acid machine would be a very small affair compared with an air or ether machine: that is to say, if carbonic acid were a suitable medium, which I do not think it is, as it assumes the critical condition more easily under high pressures than most other vapours—proportionately. No, the action of the machines working on the compression system can be explained very easily. The expenditure of a certain amount of mechanical power W results in a certain quantity of heat R being extracted from the refrigerator, and a certain quantity of heat C is transferred to the condenser. The relation between R and C will be described later on.

A consideration of the action of the "Carnot" engine when it is reversed will easily prove that if such an engine work between the lower absolute temperature T*l*, and the higher absolute temperature T*h*, and if it receives at the lower temperature a quantity of heat H, which it gives away at the higher temperature, then a certain amount of mechanical work W is absorbed. And further, if the compression and expansion of the medium be carried out adiabatically, while the reception of the heat H at the lower temperature T*l* and its delivery at the higher temperature T*h* respectively take place isothermally, no other engine working between the same temperatures T*l* and T*h*, and carrying the heat H from the former to the latter level of temperature, is able to perform this process with a smaller expenditure of mechanical work W. That is to say, in a theoretically perfect refrigerating machine the working substances must carry out exactly the reversed process of Carnot's heat engine, provided the extraction of heat takes place at the lower constant temperature T*l*. It is further evident that for such a machine, according to the law of the conservation of energy, the relation exists:—

$$C = R + AW,$$

A being the mechanical equivalent of heat, W the mechanical work expended, R the number of heat units extracted from the refrigerator, and C the number of heat units put into the condenser. As, moreover, in consequence of the reversible cycle of operations performed by the working substance, this latter is exactly in the same state after having completed the four operations (adiabatic compression, isothermal compression, adiabatic expansion, isothermal expansion) as it was at the commencement, the second law of thermo-dynamics must be fulfilled, and consequently the relation holds good:—

$$\frac{R}{C} = \frac{Tl}{Th} \text{ or } C = R.\frac{Th}{Tl}$$

Setting the two preceding values for C equal to one another it follows:—

$$R + AW = R.\frac{Th}{Tl} \text{ or}$$

$$AW = \frac{Th - Tl}{Tl}.R,$$

or the efficiency of the perfect refrigerating machine working between the absolute temperature T*l* and T*h*—

$$\frac{R}{AW} = \frac{Tl}{Th - Tl}.$$

As the only condition in the establishment of this efficiency consisted in the operations taking place according to Carnot's reversed cycle, it follows that the above value for $\frac{R}{AW}$ applies to all machines so working, irrespective of the nature of the medium employed, whether that medium be air, ether, sulphurous acid, carbonic acid, or ammonia, or any mixture of these.

The *actual* efficiency $\frac{R'}{AW'}$, of a refrigerating machine, which is always less than the theoretical efficiency $\frac{Tl}{Th - Tl}$ will approach the maximum value $\frac{R}{AW}$ the more the smaller the difference between the higher and lower temperatures can be kept, and the importance of this rule should be well observed in the design of such machines. In practice it means that the surfaces of condensers and refrigerators must be as extended as possible, that the liquid in contact with these surfaces must be kept in rapid circulation to promote the transmission of heat, and that all refrigerating work should be performed without the production of ice or any other refrigerating medium. Further, the heat of compression must not be allowed to raise the temperature of the medium appreciably above the condensing temperature (or the temperature of the water in cold air machines), and the size of the compression pump must be kept as small as possible to reduce friction of piston and piston rod—that is to say, that liquids of great latent heat are preferable to those of lower degree on this account only.

This is clearly set forth in our Journal for 1885, p. 736, where in describing his patent, William Raydt, of Hanover, advocates the use of carbonic acid as the refrigerating medium, and states that a much smaller compression pump can be used than with other media, it being less than one-sixth the size of that necessary for ammonia; but, on the other hand, the machine must be worked under a pressure of from 30 to 75 atmospheres, and therefore a very differently constructed pump must be employed than for ammonia, where the pressures are 2 to 10 atmospheres. As I have already stated, the selection of an ice machine for refrigeration purposes forced itself upon me some three years ago, and as I finally selected one made on the compression system, in fact the Linde ammonia machine, I cannot do better than give you my reasons for this selection.

It has been mentioned that all practical refrigerating machines may be conveniently divided into two classes, and having been favourable to compression I must perforce justify my rejection of the absorption system.

The absorption system has its advantages as well as its disadvantages. Amongst the former the fact that there is no large engine to run might weigh with some; the direct heat of the steam is sent into the generator coils, so that there is but little loss in previously converting the heat into mechanical work. Of course the liquor pump still remains to be driven, but the energy absorbed by this operation is very small indeed. This seeming advantage at first appeared to be a notable one, as each unit of steam, if used direct, would be as efficient as 5 units working a compressor, but on more closely going into the matter this turned out a clear disadvantage. I managed to discover that a ton of coal produced about ten tons of ice in each of the machines I saw, the Kropff and the Carrè-Reece, and the argument was, that so much of the heat of the steam was available over and above that used in the compression system.

Now, if 12 tons of ice could be produced by this latter system, which I knew to be the case, then the quantity of cooling water used in the absorption system must be very great. In fact, in refrigerating by this system the cooling water has to absorb heat from two liquefactions of the ammonia, the first in the condenser, and the second in the absorber, where the return expanded gas is collected in the cooled weak liquor.

You will observe in Fig. 1 that the cooling water enters the lower end of the condensing tank, and flowing out above the rectifier coils enters the absorber and does some useful work there.

Attached to the rectifier is a special pipe not shown in the diagram to conduct any condensed liquor back to the analyser.

In the economiser some heat is lost by radiation. In an absorption machine working to its utmost efficiency the strong liquor will probably be heated from 40° C. to 90° C., an increment of 50° C., while the spent liquor will be cooled from 130° C. to about 60° C. I must say the existence of such a high temperature with an article like liquid ammonia in boiler-shaped vessels did not increase my love for the system, and again radiation takes place from generator and analyser which cannot be put down at less than 5 per cent. on account of their extensive surfaces.

SUBSTANCE.	Vapour Density.	Weight in grms. of 1 litre.	Latent Heat.	VAPOUR TENSIONS.			Boiling Point.	SPECIFIC HEATS.			Solubility in Water.	Heat evolved during solution in Water.
				At −20° C.	At 0° C.	At +20° C.		Equal Weights Water =1.	At constant Pressure.	At constant Volume.	Vols. Gas in 1 vol. Water.	Weight of Gas.
Ether	2·556	3·314	91·1	67·5	183·3	433·3	34·2° C.	·4810	5·18	6·91	—	—
SO$_2$	2·247	2·860	—	479·5	1165·1	2462·0	−10·5°C.	·1544	1·44	1·62	40·0	120·4
Air	1·000	1·293	—	—	—	—	—	·2374	1·00	1·00	—	—
Water	0·621	0·806	537·0	0·927	4·6	17·391	100° C.	1·0000	1·26	1·36	—	—
Ammonia	0·589	0·769	320·0	1397·7	3162·9	6467·0	−33·7°C.	·5083	1·26	1·37	700·0	514·3

In the question of cost, absorption machines cannot compare favourably with compression machines, on account of the complication of the apparatus and the extra strength which has to be put into tubes of large diameter to resist these extremely high pressures satisfactorily. Again, the cost of filling one of these machines with ammonia is no small item; and last, though certainly not least, is the wear and tear of *hot* ammoniacal gases upon wrought iron. I have had considerable experience in the manufacture of liquid ammonia, and I am quite certain that this is an item which must be considered. I therefore came to the conclusion that the coal used per ton of ice produced was quite as great as that needed by the compression system; that owing to the large diameter of the vessels the apparatus could not be considered so safe; that the first cost would be greater; that more cooling water would be used, and that although no expensive engine tenter was required, yet a well-paid and careful superintendent was just as necessary as with a machine working on the compression system.

I thus became wedded to the compression system; and here another difficulty arose. There were cold-air machines, dry-air machines, ether machines, sulphurous-acid machines, ammonia machines, and others, the makers of which each and all asserting in the boldest manner possible that their special machine would make ice better and quicker than any other machine extant, and with less fuel and less cooling water than any other competing apparatus.

I have often had it in mind that a large and important Society, like our own, might well consider the advisability of appointing commissions to examine subjects of this kind. It is done on the Continent and in America, and upon my bookshelves I have several examples of the usefulness of this kind of work. As an instance, the examination into the efficiency of ice machines was conducted by a committee of eight engineers, selected by the Society of Bavarian Engineers, and a trial of the ammonia compression system (Linde's) was made at the ice factory at Munich. The details of this trial may be found in a paper read by Mr. T. B. Lightfoot before the Institution of Mechanical Engineers.

I have already stated that, physically, it matters not much what compressible vapours are employed, and have shown also, by formulæ, how this is so; but in practice there are various media employed in the different machines, and we ought to have some idea whether one is any better than another. In my selection, however, I was limited to a special object—namely, that of cooling 25,000 cubic feet of gas per hour from 20° C. to 0° C., and about 200 gallons per hour of a heavy oil from 30° C. to 4° C. The idea was not to make solid ice, though I believe the problem would remain the same if it had been so intended.

The formula already given shows $C = R + AW$ that the heat units C put into the condenser equal that number extracted from the refrigerator + the heat produced by the mechanical work of the compressor. This heat has to be absorbed and carried away by the cooling water; therefore it is necessary to have W as small as possible. It is here where the properties of vapour density, vapour tension, and latent heat come in, and these properties decide the size and capacity of compressor and engine in order to do a certain amount of work.

The above table will show the principal properties of the substances generally used in refrigerating machines.

A careful consideration of the foregoing table shows very clearly that physically ammonia is the best agent to use in any compression system, and, next to that, sulphurous anhydride, but it often happens in these questions that the commercial and mechanical side overbalances the physical side. With me, it was a question of refrigerating with chemicals or without them; the cost of chemicals was an unknown factor, and upon which I could get no decided information. Air was cheap enough, so I determined to investigate more closely the cold-air machines. It seemed that it would be very easy in my case to cool the gas, or a portion of it, to a very low temperature, and to mix this cooled gas with that at the normal temperature, to the temperature desired. The gas would thus be used in the machine in the place of air. Mature consideration, however, showed that the gas would enter the compressor at about 16° C. and often supersaturated with moisture, and in my case the apparatus to prevent this would have been complicated and costly. In one cold-air machine working (drawing in ordinary non-saturated air) the man in charge told me he had to open the snow chamber every twelve hours and take out several barrow-loads of "frost," so that this point of itself would have decided me had I not remembered also that the gas with which I had to deal with was mainly hydrogen, the lightest substance known.

Cold-air machines require large compressing cylinders, and as the pistons have to be perfectly air-tight, the power W in our formula must certainly be greater than when a vapour of high latent is used, especially as they have to work with a very low Tl and high Th; usually there is $Tl = -30°$ C. and $Th = +70°$ C. The cylinders would have had to be much larger if coal gas had been employed instead, to say nothing of certain complications which might have taken place by the introduction of tarry matters, and by the condensation of liquid matters from the gas. From all that I gathered it seemed to me absolutely certain that cold-air machines would require nearly four times the fuel that the best compression system would work with, and that air cooling would take more cooling water also.

After this I had the advantage of seeing the ether and Pictet's sulphurous anhydride machines almost simultaneously, and I noticed that the capacity of the ether compression-pump was about four times that of Pictet's; this, of course, meant more power to drive it, increasing the coal consumption again.

Ether is a liquid of low volatility as compared with the other media used in refrigerating machines, and of low vapour tension, so that an air-pump of large dimensions is necessary and a high degree of vacuum must be maintained in the refrigerator. This favours the entrance of air through the joints and stuffing-box, and the efficiency of the machine is proportionately reduced. Again, under the action of repeated vapourisations and compressions commercial ether becomes acidified and converted into less volatile bodies, so that the charge has occasionally to be withdrawn and replaced by fresh ether, the old charge being rectified from these substances and from the lubricating materials employed in the air-pump. Taking all these things into consideration, I do not see how the fuel consumption can be less than double that employed in the best system, and the cooling water must be excessive, though probably not so much as with cold-air machines.

The Pictet machine which I saw was certainly doing good work; for a large ice production its size was moderate, and, as I have already mentioned, the compressor pumps were about one-fourth of the capacity of the ether machine. It had, however, in my opinion, two faults:—The nature of the medium used compelled the employment of copper in the construction of the compressor, condenser, refrigerator, and all parts in contact with the medium, which is sulphurous anhydride. This makes the first cost greater than it need be if iron could be used instead. Then, again, the vacuum side of the system was below the ordinary atmospheric pressure, so that the tendency of air and moisture to leak in and so form sulphuric acid, was a point to be considered, seeing that sulphuric acid attacks all metals. Another point, and one which certainly weighed with me, was that the heat of the compression-cylinder was very great, and this was kept cool by a constant stream of water running through a surrounding jacket, the piston-rod being also kept cool by means of a stream of water. Perhaps this matter may be a small one, but I was anxious to strip any machine or system selected of all its complications.

Having now found faults with all existing systems and with all media save ammonia, I next came to consider refrigerating by means of the compression of ammonia. Several different machines were in the market working on this plan, but I had only the opportunity of seeing one at work. An inspection of the table will show that ammonia vapour has a very high latent heat, and on this account, as well as its low boiling point, a small compressor only is necessary; this, of course, enables a smaller piston-rod to be used, and there is consequently less friction to be overcome by mechanical work. On the other hand, high vapour tension means high pressures on the compression side of the machine, and a consequent escape of ammonia if all joints are not perfectly made. The physical side of the question being satisfactorily settled, it seemed to me the only point to inquire deeply into was the actual mechanical construction of the machine.

On account of the corrosive action of ammonia upon copper, gun-metal, brass, etc., none of these metals or alloys can be used in the construction of an ammonia machine, and consequently they are made in every part of cast and wrought iron. On the condenser side of the system which I inspected the pressure was ten atmospheres, and about two atmospheres on the refrigerator side, which showed at once the necessity of good sound castings, of perfect joints, good flat flanches, and lastly, of a good stuffing-box and gland for the compressor piston-rod. I did not despair that those conditions could be realised in practice. I fully saw that if the compression system was adopted, then ammonia was the best medium to be used, and that if ammonia was employed then only the very best workmanship was allowable.

When I saw the Linde machine at work at the Wrexham Lager Beer Brewery, the faultless character of the workmanship was easily discernible, and I had no hesitation in finally selecting the Linde machine. Then came the question of the size required. I had calculated that when fully at work we should require cold, equal to a flow of brine, of 1000 gallons per hour, to be cooled from 19° C. to 8° C., and this means a size of machine capable of producing six tons of ice every 24 hours, or a cooling power (not making ice) equal to ten tons. In this machine, the joints between the ends of the wrought-iron piping and the flanges were all carefully tinned and soldered with pure tin, the joints between two flanges being made with the thinnest sheet indiarubber obtainable. The gland and stuffing-box to the compressor-piston is very long and of peculiar construction, and it acts so perfectly that even in the hot weather, when the pressure has risen to 12 atmospheres owing to the warmth of the cooling water in the condenser, there is only the faintest smell of ammonia in the room. In fact, during the whole time it has been working the loss of ammonia for making 1800 tons of ice has only been £3 10s. The compression cylinder works perfectly cold without possessing any water-jacket or similar contrivance, and is even partially covered with frost when working at low brine temperatures. The fuel account also shows that the available coal heat passed into the steam engine has produced 9 tons of ice per ton of coal actually used. This is much lower than the efficiency reached at the Munich trial; but our steam boilers are not of the best construction, and as the result of several years' work with German machines, with coal evaporating 6lb. of water per lb. of fuel, it has been found that in a 24-ton machine 1 ton of coal will make 14 tons of ice, and in a larger machine—viz., a 48-ton capacity—1 ton of coal will produce nearly 16 tons of ice, including the pumping of water and driving all shafting.

The report on one of these machines, published by the Polytechnic Institution of Civil Engineers in Munich, stated 26lb. of ice produced per lb. of fuel, but this is a result which could not be sustained in practice without the condenser and refrigerator surfaces were considerably extended, and then that again would add to the cost of the plant.

After the working of this plant as a refrigerator for the cooling of oils and gas in my patented process, by the circulation of cold brine for many months, the low price of benzol compelled me to close the carbonising process in May last, and during last summer and autumn I manufactured ice and supplied Sheffield and the surrounding towns with it. Water identical with the Sheffield water supply was placed in moulds 6½in. square and about 3ft. long or deep, these blocks when frozen weighing about half-a-hundredweight. Keeping the brine at —8° C. and in good circulation these moulds would freeze solid in 8 hours, but with deficient circulation and the brine entering at —16° C. and leaving at —2° C. they would take 24 hours, thus in ice making it is clearly shown that T*h* and T*l* must approach each other very closely and a large volume circulated.

The ice produced by the process of freezing still water is opaque owing to the air enclosed in it; a bubble of air (or thousands of bubbles) is mechanically squeezed out near the side of the mould, and it attaches itself to the advancing ice in such a manner as to leave a capillary tube running from the outside to the very core of the mould.

When selling the half cwt. blocks we had many complaints of their melting too rapidly, and as this was I thought due to the smallness of their size, I arranged moulds to hold one cwt. 13in. by 6½in. by about 3ft. deep. I expected these to freeze in the same time as the 6½ square blocks, but in this I was wonderfully deceived. My notion was that the heat (or cold) would only have to strike across 3¼in. in each case, the line of least resistance so to speak, but in actual practice these moulds took half as long again to freeze. Hotels and fishmongers still complained of this opaque ice, though we were enterprising enough to secure their custom by freezing lobsters, salmon, etc., etc., in the centre of blocks for them The elimination of the air is not an easy problem in an improvised plant like ours; it is easily done by agitation during freezing, but with us that was hardly possible. Eventually I made the two kinds, clear and opaque, the former by inserting a small tube down the centre of each mould and by connecting it with an air compressor, which kept a small stream of air bubbling through.

The question of the rapidity of melting was an important one, and after much investigation I have come to the conclusion that in air melting, the opacity has very little to do with it. I have on several occasions exposed one cwt. blocks of clear ice (made by blowing air through it while freezing), opaque ice (made by freezing still water) and Wenham Lake ice, both out of doors and under cover, and in all cases the last few ounces were all on the plank together, but two half cwt. blocks will disappear long before a single cwt. In fact the single cwts. disappeared in 42 hours, the half cwts. in 22 hours.

When immersed in water, opaque ice will melt much sooner than clear ice, but of course it does more cooling work, and if water is to be cooled by running it through blocks of ice in a tank, as is done in some breweries, it should be run much quicker through opaque ice than through clear. But refrigeration by means of solid ice is much more costly than by means of a refrigerating machine, as a machine, when taxed to its utmost to produce six tons of ice daily, will do cooling equal to 10 tons of ice.

Another interesting fact forced itself upon my attention during the manufacture of ice, and that was that in freezing, the soluble constituents of the water were gradually forced into the centre of the mould, so that when the last quart of water remaining unfrozen was poured out, this would contain the whole, or nearly so, of the soluble impurities.

The water used for ice-making contained 8·2 grains of total solid matter per gallon, a piece of the clear ice melted contained 1·2 grains per gallon of total solids, while the residual unfrozen water in the centre of the moulds contained 264 grains per gallon.

As to the cost of making ice and delivering it to customers much may be said. One reads in print very often that by such and such a machine ice can be made at 5s. or even 3s. 9d. per ton. I will not ask you to doubt such statements, but I will say, do not build up too many hopes upon them. Ice is not like cast iron, and if you wish to store it you must have some very expensive buildings. About seven per cent. of the make will be lost in storing; if you deliver it to customers in two ton lots and are at a distance from them, the loss will be 10 per cent.; while if a retail trade is done, the loss will be 33 per cent. at least. I have come to the conclusion that without the machine is a very large one, and worked to its full capacity, ice cannot be sold wholesale under £1 per ton to leave a profit, if it has to be delivered to customers.

With refrigeration merely it is different, and I have little doubt but that cooling could be done for 5s. per ton of ice equivalent, on a six ton machine, and therefore I am surprised this system has not found its way much more into chemical manufacturing than it has at present in England.

On the Continent the aniline-colour works use very large machines, some of which I saw when amongst them in March last. They are used in the manufacture of sulphuric acid, carbolic acid, chlorate of soda, in the manufacture of best sugar by the strontium process, in distilleries, in stearine works, chocolate manufacture, dairies and in candle works. It is a matter of very simple calculation whether water cooling or refrigeration is most effective, and it very often happens that a sufficiently low temperature cannot be reached by simple water cooling, especially in summer.

DISCUSSION.

The CHAIRMAN, after thanking Mr. Davis for his interesting paper, regretted that he had entirely omitted to refer to Pictet's latest machine, and "Pictet's Fluid," when comparing critically the various systems applied to the manufacture of artificial cold. Mr. Levinstein's experience with a Linde ice machine, which extended over five years, led him to substantially confirm Mr. Davis's statements with regard to its general efficiency. The fact, however, must not be overlooked that such a machine was very costly, and it therefore became a very serious matter to those who wished to put an ice machine down what system ought to be adopted, and he was not at all prepared to say that Linde's machine was still the best, or superior to all other machines. One ought not rashly to jump to conclusions without accurate knowledge of all the other systems, and if he had to put another ice machine down he would certainly very carefully examine Pictet's latest machine, which appeared to him to possess in some respects advantages over Linde's machine. As far as he was informed, the Pure Ice Company, in Liverpool, and also the Glaciarum, in Southport, had recently altered their machines according to Pictet's latest improvements, and these were also working satisfactorily with Pictet's Fluid. He only mentioned these facts in order to show that Pictet's Fluid was already successfully used in their neighbourhood by artificial ice manufacturers, and he thought that it would have been very interesting to have heard Mr. Davis's opinion about Pictet's latest machine, and also about Pictet's Fluid. This "fluid" possessed very singular properties. Its vapour tension considerably deviated from what might have been theoretically expected. It was produced by compressing a mixture of carbon dioxide and sulphur dioxide. As promised, he now appended a table showing the comparative vapour tension at various temperatures of sulphur dioxide, of the vapour tension, both actual and calculated, of Pictet's Fluid, and also of that of ammonia :—

Centigrade.	Pressure in Atmospheres.			Ammonia.
	Sulphurous Acid.	Pictet's Fluid calculated.	Pictet's Fluid actual.	
−30°	0·76	0·77	0·77	1·14
−25	0·55	0·91	0·89	1·15
−20	0·61	1·28	0·98	1·83
−15	0·76	1·59	1·18	2·28
−10	1·00	1·97	1·31	2·82
− 5	1·25	2·41	1·60	3·45
+ 0	1·51	2·93	1·83	4·19
+ 5	1·90	3·50	2·20	5·00
+10	2·35	4·21	2·55	6·02
+15	2·78	4·98	2·98	7·12
+20	3·30	5·88	3·40	8·40
+25	3·80	6·86	3·92	9·80
+30	4·60	8·00	4·15	11·11
+35	5·30	9·15	5·05	13·08
+40	6·20	10·10	5·72	15·29
+45	7·20	12·16	6·30	17·38
+50	8·30	13·98	6·86	19·98

The vapour tension, therefore, of Pictet's Fluid was comparatively high at low temperatures and comparatively low at high temperatures, which property was a desideratum in cold-producing agents. Pictet's Fluid was stated to possess fifty per cent. more effective power than pure sulphur dioxide.*

Mr. **Thomson** thought that Mr. Davis had not given sufficient prominence to the conditions under which different ice-making machines were tested. Much would depend upon the temperature of the air and water at the time the experiment was made as to what quantity any ice machine would produce per ton of coal consumed. Some ten years ago he suggested to Mr. Gamgee the use of anhydrous ammonia instead of sulphur dioxide for use in the Pictet machine, and he aided him in making an experiment with it, which had proved very successful; he understood, moreover, that Mr. Pictet afterwards patented the use of anhydrous ammonia to be used instead of sulphur dioxide. What he (Mr. Thomson) feared most, then, was that any escape of ammonia might prove serious to workmen from its powerful pungency, but to his surprise he found that having robbed ordinary aqueous ammonia of its water, the anhydrous substance no longer possessed very pungent qualities, and he found under such conditions it could be inspired in considerable quantity with comparative comfort. He did not remember to have seen any record of this property of anhydrous ammonia. The exceedingly pungent properties were again produced by passing the anhydrous gas into a little water, and thus thoroughly saturating it. Perhaps Mr. Davis had observed this, or could throw some light upon it? This might explain to some extent why very little smell of ammonia is detected from leakages in working the Linde machine. Another point raised in the paper was the action of ammonia on iron. Could Mr. Davis give any explanation of the way in which ammonia acted on iron? One could understand that ammonia in gas works, which contained ammonium sulphide, might corrode iron, from the action of the sulphur, but it was more difficult to comprehend what could be the action of aqueous ammonia on it. Again, Mr. Davis mentioned that sulphur dioxide acted on iron, whilst copper was not acted on by it. He remembered about ten years ago speaking to Mr. Pictet on this matter, and he was informed by him that the sulphur dioxide had no action whatever on iron, and the pumping cylinders and pistons of his machine were then made of iron or steel; perhaps Mr. Pictet had changed his mind on this point since then, and probably Mr. Davis could give some explanation as to this point, and why sulphur dioxide should act on iron and not on copper? because it was evident that if the action were due to the dioxide becoming converted into sulphuric acid, that acid one would assume would attack copper as well as iron.

Mr. **Irwin** inquired if Mr. Davis had calculated the amount of coal required to refrigerate a ton of water at 0° C.; also what would be the cost of the plant required to produce ten tons of ice weekly?

Mr. **Davis**, in reply, said that in his paper he had dealt with his experiences and convictions only, and had personally no experience with the new "Pictet liquid." In fact, he had purposely refrained from mentioning this liquid, as he was aware that a warm controversy was proceeding abroad between the Linde and the Pictet companies. In reply to Mr. Thomson, the formula given in the early part of the paper would fully explain the amounts of ice produced under varying temperatures, the temperature of the ambient air having but little to do with it. The temperature of the cooling water determined the working pressure and the pressure the steam engine had to overcome. He could not say theoretically what the reaction was between ammonia and wrought iron, but it only occurred at high temperatures in presence of steam. With regard to the action of sulphurous acid on iron, he had not studied that either, as all the sulphurous acid machines that he had seen were constructed of copper. The loss of seven per cent. of ice in storage was in storing and selling nearly as made; the sale of ice was not a regular trade, some days more could be sold than made, and on others more was made than could be sold, and the loss of seven per cent. occurred in restoring an equilibrium. In reply to Mr. Irwin, he had not calculated the coal required for a ton of ice, for the simple reason that it varied so much under different conditions, but in reply to his other question, he might say that the plant required for refrigerating ten tons of water to 0° C. daily would cost about £1000.

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* See Compt. Rend. 100, 329.

Newcastle Section.

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Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held Wednesday, March 9, in the College of Science.

PROFESSOR BEDSON IN THE CHAIR.

ON NEW OR PERFECTED METHODS FOR THE DETECTION AND ESTIMATION OF ORGANIC BODIES, BASED UPON THEIR OXIDATION BY POTASSIUM PERMANGANATE.

BY JOHN HENRY SMITH, PH.D. (ZURICH),
Associate of the Royal College of Science, Dublin.

PART II.

Oxidation by MnO_2 in Acid Solution.

In the first part of this paper, it has been shown (Exp. 67) that no loss of oxygen occurs from the action of dilute sulphuric acid upon manganese dioxide, so long as no free permanganate is present. This observation, in conjunction with the fact to which we have called attention, that $KMnO_4$ can be reduced completely to MnO_2 by means of a manganous salt, renders the establishment of a method of oxidation by means of the dioxide a matter of comparative ease. We have seen (Exp. 2) that it is possible to reduce $KMnO_4$ to MnO_2 in a neutral solution, by using only the theoretical quantity of $MnSO_4$ to satisfy the equation—$K_2Mn_2O_8 + 3MnSO_4 + 2H_2O = 5MnO_2 + K_2SO_4 + 2H_2SO_4$. As the solution requires to be heated a considerable time before complete reduction is effected, and as the presence of a small excess of $MnSO_4$ is no detriment, it is preferable to effect the reduction at once with excess of $MnSO_4$. I find that an excess of 10cc. $n MnSO_4$ solution (*i.e.*, the theoretical amount required to precipitate 10cc. $n KMnO_4$) is ample to reduce the last trace of permanganate, with a couple of minutes' heating on the water-bath. A larger excess should be avoided, if a subsequent oxidation of the filtrate by $KMnO^4$ be contemplated, because whatever excess is left will appropriate its own equivalent of permanganate, which latter would consequently be unavailable for the further oxidation of the organic body.*

I find a solution of manganous sulphate, twice the normal strength, as defined above, to be most generally useful. It is made by dissolving 16·2grms. of the anhydrous salt in distilled water, and making up to 1 litre. The composition of the $MnSO_4$ employed must be carefully determined, as the salt crystallises with different amounts of water. That which I used was in the state of powder, and corresponded to the formula, $MnSO_4.H_2O$. To 50cc. $2 n KMnO_4$, contained in a 500cc. flask, 55cc. of the above solution are added. After heating for a minute or two on the water-bath, aided by gentle agitation, the solution will be found to be colourless. 10cc. $5 n H_2SO_4$ are then added, together with 50cc. *n*-organic solution, and the bulk made up to 250cc. The flask is then placed over a Bunsen burner, and the contents boiled gently for half-an-hour, the flame being increased towards the end of that time. The finely-divided MnO_2 becomes thus perfectly disseminated throughout the liquid, leaving nothing more to be desired in the matter of circulation. Although I have been able to oxidise oxalic acid completely on the water-bath, without any endeavour to promote circulation of the MnO_2; in the case of bodies more difficultly oxidisable, the full action of the dioxide is not experienced, unless means to promote the circulation of the precipitate be employed. I have ascertained that there is no loss of oxygen from the action of acid of this concentration upon the MnO_2, when the solution is maintained at actual ebullition. In a direct experiment (199), in which the solution was boiled briskly for half-an-hour, a loss of only 0·1cc. $n KMnO_4$ was observed, a quantity which comes within the ordinary errors of experiment.

After boiling, the solution is diluted considerably and filtered, and the precipitate washed with warm distilled water. It is advisable to wash the filter before use with a small quantity of hot dilute sulphuric acid. It is not necessary to wash the precipitate more than twice. If the washing be continued longer, or the wash water be too hot, a portion of the MnO_2 will be dissolved, rendering the experiment useless. Should a protracted washing be essential, then the wash water employed must be acidified.

After washing, the precipitate is washed down into the flask which it originally occupied, and dissolved, together with any MnO_2 adhering to the filter, in standard $FeSO_4$ solution, the excess of the latter being determined by titrating back with $KMnO_4$. A normal solution of $FeSO_4$, containing the equivalent of twice normal free H_2SO_4, I find very convenient for dissolving this precipitate, as well as for general purposes. The value of the precipitate, obtained in terms of $KMnO_4$, deducted from the original $KMnO_4$ added, gives the equivalent of MnO_2 reduced by the organic body under investigation.

In experiments with oxalic acid, both heated on the water-bath and boiled over a Bunsen burner, the filtrates failed to produce a further reduction of $KMnO_4$, and in the case of the latter (200) the MnO_2 reduced corresponded exactly to the complete oxidation of the acid.

After I have subjected a sufficient number of exemplary bodies to a thorough investigation, by means of this and the other processes which I have devised, I intend to tabulate the whole of the results and bring them before the notice of this Society; and I anticipate we will be able to recognise certain relationships existing between the constitution of those bodies and their susceptibility to oxidation by $KMnO_4$ and MnO_2 under varying standard conditions.

With regard to the filtrate, it may be further subjected to oxidation by $KMnO_4$. It is advisable to employ 75cc. $2n KMnO_4$ for this purpose, making up to 750cc., and giving one hour's heating. Before adding the $FePO_4$ solution, the filtrate should be neutralised with 10cc. $5n NaHO$. In all probability, the $KMnO_4$ reduced by the filtrate

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* On the whole, it is preferable to get rid of the excess of $MnSO_4$ and free acid by filtration.

would correspond to the difference between the total amount reduced by the body, and the amount equivalent to the MnO_2 reduced. It is of course possible that a very volatile body might be formed by the oxidation with MnO_2, or a body incapable of oxidation by $KMnO_4$, but not itself produced by direct oxidation with permanganate. I should consider that these cases, and more especially the latter, would very rarely occur. In any case such an irregularity could be easily detected by the oxidation of the filtrate.

OXIDATION BY $KMnO_4$ IN ALKALINE SOLUTIONS.

Great difficulty was experienced in working out a method adapted to the estimation of the amount of permanganate reduced by organic bodies in alkaline solution. The method which most naturally suggested itself—*i.e.*, of adding excess of acidified $FeSO_4$ after the oxidation is complete, and titrating back with $KMnO_4$—is altogether unreliable. Even could further oxidation during the mixing of the liquids be prevented by adding the alkaline solution *very slowly* into a *large excess* of strongly acidified $FeSO_4$, there is still the probability of too great a quantity of $KMnO_4$ being absorbed in titrating back (even should the solution be quite cold during titration) on account of the large quantity of $MnSO_4$ present in the solution, which we found to be a great accelerator of the speed of oxidation in direct titrations. This source of error becomes all the more serious when we consider that oxalic acid, which we know to be a very frequent product of oxidation in alkaline solutions, is one of the organic bodies most easy of oxidation by $KMnO_4$ in acid solution. I considered, therefore, that the most certain test of the accuracy of such a method as I was hoping to establish, would be that it should indicate no reduction of permanganate with pure oxalic acid. Bertholet* states that oxalic acid is oxidised slowly to CO_2 and H_2O in alkaline solutions; but, as we shall see later on, this is not the case, at least not to any appreciable extent.

In order to determine whether any loss of oxygen occurs when $KMnO_4$ is heated in alkaline solution, as maintained by Jones,† the following experiments were made:—To 50cc. $nKMnO_4$, 50cc. n-alkali were added, the bulk made up to 250 with distilled water, and heated on the water-bath. After heating, excess of standard $FeSO_4$ was added, and the excess titrated back with $KMnO_4$. The results are given below:—

No. of Experiment—	201	202	203	204	205
Alkali added	KHO	K_2CO_3	KHO	K_2CO_3	$KHCO_3$
Length of heating	½hr.	¾hr.	3hrs.	3hrs.	3hrs.
Loss = cc. $nKMnO_4$ ..	0·3	0·9	0·1	0·9	0·2

These experiments show that the alkalis contained impurity oxidisable by $KMnO_4$; but no loss of oxygen occurs, since after three hours' heating practically no greater loss is experienced than after only half or three-quarters of an hour's heating. To confirm the presence of these impurities, 50cc. of the normal alkalis were acidified and titrated directly with $KMnO_4$ at a temperature approaching ebullition; while to other equal quantities excess of H_2SO_4 (free from oxidisable impurity) was added, together with 50cc. $nKMnO_4$, and the solution, made up to 250cc., heated for three hours on the water-bath. The following results were obtained:—

No. of Experiment—	206	207	208	209	210
Alkali added	KHO	KHO	K_2CO_3	K_2CO_3	$KHCO_3$
cc. nH_2SO_4 added	100	100	100	100	100
cc. $nKMnO_4$ lost......	0	0·25	0·2	0·25	0
	cold	boiling	cold	boiling	boiling

Direct titrations.

No. of Experiment—	211	212	213	214
Alkali added	none	KHO	K_2CO_3	$KHCO_3$
cc. nH_2SO_4 added	50	100	100	100
cc. $nKMnO_4$ lost......	0·7	1·25	1·65	0·8
cc. $nKMnO_4$ lost, after deducting result of 211	—	0·55	0·95	0·1

Here it is seen we have sufficient impurity in the alkalis to account for the loss we had observed. As the impurity is only partially and difficultly oxidised in direct titration, it is probably of organic nature, and oxidised to oxalic acid by permanganate in alkaline solutions, since the numbers obtained in these solutions (Experiments 203 and 204) agree very closely with the above. It is evident, therefore, that unless the impurity in the alkalis be estimated and allowed for, serious errors might be introduced; but none need be feared from actual evolution of oxygen in alkaline solutions under the conditions existing. Other samples of alkalis gave the following results:—

No. of Experiment—	215	216	217	218	219
Alkali used	NaHO	K_2CO_3	$KHCO_3$	NaHO	NaHO
cc. nH_2SO_4 added	125	125	125	none	$MnSO_4$ added
cc. $nKMnO_4$ lost after deducting error	0·1	0·2	0·5	0·1	0·1

Considerable difference exists, therefore, in the oxidisable impurity of different samples of alkali. It is probable that the sodium alkalis will be more generally pure in this respect than those of potassium. In Experiment 218 the solution was boiled briskly for half-an-hour with 50cc. $nKMnO_4$, but still no greater loss was experienced than that due to the impurity in the NaHO. The same result was yielded in Experiment 219, in which one-half of the $KMnO_4$ had been precipitated as MnO_2 by $MnSO_4$ before heating. There is no loss, therefore, from the mutual action of MnO_2 and $KMnO_4$ in alkaline solutions, as there is in acid ones.

The next method which suggested itself for the estimation of the oxidation occurring in alkaline solutions, was to filter the solution through asbestos or glass-wool after the oxidation was complete, and determine the amount of MnO_2 remaining on the filter after washing the same. The following experiments were, therefore, instituted with the double object of testing this method and of ascertaining the possibility of utilising the same for the estimation of manganous salts. A solution of manganous sulphate, whose strength had been accurately determined, or one formed by the exact titration of acidified oxalic acid, was added to a warm solution of $KMnO_4$,

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* Jahresb. 1867, p. 331.

† J. Chem. Soc., 1878, p. 95.

previously made sufficiently alkaline with NaHO that after mixing 20cc. n-alkali would remain free. After heating on the water-bath the bulk was made up to 500cc., and the remaining $KMnO_4$ determined in an aliquot part of the filtrate. The MnO_2 on the filter after washing was also estimated as a check. The solution was filtered through glass-wool free from oxidisable impurity. The following are the results :—

No. of Experiment—	220	221	222
cc. $nKMnO_4$ employed	100	200	100
Addition	Titrated Oxalic Acid	$MnSO_4$	$MnSO_4$
Time of heating	½hr.	½hr.	½hr.
cc. $nKMnO_4$ theoretically reduced	16·55	22·25	22·25
cc. $nKMnO_4$ actually reduced	18·1	27·25	25·75
% $MnSO_4$ indicated	109·3	122·5	115·7

We learn from these experiments that the amount of $KMnO_4$ retained by the precipitate after washing is so large as to render such a method quite impossible. As no loss of oxygen occurs, it is difficult to account for the precipitate containing so much more available oxygen than the calculated quantity. It may be that the $KMnO_4$ is mechanically held by the precipitate, or, I think it is more likely, that in an alkaline solution in presence of pre-existing MnO_2, $KMnO_4$ is further reduced to the same form, as it is in acid solution, but that the liberated oxygen, instead of being lost, forms some peroxide, which remains in solution. The following facts may be taken in support of this view :— An acid solution of $KMnO_4$ may be boiled over a naked flame without the slightest inconvenience. An acid solution containing precipitated MnO_2, but no free $KMnO_4$, may likewise be boiled with impunity ; but an acid solution containing both $KMnO_4$ and MnO_2 cannot be so boiled, or even on the sand-bath, without causing severe concussions of the liquid. In a similar manner $KMnO_4$ and MnO_2 may be boiled separately in an alkaline solution with perfect safety ; but if *both* be present the same concussions are produced. Now, I have referred in the first part of this paper to the chemical action which takes place in acid solution, in virtue of which oxygen is liberated and $KMnO_4$ reduced to MnO_2. Is it not exceedingly probable that this action is the cause of the incontrollable behaviour of the solution in *both* acid and alkaline solutions, but that in the latter oxygen, in place of being evolved, remains in solution as a peroxide ?

This filtration method having failed, it occurred to me to precipitate the whole of the free $KMnO_4$ remaining after the oxidation was complete by $MnSO_4$, to filter the alkaline solution, and, after washing the precipitate, to dissolve it in $FeSO_4$ and titrate back with $KMnO_4$. The difference between the amount of $KMnO_4$ equivalent to the precipitate and that originally added would, of course, be a measure of the oxygen obsorbed by the body under investigation.

With regard to the filtering medium, I was very anxious to dispense with the use of asbestos and glass-wool, chiefly on account of the long time taken up by the process when these bodies are used. The filtration through paper is, on the other hand, very rapid and very suitable for the purpose, more especially as the precipitate always contains a certain amount of MnO, which is liable to oxidation. The following experiments with various filters are interesting, as showing the effect of $KMnO_4$ and of the alkalis upon filtering paper and the conditions under which it may be used for filtration. In the first six experiments the solution employed contained 50cc. $nKMnO_4$, either neutral or with 50cc. nH_2SO_4 or KHO added. The total bulk was 250cc. in each case, and the solution was either filtered through cold, or heated for half-an-hour on the water-bath with a 7½-in. English filter. The results, which are only roughly comparative (as no Fe_23SO_4 or phosphate was present in the acid solution ; and the other solutions were treated with excess $FeSO_4$ immediately after oxidation), are here given :—

No. of Experiment—	223	224	225	226	227	228
State of solution	Acid	Alk.	Neut.	Acid	Alk.	Neut.
How applied	Passed through cold			Treated on water-bath		
cc. $nKMnO_4$ absorbed	1·55	5·25	0 5	32·75	43·75	17·75

In Experiments 226 and 227 we see that the reduction to MnO_2 has been complete. The largely-increased oxidation in alkaline solution should be noted, it being due, of course, to the solvent action of the alkali upon the material of the filter.

To determine the action of the alkalis alone upon the filters, the following series of experiments was undertaken. In each case the solution, made up to about 300cc., was filtered four or five times at a temperature of 80° to 90° C. through a 7½-in. English filter. The solutions were then acidified, and the organic matter dissolved, either wholly oxidised by excess of $KMnO_4$ in the usual manner, or merely titrated directly at boiling temperature :—

No. of Experiment—	229	230	231
cc. n-Alkali employed	100KHO	$100K_2CO_3$	$100KHCO_3$
How estimated	With excess $KMnO_4$		
cc. $nKMnO_4$ absorbed, after deducting impurity	3·4	2·0	1·1

No. of Experiment—	232	233	234
cc. n-Alkali employed	50KHO	$50K_2CO_3$	$50KHCO_3$
How estimated	By direct titration		
cc. $nKMnO_4$ absorbed, after deducting impurity	0·1	0·15	0·1

The above experiments show that the filtrates might be utilised, in the method contemplated, for direct titration without any serious error arising, but the error is too great to allow of their being subjected to complete oxidation with excess of $KMnO_4$. As might be expected, the solvent action is greatest in the case of KHO, and least in the case of KHCO .

The next series shows the influence of various qualities of filters. 100cc. nNaHO were employed, and passed two or three times through the filter at a temperature near boiling point. After the treatment the solution was rendered acid, and the $FePO_4$ solution added with the $KMnO_4$ as usual. The bulk was made up to 250cc., and heated half-an-hour. The filters were all 5½in. in diameter. The last three experiments show the effect of a second, but exactly similar, treatment of the same filters.

No. of Experiment—	235	236	237
Quality of Filter	English	Swedish	Schleicher's Washed
cc. $nKMnO_4$ absorbed by organic matter dissolved....	2·0	1·2	2·5

No. of Experiment—	238	239	240
Quality of Filter	English	Swedish	Schleicher's Washed
cc. $nKMnO_4$ absorbed by organic matter dissolved....	0·1	0	0·5

These experiments show us that the filtrates in the method under consideration might be made available for subsequent oxidation in acid solution with excess of $KMnO_4$, when paper filters are employed which have received a preliminary washing with boiling normal alkali. The second treatment with boiling normal alkali, which was given in the above experiments, is really a much more severe test than they would be required to stand in practice, as the solution would be much more dilute and not quite so hot. At the same time, it is much preferable to employ the cheaper filters, more especially as they are really superior for this purpose.

Of course, it will be understood that the action of the alkali upon the filter does not absolutely stop after this preliminary treatment, but that the superficial or more easily oxidisable portions of the filter are withdrawn by the process. The following experiment (241) will show that the solution of the filter by the alkali is a continual process. Six of Schleicher's washed filters, 5½in. diameter, were boiled with 100cc. nNaHO for half-an-hour. The solution was then neutralised and filtered, and excess of $KMnO_4$, together with 20cc. of the acidified $FePO_4$ solution added. The solution was then heated for one hour. 128·8cc. $nKMnO_4$ had been absorbed by the solution. After treating the same filters, previously well washed, a second time in exactly the same manner, 129·4cc. $KMnO_4$ were required by the solution. After a third treatment 72cc. $nKMnO_4$ were absorbed. It is instructive to note that oxalic acid could only have formed a small portion of the dissolved organic matter, because the last solution obtained only absorbed 12cc. $nKMnO_4$ by direct titration in a hot acid solution—*i.e.*, only one-sixth of the total $KMnO_4$ required.

From Experiments 12 to 16 we learned that MnO is continually oxidised to MnO_2 by atmospheric oxygen. The oxidation naturally diminishes in intensity as the amount of the lower oxide decreases and that of the higher oxide increases. The error introduced by this oxidation is very small, if only the least possible excess of $MnSO_4$ to precipitate the whole of the free $KMnO_4$ be added, and the filtration be executed as rapidly as practicable; but I was anxious to check this oxidation altogether if possible. Although I was not successful in achieving this object, a short account of my experiments in this direction may save others the trouble of going over the same ground again.

The general conditions of working were as follows:—To 50cc. $nKMnO_4$ 50cc. n-alkali were added. The total bulk was made up to 250cc., and the solution heated for half-an-hour on the water-bath. In order to magnify the error arising from the oxidation of the atmosphere, the $MnSO_4$ solution was added in much larger quantity (50% excess) than that actually required for precipitation of the $KMnO_4$. The solution, after being well shaken, became colourless almost immediately. It was then filtered, and the precipitate washed as rapidly as possible. The funnel was then transferred to the flask in which the precipitate had been formed, and the latter washed down into the flask with hot water. The precipitate, and any MnO_2 adhering to the filter, were then dissolved in excess of strongly acidified normal $FeSO_4$ solution, and the excess titrated back with $KMnO_4$ in the usual manner. When oxalic acid was added in the experiment, the filtrate was also estimated by direct titration, after acidifying with H_2SO_4. As a rule, parallel experiments were made with all three forms of alkali—viz., caustic, carbonate, and acid carbonate, in order to find which was the most preferable to employ. The filtration proceeded very rapidly through English filtering paper, and one's whole time was employed in attending to the filtering entailed by three parallel experiments. In the following tables some average results of these experiments are given:—

No. of Experiment.	Alkali added.	cc. $nKMnO_4$ equivalent to O gained.	REMARKS.
212	KHO	1·65	
213	Do. (10cc. n)	1·85	No decreased oxidation with less alkali.
214	KHO	1·0	Added dilute H_2SO_4 to the precipitate on filter as soon as solution had passed through.
215	K_2CO_3	0·8	Less oxidation than with KHO.
216	,,	0·7	Washed precipitate with dilute H_2SO_4 on filter.
247	$KHCO_3$	0·4	Less oxidation than with K_2CO_3.
248	,,	0	Washed precipitate with dilute H_2SO_4
249	,,	0	50cc. n-oxalic acid added; washed with acid; filtrate had lost 3·3cc. n-oxalic acid.
250	$NaHCO_3$	0·1	Similar to 248; washed with acid.
251	,,	0	Oxalic acid added; 3·3 cc. deficient in filtrate; washed precipitate with acid.

As might have been expected, the addition of acid to the precipitate checks the atmospheric oxidation to some extent. It is very doubtful, however, if such a course could be adopted in practice. The only advantage which could be gained by its employment would be in the case of the addition of the acid before the precipitate had been thoroughly washed, and under such conditions the probability is that even with cold acid the organic body under investigation would be oxidised by the MnO_2 in contact with it. Experiments 249 and 251 confirm this view in the case of oxalic acid.

The very slight atmospheric oxidation with the acid carbonate should be noted. The difference in the behaviour of the three alkalis was rendered visible by precipitating simultaneously equal volumes of manganous sulphate solution with equivalent quantities of KHO, K_2CO_3, and $NaHCO_3$ respectively. The first two precipitates turned brown almost immediately, while the last (doubtless a bicarbonate of manganese) remained perfectly white after being exposed to the atmosphere a whole day. That the oxidation is much more active in the case of the caustic alkali than with the carbonate, was shown by the precipitate with the former finally turning black, while that with the latter remained brown in colour.

In experiments with caustic alkali, in which variations were made in the order in which the solutions were mixed, it was found that the gain from atmospheric oxidation was much less when the alkali was added *after* mixing the $KMnO_4$ and $MnSO_4$. This was no doubt due to the formation of a large bulk of MnO_2 in the first instance, while in the presence of alkali a large quantity of MnO would be naturally formed initially, which would be subjected to partial oxidation by the atmosphere before being completely oxidised by the $KMnO_4$ present. As a matter of fact, hardly any less gain was experienced when the $MnSO_4$ was precipitated with KHO, and *then* $KMnO_4$ added, than when sulphate was added to the *alkaline* permanganate. Although $MnSO_4$ must be the final addition in practice, we may infer that an advantage would be experienced by adding it *slowly*, and I find in practice that less of the solution is required when this precaution is attended to.

In the next series of experiments 50cc. *n*-oxalic acid were employed. The first four were precipitated with 50 per cent. excess $MnSO_4$, after heating a quarter of an hour only, while the last four were heated for four and a-half hours, and precipitated with the least possible amount of $MnSO_4$ solution.

No. of Experiment.	Alkali employed.	cc. $nKMnO_4$ = Oxalate deficient in Filtrate.	cc. $nKMnO_4$ = Actual Gain or Loss of O.	REMARKS.
252	KHO	0·1	2·1 gain	Oxalate nearly completely washed out.
253	K_2CO_3	0·4	1·0 ,,	Oxalate not so completely washed out.
254	$KHCO_3$	3·4	0·1 ,,	Large deficiency of oxalate in filtrate.
255	Ditto 33cc. *n*	5·4	0·2 loss	Still larger ditto.
256	KHO	0·4	0·3 gain	Much less atmospheric oxidation than 252 with more $MnSO_4$ added.
257	K_2CO_3	1·2	0·1 loss	Greater deficiency of oxalate than 253.
258	$KHCO_3$	3·65	0·35 ,,	No more oxalate deficient than with only quarter of an hour's heating.
259	Ditto 33cc. *n*	5·25	0·3 ,,	

These experiments are a further confirmation of the less liability of the precipitate in acid carbonate solution to oxidation. The beneficial influence of adding only sufficient $MnSO_4$ to effect the precipitation is very marked in Experiments 256 and 257. In the case of the carbonates, we find there is a great tendency to the precipitation of the oxalate. That this is a *mere precipitation*, and not an actual oxidation of the oxalate, may be inferred from the experiments with bicarbonate: after four and a half hours' heating we find there is no greater deficiency in the filtrate than after only a quarter of an hour's heating.

It is worthy of remark that the precipitation seems to occur during heating, and is apparently accompanied by MnO_2, without any loss of oxygen, however. Additional evidence is here presented by the experiments with the long heating, that no absolute evolution of oxygen takes place—at least, not with KHO or K_2CO_3.

As the bicarbonate precipitate is practically not oxidised by the atmosphere, it seemed advisable to endeavour to render this alkali available by adopting means to remove the oxalate adhering to the precipitate. The next experiments were made in this direction; 50 per cent. excess $MnSO_4$ solution being added as before. The following table exhibits the average results obtained:—

No. of Experiment.	Length of heating.	cc. $nKMnO_4$ = Oxalate deficient in Filtrate after— 1st Washing.	cc. $nKMnO_4$ = Oxalate deficient in Filtrate after— 2nd Washing.	Total Gain or Loss of Oxygen.	REMARKS. Second Washing of Precipitates with—
260	½hr.	4·6	3·1	0·2 gain	Strongly ammoniacal solution of $(NH_4)_2SO_4$.
261	,,	4·3	3·5	0·3 loss	Strong solution of NH_4Cl.
262	,,	4·1	2·8	0·1 gain	Strong solution of ammonium carbonate.
263	,,	1·1	3·6	0	Hot normal acetic acid.
264	¾hr.	3·4	2·1	0·5 gain	Ammonia water.
265	,,	2·0	2·0	1·4 ,,	Added 25cc. strong NH_4HO before filtering, and washed with ammonia water.
266	,,	2·4	—	1·25 ,,	Added 50cc. nNH_4HO after precipitation, but before filtering.
267	½hr.	4·5	—	0·5 ,,	Gave ½hr. extra heating with 200cc. nNH_4Cl.
268	,,	1·75	—	0·7 ,,	After precipitation added — 400cc. nNH_4HO + 400cc. $n(NH_4)_2SO_4$
269	,,	1·95	—	0·2 ,,	400cc. nNH_4HO + 400cc. nNH_4Cl.
270	,,	4·15	—	0·05 loss	Washed with hot nH_2SO_4 on filter.
271	,,	2·3	—	0·5 gain	Added 100 nNH_4HO + 10grms. NH_4Cl, before the $MnSO_4$.
272	,,	2·1	—	0·2 loss	Immediately after heating, added more than sufficient Na_2HPO_4 to precipitate excess $MnSO_4$.
273	,,	0	—	0·2 ,,	Like 272, but no oxalate present.
274	,,	2·4	—	0·3 ,,	Like 272, but phosphate added before heating.
275	,,	0	—	0·2 ,,	Like 274, but no oxalate present.
276	,,	1·9	—	0·4 ,,	Added more than sufficient Na_2HPO_4 to precipitate all the $MnSO_4$ subsequently added.

As a general result, we learn from these experiments that a certain portion (about ½) of the precipitated oxalic acid may be washed out by solutions containing free ammonia. The advantage gained in this respect is, however, more than counterbalanced by the fact of a considerable amount of atmospheric oxygen being absorbed by the precipitate, after treatment with the ammoniacal solution. This oxidation may be readily observed by treating the white precipitate formed by the addition of excess of $KHCO_3$ to $MnSO_4$ with ammonia, when it will turn of a brown colour at once, owing to the decomposition of the acid carbonate of manganese with formation of

MnH_2O_2, which is further oxidised without delay. When accompanied by NH_4Cl, the oxidation of the precipitate is considerably checked (269), but the same result may be more easily obtained by the simple addition of sodium phosphate to the solution, preferably before the addition of $MnSO_4$ (276). In that case only about half of the oxalate which would otherwise be held by the precipitate remains fixed. The phosphate was added in the hope that the formation of the oxalate precipitate, if it consisted of MnC_2O_4, might be altogether prevented, in favour of the production of the more stable manganese phosphate.

The reason why the addition of ammonium chloride prevents the oxidation of the precipitate to a great extent is due, I think, to the formation of an oxychloride of manganese. In all cases in which the chloride was employed, I observed, on dissolving the precipitate in $FeSO_4$, a finely divided white precipitate suspended in the solution, which was quite insoluble in acid solution even on heating. No similar precipitate was obtained with $(NH_4)_2SO_4$, or any other salts made use of.

The bicarbonate having thus failed to yield satisfactory results, I was led to return to the other alkalis. The following table shows the results of my endeavours to reduce the atmospheric oxidation, which had been experienced with KHO and K_2CO_3. The heating lasted half-an-hour, other conditions being also normal :—

No. of Experiment.	Alkali employed.	cc. $n KMnO_4$ = Oxalate deficient in Filtrate.	cc. $n KMnO_4$ = Total Gain of Oxygen.	Remarks.
277	KHO	0·6	1·75	No addition.
278	,,	0·3	2·1	Added sufficient Na_2HPO_4 to precipitate all $MnSO_4$ subsequently added.
279	,,	0·5	1·8	Added 40cc. $n H_2SO_4$ and large excess of Na_2HPO_4.
280	,,	0·5	0·25	Added 20grms. NH_4Cl after the addition of $MnSO_4$.
281	K_2CO_3	0·8	0·85	No addition.
282	,,	0·6	0·4	Na_2HPO_4 added before $MnSO_4$.
283	,,	1·2	0·5	10grms. NH_4Cl added immediately after the $MnSO_4$.

It will be seen that the ammonium chloride is very effective in checking the atmospheric oxidation, both in the caustic solution and that made alkaline with K_2CO_3. It seems, however, to prevent the solution of the oxalate precipitated with the MnO_2 in the case of the carbonate (283). The addition of phosphate seems also to have a slight advantage, in reducing the atmospheric oxidation when the carbonate is employed.

I next tried the effect of rendering the solution nearly neutral, just before precipitating with $MnSO_4$; but the results were again unsatisfactory. In an experiment (284) in which acid was added to the solution after heating, sufficient to leave only 3cc. n-free alkali after the addition of $MnSO_4$, 1·0cc. of the oxalic acid was retained by the precipitate, and a gain of oxygen equivalent to 0·8cc. $n KMnO_4$ was affected by the latter. The gain of oxygen was therefore not much diminished by this means, while the amount of oxalic acid retained by the precipitate was materially increased.

In point of fact, the KHO has the same effect of preventing the precipitation of the oxalic acid which we found ammonia to possess. In the next experiments, therefore, additional alkali was added, just before precipitation by $MnSO_4$. Only *twenty-five per cent. excess* $MnSO_4$ was added, but in other respects the normal conditions obtained. The results are here tabulated—

No. of Experiment.	Alkali used.	cc. $n KMnO_4$ = Oxalate deficient in Filtrate.	cc. $n KMnO_4$ = Total Gain or Loss.	Remarks.
285	KHO	0·25	0·9 gain	One hour's heating.
286	,,	0	0·1 ,,	,, ,, ,, Sufficient $KHCO_3$ added to form completely K_2CO_3.
287	,,	0·7	0	Added 10grms. NH_4Cl after the $MnSO_4$.
288	,,	0·05	1·1 gain	Added 50cc. nKHO just before $MnSO_4$.
289	K_2CO_3	0·4	0·25 loss	No addition.
290	,,	0	0·55 gain	Added Na_2HPO_4 sufficient to precipitate all the $MnSO_4$ subsequently added.
291	,,	0·15	0·15 ,,	Added 50cc. $n K_2CO_3$ just before $MnSO_4$.
292	$KHCO_3$	2·5	(?)	No addition.
293	,,	1·1	0·35 gain	Added just sufficient KHO to form K_2CO_3.
294	,,	0·25	0·1 loss	Added double the above quantity.

The addition of extra alkali has a marked effect in dissolving out, or preventing the precipitation of the oxalic acid along with MnO_2. Even in the case of the bicarbonate (294) we find the solution is nearly complete. Experiment 286 with KHO yields the best result, since the oxidation is diminished, as well as the oxalate being perfectly dissolved. The addition of NH_4Cl obviates the former error very satisfactorily, but increases the latter. The Na_2HPO_4 seems to have the reverse action on the carbonate; in fact, it appears to produce the same effect as free caustic alkali.

A few experiments were made with borax and potassium silicate solutions, in order to find if they would be likely to give more encouraging results than the sodium phosphate. The reverse was the case. The precipitates formed by these solutions with $MnSO_4$ are decomposed by free alkali even quicker than the precipitated phosphate, and turn brown or flesh-coloured almost immediately, owing to the oxidation of the MnO_2H_2 formed.

The only remaining resource seemed to be to employ as small an excess of $MnSO_4$ as possible, and to have plenty of MnO_2 present after precipitation, in order that the manganous hydrate might be protected from the atmosphere as far as practicable. Of course the difficulty might have been overcome by the use of elaborate and expensive apparatus, for filtering in an atmosphere free from oxygen, but I was anxious to avoid such complications as much as possible.

With regard to the amount of excess of $MnSO_4$ required to be added to obtain perfect discolouration of the solution, the following numbers give fair average results, obtained by the careful addition of the manganous salt to a boiling permanganate solution. The total bulk in each case was 250cc. :—

No. of Experiment—	295	296	297	298
State of solution ..	Neutral.	50 nH_2SO_4	50 nNaHO	11 nNaHO
cc. $nKMnO_4$ employed	50	50	50	100
excess $MnSO_4$ required	1	8—10	8—10	7—8

No. of Experiment—	299	300	301	302
State of solution ..	50 nNaHO	50 nNaHO + $ZnSO_4$	50 nK_2CO_3	50 $nKHCO_3$
cc. $nKMnO_4$ employed	100	100	100	100
excess $MnSO_4$ required	8—10	8·5	7—8	7—8

We learn from these experiments that the amount of excess of $MnSO_4$ bears a general ratio to the quantity of $KMnO_4$ precipitated. In neutral solutions, as we had already found (Experiment 2), a smaller excess is required than in either acid or alkaline ones; but if sufficient alkali be added to a neutral solution to neutralise the free H_2SO_4 liberated in the precipitation, as was done in Experiment 298, then the excess demanded is not much less than in the strongly alkaline solutions. With the carbonates, the amount of excess required is also somewhat diminished. There is no advantage in the addition of $ZnSO_4$ to the alkaline solutions, because, in Experiment 300, in which $ZnSO_4$ was added equivalent to the whole of the manganese precipitated, but before the addition of $MnSO_4$, exactly the same excess was required as in a parallel experiment without the addition of the zinc salt.

In the next experiments, the $MnSO_4$ was added very gradually, and the solution was well shaken after each addition, so that the least possible quantity should be used. The amount of $KMnO_4$ was also increased from 50cc. to 100cc. normal.

No. of Experiment.	Time of heating.	Alkali employed.	cc. $nKMnO_4$= Oxalate deficient in Filtrate.	cc. $nKMnO_4$= Total Gain or Loss.	REMARKS.
303	½hr.	NaHO	0·05	0·1 loss.	Only 50 KMO_4 and 50 oxalic acid added. $KHCO_3$ added to form K_2CO_3 completely.
304	½hr.	,,	0·3	0	$KHCO_3$ added as above
305	1hr.	100 nNaHO	0·05	0	No subsequent alkali added.
306	½hr.	,,	0	0·15 gain	Washed the precipitate longer. No subsequent alkali added.
307	½hr.	K_2CO_3	2·2	0	No further alkali added.
308	½hr.	,,	0·6	0·1 loss.	50 nK_2CO_3 added after precipitation.
309	1hr.	100 nK_2CO_3	0·6	0·2 loss.	No subsequent alkali.
310	½hr.	,,	0·7	0·4 loss.	No subsequent alkaii.
311	1hr.	$KHCO_3$	1·7	0·4 gain.	100 nNaHO added after precipitation.

We note that the larger amount of $KMnO_4$ employed, causes a larger proportion of the oxalate to be held by the precipitate, which is, of course, most conspicuous in the case of the carbonates. This may be obviated, however, to some extent, by increasing the quantity of free alkali, resulting, of course, in a greater tendency to oxidation of the precipitate.

In summing up the results of these experiments in alkaline solutions, it is very evident that the caustic alkali is the best to employ for the oxidation in question. Any advantage which the acid carbonate possesses, owing to the immunity of the precipitate formed in such solutions from atmospheric oxidation during filtration, is quite counterbalanced by the fact that such precipitate retains a considerable quantity of oxalic acid; and although oxalic acid might neither be present in the original solution or formed as a product of oxidation, still it is mostly probable that other organic salts would be held by the precipitate in the same manner. That the oxalic acid may be entirely dissolved out of the precipitate is no consolation whatever, because to do this would be to destroy altogether the only advantage which the use of this form of alkali presents. I am inclined to think that the full products of oxidation in alkaline solution wonld not always be obtained in the presence of acid carbonate, as this would probably form practically a neutral solution. Any additional source of information which this might otherwise have opened up to us, is, however, sealed on account of the liberation of CO_2 in the hot solution with formation of the normal carbonate. Even with the normal carbonate we would anticipate that a different stage of oxidation would sometimes be reached from that in a caustic solution. For experimental purposes its use might therefore be of considerable value. Such a large quantity of oxalic acid as we have employed would never actually be present in the ordinary course of working; and even the error due to this source may be removed by the addition of extra carbonate.

For practical purposes, however, the caustic alkali possesses the chief advantages. Before we can decide upon the best method for its application, and the best proportions to use, it will be well to consider the general conditions obtaining in actual working. When 100cc. $nKMnO_4$ are employed, if no oxidation of the organic body takes place, it is evident that the best mode of procedure would be similar to that adopted in Experiment 305 or 306; at least if any precipitation of the organic body with the MnO_2 was feared. We find that sufficient MnO_2 is present to protect the accompanying MnO from atmospheric oxidation. If an oxidation of the organic body occurred, however, the total quantity of MnO_2 after precipitation would, of course, be less than in the former case. At the same time there would be less of the organic body, or its product of oxidation, to precipitate. If the caustic alkali were left free in this case, as in Experiments 285 and 287, a considerable gain of oxygen would be the result; but if acid carbonate be added sufficient to form the normal carbonate, as in Experiments 286 and 303, then the error resnlting is inconsiderable. The error arising from employing this method in the presence of a larger amount of both MnO_2 and of oxalate, as in 304, is still less than that resulting from the employment of free alkali only, with the smaller quantity of dioxide, as a comparison with Experiment 285 will show. The method, therefore, which seems to recommend itself for all general purposes, is to increase the amount of caustic alkali from 50 to 75cc. normal, and convert it into the normal carbonate after the completion of the oxidation. By this means the error in 304 would be reduced. Indeed, this increase in the amount of alkali has a beneficial influence in another direction, as some bodies, such as glycerol, are only difficultly oxidised to their full extent, unless a large excess of alkali be present. I have now satisfied myself that many bodies are capable of reducing $KMnO_4$ to the form of Mn_2O_6 *only* in alkaline solution, and that the oxidation of the body may be completed in the *cold*, provided sufficient $KMnO_4$ be present. To employ such a large proportion (*i.e.*, three times as much as is required with reduction to MnO_2) would be very inconvenient ; but it is not necessary, since, in a boiling solution, the Mn_2O_6 is again split up into Mn_2O_7 and MnO_2. As this recuperation of the $KMnO_4$ is only *partial*, a *certain* excess of the latter is still necessary. The method which I have found most efficacious and economical is to add extra 25cc. $2nKMnO_4$ after a quarter of an hour's heating, should a considerable reduction appear to have been effected. This allows time for a substantial recovery of the first portion of $KMnO_4$ added, and provides fresh $KMnO_4$ for the oxidation of the last traces of the organic body.

The addition of the $MnSO_4$ solution is a matter of considerable importance. It should be added slowly, and the solution well shaken after each addition. With practice it will be seen, by the transparency of the solution after the precipitate has subsided, when the precipitation is nearly completed, and when so, only ½ or ¼cc. of the double normal solution of $MnSO_4$ should be added at a time, until the solution is perfectly colourless. The contents of the flask should then be diluted considerably, and the precipitate allowed to settle before filtration. Very little washing of the precipitate will thus be required.

It is well to subject the filtrate to direct titration, after acidifying with H_2SO_4, and raising nearly to boiling temperature. If the original body operated upon be not capable of direct titration, while the filtrate is, the formation of oxalic acid will be rendered probable. If, however, the filtrate be not capable of direct titration, then oxalic acid cannot be a product of oxidation. If both the original body and the filtrate be capable of direct titration, then the difference between the amounts of $KMnO_4$, reduced in the two cases, may prove a factor of importance.

Should the amount of $KMnO_4$ absorbed by the filtrate, and that reduced by the body in alkaline solution, not be equivalent to the whole of the oxygen demanded by the body for complete oxidation, then an oxidation in acid solution should follow the alkaline one. This is easily accomplished by adding the requisite amount of H_2SO_4 to neutralise the solution after oxidation in alkaline solution is complete. Then 20cc. $5nFePO_4$ are added, and the solution is heated for half-an-hour longer on the water-bath, and treated as described in Part I.

OXIDATION BY MNO_2 IN ALKALINE SOLUTION.

The MnO_2 is formed as already described in treating of oxidation by MnO_2 in acid solutions. It is necessary to filter the solution after it has become colourless, to get rid of the excess of $MnSO_4$. After washing the precipitate once, it is washed down into the flask in which it was formed, the filter, which will retain a small portion of the MnO_2, being carefully reserved until the end of the operation. 15cc. $5nNaHO$ are then added to the precipitate, together with 50cc. of the normal organic solution. The bulk is made up to 250cc., in a 500cc. flask, and the contents heated on the water-bath for half-an-hour, with agitation at intervals. The boiling is very irregular if placed directly over a Bunsen burner. I have ascertained that no loss of oxygen occurs here from the mere heating of the MnO_2 in the alkaline solution. After heating, the solution is considerably diluted and filtered, and the remaining MnO_2 determined in the manner already prescribed. It is evident that if considerable reduction take place an error would creep in, owing to the gain of oxygen by the manganous hydrate on the filter. Owing to this fact, and to the impracticability of obtaining a better circulation of the manganese dioxide in the solution, it is doubtful if more than approximate results will be obtained from this method. The filtrate could be directly titrated as in the method previously considered. If no oxidation occurred with $KMnO_4$ in alkaline solution, it would be quite unnecessary to subject the body to this treatment with MnO_2.

OXIDATION BY MNO_2 IN NEUTRAL SOLUTIONS.

If MnO_2 be formed in the manner already described, and washed until no free acid is present ; and oxalic acid, previously exactly neutralised, be heated with the precipitate on the water-bath, it will be found on filtration of the solution that the oxalic acid has been oxidised to some extent. That this is not due to a mere retention of the oxalate by the precipitate is proved by washing the latter with dilute alkali, which we have found to dissolve out the precipitated oxalate. It is evident, therefore, that on the addition of alkali to the precipitated MnO_2 a point would be reached at which no oxidation of the oxalic acid would occur. Now, this point I have found to correspond to the formation of the compound $K_2Mn_5O_{11}$, according to the equation—$2K_2C_2O_4 + 11MnO_2 = 2K_2Mn_5O_{11} + MnC_2O_4 + 2CO_2$. From this equation we see that, if MnO_2 and $K_2C_2O_4$ be added in the theoretical proportions for complete oxidation (in acid solution), $\frac{1}{11}$th of the oxalate would be oxidised before the complete formation of this compound. In experiments in which 50cc. *n*-oxalic acid exactly neutralised were added to the MnO_2 obtained from 50cc. $nKMnO_4$, only 44·7cc. of the oxalate were found in the filtrate, after thoroughly washing the precipitate with alkali, corresponding very nearly to the oxidation of $\frac{1}{11}$th of the total as shown above. We further learn from the above equation, that the quantity of alkali necessary to be added to the solution to render it neutral to oxalic acid, is exactly $\frac{1}{5}$th of that required to neutralise the whole of the oxalic acid which the amount of MnO_2 present is capable of exactly oxidising in its reduction to MnO. Now, as 1cc. *n*-oxalic acid (in reference to $KMnO_4$) requires 0·18cc. *n*-alkali to neutralise it, it is evident that the MnO_2 obtained from 1cc. $nKMnO_4$ requires one-fifth of this amount of alkali to render it neutral to the oxidation of the oxalate. It is advisable, however, to add a little more than is represented above, as less danger is likely to ensue by the solution being slightly alkaline than if it were slightly acid. The following experiments show that 0·05cc. $nNaHO$ added for every cc. $nKMnO_4$ precipitated is quite enough—*i.e.*, 50 per cent. in excess of the theoretical quantity required :—

No. of Experiment—	312	313	314
cc. *n*NaHO added	0	9	2·5
cc. *n*-oxalic acid deficient in filtrate	5·4	0·0	0·0
cc. $KMnO_4$ lost by precipitation	5·5	0·1	0·1

It will be unnecessary to describe this method further, as the other particulars with reference to it are common to the oxidation by MnO_2 in acid and alkaline solutions. It is preferable to obtain complete circulation of the MnO_2 by boiling the solution in a 500cc. flask, as was recommended in oxidising in acid solutions.

OXIDATION BY $KMnO_4$ IN NEUTRAL SOLUTIONS.

The *modus operandi* is exactly similar to that in alkaline solution, with, of course, the omission of the alkali. In order to preserve the solution neutral it is necessary to add alkali during precipitation by the $MnSO_4$ to neutralise the H_2SO_4 liberated. From the above remarks on oxidation by MnO_2, it will be evident that alkali should be added to satisfy the following equation:— $K_2Mn_2O_8 + 3MnSO_4 + 6NaHO = K_2Mn_5O_{11} + 3Na_2SO_4 + 3H_2O$. It is easy to calculate that 1cc. $nKMnO_4$ would require 0·212cc. $nNaHO$ to render it neutral after precipitation. It is here also advisable to add rather more than the theoretical quantity. I find a solution of NaHO ¼-normal is very convenient. Each cc. contains sufficient alkali (with 20 per cent. excess) to neutralise 1cc. of the double normal $MnSO_4$ solution, which I employ for precipitation. These solutions, being added in small and equal quantities at a time, the solution remains nearly neutral during the whole of the precipitation. The following experiments show the results obtained by this method, with 50cc. n-oxalic acid exactly neutralised:—

No. of Experiment.	cc. $nKMnO_4$ added.	Time of Heating.	cc. n-Alkali added before or during Precipitation.	cc. n Oxalic Acid deficient in Filtrate.	REMARKS.
315	50	1hr.	50KHO	1·7	Total gain of oxygen, 2·4cc.
316	50	1 „	100KHO	0·1	Total gain of oxygen, 1·2cc.
317	100	½ „	$12KHCO_3$	22·4	—
318	100	½ „	$12K_2CO_3$	10·3	—
319	100	½ „	12NaHO	0·1	Total gain of oxygen = 0·1cc.: 0·9cc. deficient in the first (neutral) filtrate.

We learn from 316 that the deficiency of oxalate in the filtrate in 315 is due, not to oxidation, but to mere precipitation, since it can be dissolved out by increasing the amount of alkali. A considerable gain of oxygen was recorded in these two experiments, owing to the $MnSO_4$ having been added in large (25 per cent.) excess. In the last three experiments, little more than the theoretical amount of alkali necessary to preserve the solution neutral was added. It is worthy of remark that the acid carbonate seems to be incapable of neutralising the H_2SO_4 liberated, while the normal carbonate is only capable of doing so partially. The caustic alkali, on the other hand, is perfectly efficacious. In Experiment 319 the actual conditions of working were fulfilled. After heating, the solution was precipitated with $MnSO_4$, with which the alkali was simultaneously added. The solution was then diluted, and after the precipitate had settled it was filtered. After washing slightly with distilled water, the precipitate was washed down into its own flask again; 150cc. nK_2CO_3 were added, and the solution heated on the water-bath, and again filtered. In the first filtrate there was a deficiency of 0·9cc. n-oxalic acid, but this was nearly completely restored after the treatment of the precipitate with the alkali.

In the table on following page, the various methods which I have discussed are conveniently arranged, and briefly described for reference. The composition of the different solutions employed is also given.

It is very probable that this table will require to be modified in some of its details; but the general principles underlying these methods have been so repeatedly confirmed, and the standard tests to which they have been submitted so satisfactorily complied with, that the general outline of the system will remain unaffected thereby.

ADDENDA TO OXIDATIONS BY $KMnO_4$ IN ACID SOLUTIONS.*

Modification in the case of Bodies not completely Oxidised.—I have found that some bodies are so difficult of oxidation when only the last traces remain, that a modification of this method is required. The simplest general method for determining whether the oxidation is complete will be to employ only one-half the prescribed quantity of the organic solution, and give the same length of heating. This will prove more expeditious than increasing the latter. In acid solutions, if a considerable reduction of the organic body takes place with the prescribed quantities (say more than 60 per cent. of the total possible), I prefer to perform another experiment, using 75cc. instead of 50cc. $2nKMnO_4$, preserving the other proportions. There is necessarily a slight increase in the error. This error amounts to not more than 0·18cc. $nKMnO_4$ per half-hour, or 0·35 per cent. of the body operated upon. This result was obtained from an experiment (No. 320) with 75cc. $2nKMnO_4$ and 50cc. n-oxalic acid. After heating for two and a-half hours on the water-bath, a loss of oxygen = 0·9cc. $nKMnO_4$ was recorded.

On the Influence of Chlorides.—A condition which has long been insisted upon, in titrations with potassium permanganate, is that chlorides, and especially free HCl, should be absent. Now Lunge† and others have shown that titrations with $KMnO_4$ may frequently be effected in the presence of large quantities of chlorides, without any error arising. Of course any error which would arise in direct titrations would be considerably increased by the high temperature and the large excess of $KMnO_4$ which I employ. The experiments in the first table on page 270, however, show that the errors introduced by the presence of small quantities of chlorides is very small indeed with the conditions of working which I have described. In each case the error due to the loss of oxygen in absence of the chloride has been deducted, and the normal conditions obtained, unless where otherwise stated.

We see that with such quantities of chlorides as are equivalent to 0·3 or 0·5 NaCl the loss with half-an-hour's heating is very slight indeed, more especially if an organic body is present. From Experiment 323 it will be seen that the error with the usual length of heating would be only 0·1 per cent. in the case of an organic body capable of complete oxidation. Although the evolution of chlorine is somewhat less when the $FePO_4$ is present than when it is replaced by even a smaller amount of H_2SO_4 than it contains (325), it has not the same influence here as it has in preventing the loss of oxygen from the mutual action of MnO_2 and $KMnO_4$. In the alkaline solution (327), as we had expected, there is no liberation of chlorine or loss of oxygen. It should be particularly noted, in Experiment 328, that although NaCl was added equivalent to more than the whole of the free acid in the $FePO_4$ solution, a

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* As several experiments with cane sugar are quoted in the first part of this paper, I should state that I have since found the sample employed to be very *impure*. With pure crystallised cane sugar, I obtain *complete* oxidation to CO_2 and H_2O. Glycerin and tannin may also be completely oxidised by adopting the modification here recommended.

† Dingl. Polyt. J. 235, 300.

STANDARD SOLUTIONS REQUIRED.

Abbreviated Designation.	Equivalent.	Composition per Litre.	Standardised by—
$2n\mathrm{KMnO}_4$	1cc. = 0·02grm. pure Fe = 0·0285 grm. oxygen.	12grms. recrystallised KMnO_4 diluted to 2-normal	Iron wire (occasionally)
$n\mathrm{FeSO}_4$............	2cc. = 1cc. $2n\mathrm{KMnO}_4$	50grms. crystallised $\mathrm{FeSO}_4.7\mathrm{H}_2\mathrm{O}$ + 55cc. $\mathrm{H}_2\mathrm{SO}_4$ (sp. gr. = 1·81)	$2n\mathrm{KMnO}_4$ (daily)
$5n\mathrm{FePO}_4$	20cc. prevents loss of oxygen occurring from the reduction of 50cc. $2n\mathrm{KMnO}_4$ by organic body.	200grms. crystallised $\mathrm{Na}_2\mathrm{HPO}_4.12\mathrm{H}_2\mathrm{O}$ + 15grms. $\mathrm{Fe}_2 3\mathrm{SO}_4$ (calculated anhydrous) + 100cc. $\mathrm{H}_2\mathrm{SO}_4$ (sp. gr. = 1·81)	Analysis
$2n\mathrm{MnSO}_4$	1cc. precipitates 1cc. $2n\mathrm{KMnO}_4$	16·17grms. MnSO_4 (calculated anhydrous)	Analysis
$5n\mathrm{H}_2\mathrm{SO}_4$	Ordinary.	137·5cc. $\mathrm{H}_2\mathrm{SO}_4$ (sp. gr. = 1·81)...........	$2n\mathrm{Na}_2\mathrm{CO}_3$
$5n\mathrm{NaHO}$	do.	200grms. NaHO (calculated anhydrous)	do.
$\frac{1}{4}n\mathrm{NaHO}$	do.	10grms. NaHO (calculated anhydrous)	do.
$2n\mathrm{Na}_2\mathrm{CO}_3$	do.	106grms. $\mathrm{Na}_2\mathrm{CO}_3$ (ignited)..............	(Own Standard)
$n\mathrm{NaHCO}_3$	do.	84 grammes NaHCO_3 (calculated anhydrous)	$2n\mathrm{Na}_2\mathrm{CO}_3$
n-Organic solution.	2cc. requires 1cc. $2n\mathrm{KMnO}_4$ for perfect oxidation.	Very variable	Ordinary Analysis

SCHEME OF ORGANIC ANALYSIS.

OXIDATION IN ACID SOLUTION BY:—

KMnO_4. (I.)

50cc. $2n\mathrm{KMnO}_4$ + 20cc. $5n\mathrm{FePO}_4$ + 50cc. n-organic solution, made up to neck of a 250cc. flask, with distilled water. Heat 35 minutes on water-bath. Pour contents *gently* into an 800cc. beaker, containing sufficient (say 25cc.) excess $n\mathrm{FeSO}_4$. Rinse flask with solution, if necessary. Make up bulk to 700 or 750cc., with *cold* distilled water, and titrate back at once with $2n\mathrm{KMnO}_4$. Let a = number of cc. $2n\mathrm{KMnO}_4$ equivalent to FeSO_4 added, and b = number of cc. $2n\mathrm{KMnO}_4$ absorbed in titration. Then for a body considerably oxidised :—

% total oxidation $= 4(50 + b - a - 0{\cdot}05)$.

For a check experiment, employing 75cc. $2n\mathrm{KMnO}_4$:—

% total oxidation $= 4(75 + b - a - 0{\cdot}1)$.

MnO_2. (II.)

In a 500cc. boiling flask mix—50cc. $2n\mathrm{KMnO}_4$ + 55cc. $2n\mathrm{MnSO}_4$. Heat on water-bath two minutes. When colourless, filter. Discard filtrate. Wash precipitate down into its original flask. Preserve filter. Add 10cc. $5n\mathrm{H}_2\mathrm{SO}_4$ + 50cc. n-organic solution, and make up bulk to about 250cc. Boil half-an-hour, first gently, finally briskly. Dilute considerably, and filter.

Precipitate.	Filtrate and Washings.
Wash twice with warm water. Wash down into original flask. Dissolve, together with any MnO_2 adhering to this or to the reserved filter, in excess $n\mathrm{FeSO}_4$, and titrate back with $2n\mathrm{KMnO}_4$.	Add 10cc. $5n\mathrm{NaHO}$ + 20cc. $5n\mathrm{FePO}_4$ + 75cc. $2n\mathrm{KMnO}_4$, and make up to neck of a 750cc. flask. Heat one hour, and proceed as directed in (I.). % total oxidation $= 4(75 + b - a - 0{\cdot}1)$.

For a check experiment, employ only 25cc. n-organic solution

OXIDATION IN ALKALINE SOLUTION BY:—

KMnO_4. (III.)

In a 750cc. flask mix 50cc. $2n\mathrm{KMnO}_4$ + 15cc. $5n\mathrm{NaHO}$ + 50cc. n-organic solution (neutralised), and make up bulk to 250cc. Heat 35 minutes on water-bath. Should considerable reduction occur, after a quarter of an hour's heating, add extra 25cc. $2n\mathrm{KMnO}_4$. Add 75cc. $n\mathrm{NaHCO}_3$, and subsequently $2n\mathrm{MnSO}_4$ (*slowly*, with constant agitation), until solution is *just* rendered colourless. Dilute considerably with hot distilled water, allow precipitate to settle, and filter through paper previously washed with boiling dilute NaHO.

Precipitate.	Filtrate and Washings.
Wash twice with hot water as rapidly as possible. Wash down into original flask. Dissolve in excess $n\mathrm{FeSO}_4$, and titrate back with $2n\mathrm{KMnO}_4$.	Heat to boiling temperature. Add 10cc. $5n\mathrm{H}_2\mathrm{SO}_4$, and titrate directly with $2n\mathrm{KMnO}_4$.

For a check experiment employ only 25cc. n-organic solution.

MnO_2. (IV.)

The MnO_2 is obtained as directed in (II.). After washing the precipitate once on the filter with warm water, it is washed down into its original flask, and 15cc. $5n\mathrm{NaHO}$ + 50cc. n-organic solution added, the bulk being made up to 250cc. Heat 35 minutes on water-bath, with frequent agitation, dilute considerably, and filter through paper previously washed with boiling dilute NaHO.

Precipitate.	Filtrate and Washings.
Wash twice with hot water as quickly as possible. Wash down into original flask. Dissolve, together with any MnO_2 adhering to this or to the reserved filter, in excess $n\mathrm{FeSO}_4$, and titrate back with $2n\mathrm{KMnO}_4$.	Heat to boiling temperature. Add 25cc. $5n\mathrm{H}_2\mathrm{SO}_4$, and titrate directly with $2n\mathrm{KMnO}_4$.

For a check experiment employ only 25cc. n-organic solution.

OXIDATION IN NEUTRAL SOLUTION BY:—

KMnO_4. (V.)

In a 750cc. flask mix 50cc. $2n\mathrm{KMnO}_4$ + 50cc. n-organic solution (exactly neutralised) + 150cc. distilled water. Heat 35 minutes on water-bath. Add $2n\mathrm{MnSO}_4$ *slowly*, and with constant agitation, until the solution is *just* rendered colourless, each addition being *preceded* with an *equal volume* of $\frac{1}{4}n\mathrm{NaHO}$. Dilute considerably with warm water; allow the precipitate to settle, and decant the solution through a paper filter previously washed with boiling dilute NaHO. To the precipitate add 10cc. $2n\mathrm{Na}_2\mathrm{CO}_3$ and dilute considerably with boiling water. Heat on water-bath for a few minutes with agitation. Filter, and proceed as directed in (III.).

MnO_2. (VI.)

The MnO_2 is obtained as directed in (II.). After washing the precipitate twice on the filter with warm water, it is washed down into its original flask, and 20cc $\frac{1}{4}n\mathrm{NaHO}$ + 50cc. n-organic solution added; the bulk being made up to 250cc. Boil for half-an-hour, at first gently, and finally briskly. Proceed further as directed in (IV.).

For check experiments in this and (V.) employ only 25cc. n-organic solution.

much less loss of chlorine is the result than when the same equivalent of free HCl is added *instead of* the $FePO_4$ solution (329). This pointed to the possibility of checking the action of even a large quantity of free HCl by fixing it with the addition of a neutral salt. In Experiment 330 this has been successfully accomplished by means of Na_2SO_4, the loss being very slight indeed, considering the large amount of free HCl added. Experiments 331 and 332 yield further confirmation that the amount of chlorine evolved depends upon the amount of *free* HCl, not *added*, but present after the solution has *assumed stability*, as well as upon the *total* free acid present.

No. of Experiment.	Grms. NaCl added.	Time of Heating.	Loss—c.c. $nKMnO_4$.	REMARKS.
321	0·325	½hr.	0·2	
322	,,	10mins.	0·7	$FePO_4$ solution replaced by 50cc. n H_2SO_4.
323	,,	2hrs.	0·2	50cc. n-oxalic acid added.
324	1·0	,,	1·5	
325	0·5	2½hrs.	1·6	$FePO_4$ solution replaced by 50cc. n H_2SO_4.
326	0·5	,,	1·2	
327	0·5	½hr.	0	Experiment in alkaline solution.
328	5·0	,,	6·0	
329	75cc. nHCl	,,	53·4	The HCl replaced the $FePO_4$ solution.
330	50cc. nHCl	,,	0·6	HCl replaced $FePO_4$ solution. 100cc. n Na_2SO_4 added.
330*a*	75cc. nHCl	,,	0·6	As above, but 200 Na_2SO_4 added.
331	37½cc. nHCl	,,	7·7	HCl replaced the $FePO_4$ solution.
332	,,	,,	14·9	37½cc. nH_2SO_4 added in addition, but no $FePO_4$ solution.

Now, it seems to me that we must look for the explanation of these results in the thermo-chemical investigations of Thomsen. The following experiments were instituted to decide this point. In the first table no base, except that of the $KMnO_4$ added, was present, and HCl and H_2SO_4 were employed in varying proportions to produce a total of 75cc. n-acid. Of course no $FePO_4$ solution was introduced :—

No. of Expt.—	333	334	335	336	337	338	339	340
cc. nHCl added	15	35	40	45	50	55	60	75
Length of heating	¾hr.	¾hr.	¾hr.	¾hr.	¾hr.	¾hr.	¾hr.	¾hr.
Loss = c c. $nKMnO_4$ ..	4·6	13·4	18·4	11·4	11·8	11·0	15·4	40·8

As an average result of the above experiments, we may state that 1cc. nHCl in the free state is equivalent to a loss of 0·9cc. $nKMnO_4$ per hour. In the next series of experiments, 75cc. nH_2SO_4 were added instead of the $FePO_4$ solution, and varying amounts of NaCl. The time of heating was half-an-hour in each case.

No. of Experiment—	341	342	343	344
cc. nNaCl added	15	35	55	75
Loss = cc. $nKMnO_4$ ..	2·1	9·2	12·4	21·6
Equivalent to a loss arising from—cc. n *free* HCl	4	20	27	47

It would seem from the above that the amount of HCl which the H_2SO_4 is capable of liberating increases in a greater ratio than the amount of NaCl present. It should be borne in mind, however, that the evolution of oxygen would have increased faster, also, if no chloride had been present, owing to the absence of $FePO_4$.

I was anxious to find if the amount of free HCl present (with a constant amount of total free acid and a known amount of base), as indicated by the quantity of Cl evolved, would correspond to the avidity of HCl as given in Thomsen's table. The following experiments were therefore instituted :—100cc. nHCl were added in each case (except No. 346), and 100cc. of the given neutral and normal salts employed. In order to render the error due to the small amount of K_2O in the permanganate smaller, only 50cc. $nKMnO_4$ were employed. The heating lasted in each case a quarter of an hour.

No. of Experiment.	Salt added.	cc. $nKMnO_4$ lost.	REMARKS.
345	none	9·8	
346	none	5·4	50cc. HCl replaced by 50cc. nH_2SO_4
347	Na_2SO_4	6·4	= about 70 free HCl.
348	$NaNO_3$	20·8	Another gave = 20·6.
349	CH_3COONa	3·8	Another gave 3·4 = about 40cc. n free HCl.
350	Na_2HPO_4 + 33·3cc. nNaHO.	0	

The relative "avidities" of the different acids for sodium, calculated from the above results, are, roughly :—$HCl = 100$, $H_2SO_4 = 175$, $CH_3COOH = 50$, and $H_3PO_4 = 0$. These numbers do not agree with those given by Thomsen, and this may be owing to the high temperature at which the experiments were made.* It is a very general result, however, of all these experiments that in boiling dilute solutions H_2SO_4 has a much greater avidity for Na_2O than HCl. The influence of HCl and HNO_3 united is very marked (348). The loss is much greater than with HCl alone, although HNO_3 itself causes no loss, as we shall presently see. The cause is no doubt due to the formation of aqua regia, which assists the oxidation of the HCl.

The practical outcome of these experiments is that the loss of oxygen due to the presence of even

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* In the March number of the *Berichte* (xx. p. 556) I note that G. A. Hagemann criticises very severely the groundwork of Thomsen's "avidity" calculations. If Hagemann's position be accepted, then the influence of the Na_2SO_4 must be ascribed to the alkaline nature of the residual energy ("Restenergie") of the sulphate in solution. I find that the addition of Na_2SO_4 in *very large quantity* diminishes the loss of oxygen which occurs in acid solution when no $FePO_4$ is present.

large quantities of free HCl may be avoided by the addition of sufficient Na_2SO_4 to fix practically the whole of the HCl.[*]

On the Influence of Nitric Acid and Ammonium Salts.—That these are without influence is shown by the following experiments, in which the usual conditions prevailed :—

No. of Experiment.	Addition.	Length of heating.	cc. $nKMnO_4$ lost.	Remarks.
351	0·5grm. KNO_3	2½hrs.	0	
352	„	„	0	$FePO_4$ replaced by 50cc. nH_2SO_4
353	0·5grm. KNO_3 + ·5grm. NaCl	„	0·6	No greater loss by addition of KNO_3
351	0·5grm. NaCl	„	0·6	
355	8grms. KNO_3	½hr.	0·2	Loss due to impurity.
356	„	2½hrs.	0·2	
357	75cc. $nHNO_3$	½hr.	0·9	HNO_3 replaced the $FePO_4$
358	„	2½hrs.	1·0	Loss due to impurity.
359	100cc. $n(NH_4)_2SO_4$	½hr.	0	
360	„	½hr.	0·15	$FePO_4$ replaced by 75cc. nH_2SO_4

We learn from these experiments that HNO_3 might even be employed as a substitute for H_2SO_4, if the impurity which it contained were allowed for. There is practically no greater loss in Experiment 358, after 2½ hours' heating, than in the previous experiment, with only half-an-hour's heating.

It is very evident that in the analysis of potable waters, no error would be introduced by adopting this method, owing to the presence of chlorides, nitrates, and ammonium salts. Nitrous acid would, of course, be oxidised to nitric acid.

Ultimate Analysis by means of $KMnO_4$.—I have obtained further encouraging results, which lead me to expect that my method will prove well adapted to the above purpose. I am designing a modification of Lunge's nitrometer for the purpose of collecting and measuring the gases evolved, and I hope soon to communicate the results I obtain therewith to the Society.

I might state here also that I find that some bodies which are not at all attacked by $KMnO_4$, even in acid solutions, may be completely oxidised by the introduction of a *carrier* of oxygen in very small quantity. By this means the number of organic bodies withstanding the action of $KMnO_4$ will be considerably diminished, if not even reduced to nil.

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Notices of papers and communications for the meetings to be sent to the Local Secretary.

The Sixth Meeting of the Fourth Session of this Section was held in the Rooms, 207, Bath Street, Glasgow, on Tuesday, April 5, 1887.

MR. J. NEILSON CUTHBERTSON IN THE CHAIR.

DISCUSSION ON MR. SUTHERLAND'S PAPER ON SCALE TESTING (THIS JOURNAL, VI. 123).

THE SECRETARY read the following letter from Mr. BOVERTON REDWOOD :—

85, GRACECHURCH STREET, LONDON,
March 30, 1887.

D. A. SUTHERLAND, Esq.,
BURNTISLAND OIL WORKS,
BURNTISLAND.

DEAR SIR,—I regret that I shall be unable to be present when your interesting and valuable paper on paraffin scale testing is discussed.

With reference to the differences between the method of determining oil proposed by the Scottish Mineral Oil Association, and that which I adopt, I should like to make the following remarks.

1. The press, of which Mr. McCutchon was good enough to send me drawings, appears well designed, and would, I have no doubt, furnish results quite as satisfactory as those which I obtain with my press, provided that the spiral springs remain of unimpaired elasticity.

2. My experiments indicate that the application of a higher pressure than that which I employ is not necessary to the attainment of strictly comparative results, and may in some cases cause loss of the solid material.

3. The principal objection to a lengthened duration of pressure is that the difficulty of maintaining the standard temperature throughout the test is increased.

4. I prefer to work with 500grs. rather than with 250grs., because the loss of solid material, by adherence to the press cloths, etc., bears a smaller ratio to the total in the former case than in the latter.

Against the objections specified, I am not aware that there are any marked advantages to be set, having regard to the fact that the test must always remain a purely arbitrary one.—Yours truly,

BOVERTON REDWOOD.

Mr. IVISON MACADAM, in a communication made to the Secretary, desired to bear testimony to the great advisability of securing some definite and fixed process for the testing of scales. About two years ago he had occasion to show that the usual volumetric process was inaccurate, and gave results decidedly too high, being thus unfair to the manufacturer. For some years he had adopted the process described by Mr. Sutherland as in use in Dr. Wallace's laboratory, and found it to give constant and fair results.

Mr. R. TERVET said that he was sure the Section was very much indebted to Mr. Sutherland for bringing before the Society such a complete synopsis of the

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[*] Since writing the above, I have found that the presence of chlorides, even in very small quantities, produces marked irregularities in the oxidation of nitrogenous bodies (including ammonium salts) by $KMnO_4$. To obviate these irregularities the addition of the sodium salt is absolutely necessary, and I would recommend 50 parts of crystallised sodium sulphate to be added for every part by weight of chlorine which the amount of solution employed contains. I have also a modification of this method in view, for the determination of the *nitrogenous* organic matter in waters, in addition to the other organic constituents which will be estimated by the process as already described.

various methods in use for the analysis of crude paraffin scale, as pursued in our works laboratories, and also in those outside where such testings are done. From a practical point of view, however, he did not think any of the processes mentioned are likely to get us out of the difficulties which beset the question. It is well known that when we have to valuate a crude mineral oil, we submit it to a course of purification and analysis identical with that pursued on the practical scale in our works. The results are expressed in terms of per cent. of burning oil, intermediate oil, lubricating oil, naming the specific gravity of each, and per cent. of scale, with its melting point. From these figures the value of the crude oil is determined. With regard to scale, the matter is quite different. It is manufactured and delivered in a state of purity—that is, the substances associated with it are not chemically combined with the scale. The analysis ought, therefore, to be very simple, but we find both in theory and practice the contrary to be the case. Mr Boverton Redwood on this subject touches the keynote when he says (this Journal, iii. 432): "To the fact that the test must under any circumstances be only an arbitrary one, the value to the buyer lies in its association by experience with results obtained in practical working the material." This is exactly the base upon which many of our commercial analyses stand—viz.: An arbitrary test which cannot be dissociated from results obtained in practical working. The mineral oil refiner buys his crude oil by an arbitrary test, the results of which tell him what he may expect from the practical working. It seems curious indeed, then, that the practically exact method of valuating nearly every substance that is bought and sold by analysis should not be extended to paraffin scale. It would appear from what has been said and written on the subject, and also from the minutes of the Scottish Mineral Oil Association, that the difficulty is in the estimation of the oil. Now, if it is an arbitrary test, independent of what results may be obtained in practical working, that is wanted, or in other words, if the test is simply to ascertain what proportion can be expressed from a sample of scale under given conditions, then the method employed by Mr. Boverton Redwood furnishes all that is required. But it must be urged that it is a mistake to adopt a method of analysis for a substance which is to undergo manufacture, which has no bearing for, and gives no indication of, what result may be expected in practice. As an example; if the time—viz.: 15 minutes, prescribed by the Scottish Mineral Oil Association had been adopted to press the samples A, B and C, as shown in Mr. Boverton Redwood's paper, they would have contained after pressing respectively, 1·24: ·85: ·70 per cent. of oil which their test took no cognisance of. This is clearly shown by the fact that when the times of experiment were extended to sixty minutes the results obtained were practically constant, and no further absorption took place by extending the time to 120 minutes. To make this clear he took the liberty of quoting a few of Mr. Boverton Redwood's numbers. (See table on preceding column.)

Reference Number.	Mark of Sample.	Quantity in Grains.	Pressure in Tons.	Tempt. in degrees F.	Time in Minutes.	Percentage of Oil.
1	A	500	9	60	5	5·30
2	,,	,,	,,	,,	15	7·52
3	,,	,,	,,	,,	30	7·92
13	,,	250	,,	,,	5	6·40
14	,,	,,	,,	,,	15	8·16
15	,,	,,	,,	,,	30	8·60
25	B	500	,,	,,	5	11·04
26	,,	,,	,,	,,	15	12·22
27	,,	,,	,,	,,	30	13·08
37	,,	250	,,	,,	5	11·68
38	,,	,,	,,	,,	15	12·88
39	,,	,,	,,	,,	30	13·21
49	C	500	,,	,,	5	6·12
50	,,	,,	,,	,,	15	7·81
51	,,	,,	,,	,,	30	8·54
60	,,	250	,,	,,	5	6·84
61	,,	,,	,,	,,	15	8·44
62	,,	,,	,,	,,	30	8·80
4	A	500	,,	,,	60	8·62
5	,,	,,	,,	,,	120	8·58
16	,,	250	,,	,,	60	9·08
17	,,	,,	,,	,,	120	9·01
28	B	500	,,	,,	60	12·98
29	,,	,,	,,	,,	120	13·22
40	,,	250	,,	,,	60	13·20
41	,,	,,	,,	,,	120	13·60

From these figures we see that at a temperature of 60°, and at a pressure of 9 tons, which may vary from 5 to 60 minutes in duration, the results obtained differ:

For A .... 5·30 to 9·08 = 3·78%
,, B .... 11·04 to 13·20 = 2·16
,, C .... 6·12 to 8·81 = 2·72

It may be said that the comparison is not fairly made, as the times and quantities vary, and that the two extremes in time are taken—viz., 5 to 60 minutes, but an inspection of Mr. Boverton Redwood's figures, as tabulated above, will show that his results are remarkably concordant throughout the whole series for any particular time. Therefore, if this was the only difficulty all that need be decided is what quantity should be taken for the test, and what time should be employed in testing.

From what has been said, one need feel no surprise that Mr. Sutherland should meet with differences of 2 per cent. in the results obtained by two different analysts. Such differences are almost certain to continue, until it forms part of the analytical process, that the pressing of the sample shall be continued until its weight remains constant.

Perhaps the most interesting and valuable results obtained by Mr. Boverton Redwood are those done at a temperature of 70° F. It is to be regretted, however, that particulars are wanting with regard to melting points, before and after pressing; also the "setting" point of that portion which is expressed.

In tabulating the experiments made at 70° F., no notice was taken of results obtained by pressing for 5 minutes, for reasons already stated. (See table on p. 273.)

When we compare the figures thus obtained between 15 and 30 minutes' pressure, the results are remarkably constant, the greatest variation being in sample A. Again, when those tests done at 30 minutes for both quantities, and of the three samples, we have a set of results which leave little to be desired, the greatest difference being 0·3, and the least 0·1. As hot-pressing is an approach to the practical method of refining paraffin scale, he was of opinion that one hour should be given, even at a temperature of 70° F.

Mr. Sutherland says, page 124, vol. vi., "Scale is of value to the candlemaker and refiner, only for the wax it contains, of a melting point higher than that of the ordinary temperature, consequently he makes a claim upon each delivery . . . for what he terms oil, which, however, consists mostly of soft paraffin held in solution." Mr. Boverton Redwood says: "From an examination of the foregoing figures, it will be seen that the results are most influenced by variations of temperature. . ." Moreover, I am of opinion that in some cases, at any rate, a portion of the semi-solid hydrocarbons contained in the scale, which certainly cannot fairly be called oil, is gradually squeezed out during a prolonged pressure of so thin a cake.

Reference No.	Mark of Sample.	Quantity taken in grains.	Pressure in tons.	Temperature in degrees F.	Time in minutes.	Percentage of Oil.
10	A	500	9	70	15	11·62
11	,,	,,	,,	,,	30	12·26
22	,,	250	,,	,,	15	12·00
23	,,	,,	,,	,,	30	12·56
31	B	500	,,	,,	15	11·72
35	,,	,,	,,	,,	30	15·20
46	,,	250	,,	,,	15	15·08
47	,,	,,	,,	,,	30	15·32
56	C	500	,,	,,	15	10·22
57	C	,,	,,	,,	30	10·66
67	,,	250	,,	,,	15	10·61
68	,,	,,	,,	,,	30	10·76

He thought these statements brought the matter to an issue, and indicated exactly upon what line the examination of a paraffin scale should be conducted. Now, as scale is of value to the candlemaker only for the wax it contains, which is capable of being made into candles; and as it is not the business of the wax refiner or candlemaker to extract soft paraffin held in solution, it is only reasonable that he must, and should, reject that portion he cannot use. This finds ample confirmation from the case cited by Mr. Sutherland, when he says, page 123: "Somewhat recently I have had occasion to test a large number of samples. . . . That my results were accurate according to the method I used, was proved, ere repeated arbitration, by the public analyst whose method it was. *But the buyers were still unsatisfied, and adhered to their own results.*" Now, if it is safe for us to assume that the scale referred to was made in cold weather, then we may possibly find the reason why the buyers adhered to their own results, from Mr. Sutherland's own explanations. As he says, further on, "The claim is generally allowed up to 6 per cent., being less in summer, or when the weather is warm, and *greater in winter time and cold weather, when the cooling power is greater, and a corresponding increase of soft paraffin extracted.*"

Further, those paraffins whose melting point is *immediately* above the ordinary temperature, and the semi-solid hydrocarbons contained in the scale which cannot be called oil, are of little or no use to the candlemaker, and are an unfailing nuisance to the wax refiner, entailing much loss and endless labour.

In order to see what relation the low melting points of paraffin scale and wax have to ordinary temperatures, he would refer to his "Note on an Improved Apparatus for the Manufacture of Refined Paraffin Wax" (to follow next month).

He did not mean to say that the melting points there shown are the lowest obtainable, because they are derived from a fractional distillation, and are therefore controlled by Kopp's law for mixed boiling points, and it is certain that lower fractions and a different curve would be obtained by fractional fusion.

It is quite obvious, then, that the only way of properly testing paraffin scale is to convert it into a substance of a composition similar to that from which candles are made, or for whatever purpose the wax is to be used; perhaps the most simple and direct method is exactly that adopted by Mr. Boverton Redwood—viz., hot pressing at a temperature suitable for each grade of scale. Mr. Boverton Redwood's figures are important in another direction, inasmuch as they show how the results may be interpreted, and what influence they have on buyer and seller. Suppose we allow—

8 % as deduction for oil in sample A
12 ,, ,, B
8 ,, ,, C

and after deduction the value of the scale is 2d. per unit—

A 100 − 8 = 92 × 2d. = 184d.
B 100 − 12 = 88 × 2d. = 176d.
C 100 − 8 = 92 × 2d. = 184d.

But to the candle-maker, after the soft and worthless paraffin had been removed, at a temperature even as low as 70° F., they would stand relatively thus:—

A − 12 = 88 × 2d. = 176d.
B − 15 = 85 × 2d. = 170d.
C − 10 = 90 × 2d. = 180d.

which gives a difference per 100 units for—

A − 7·36d.
B − 5·28d.
C − 3·68d.

Another very important point for the scale manufacturer is, that he is really selling to the wax refiner a product for which he is not receiving the full value. In the absence of exact figures in Mr. Boverton Redwood's tests I am only able to assume values which would be only approximately correct if we allow that the original scale had a melting point of 120° F., and the portion expressed a setting point of 85° F. Then:

	A.	B.	C.
Hot pressed scale....	125°, 88% ..	126°, 85% ..	124°, 90%
Oil and soft ,, ...	85 12 ..	85 15 ..	85 10

To summarise these remarks, he had only to repeat, first, that the only method for the analysis of paraffin scale which appeared to him likely to give satisfactory results must be constructed on the principle of that pursued in the manufacture of the refined substance, so that the results obtained may be a guide in the practical working of the material. This may be easily effected either by hot pressing or by "sweating." In the latter case it would only be necessary to submit a cake of the melted scale of a given thickness to a given temperature until it ceased to lose weight, or for a given time. An examination can then be made of the resulting wax, and also of the liquid portion which has been fused out of it.

In dealing with this latter portion a diagram is appended which may be found useful in ascertaining what percentage of solid paraffin these oily residues contain. It is not as perfect as could be wished, and, he might mention, it was constructed and drawn for this purpose by two workmen who attended his works' chemistry-class. Secondly, those very soft fractions of paraffin are almost valueless for candle making, and are in large part almost liquid at ordinary temperatures when isolated from the members of higher melting point. Hence the wax refiner designates them as oil. Besides, their presence degrades the melting point to an enormous degree of what would otherwise be a first-rate scale. This occasions serious loss to the scale manufacturer, and a corresponding gain to the refiner. Thirdly, those scales of irregular make, and which are described by Mr. Boverton Redwood as being "doughy"—that is, when the crystals are imperfectly formed by their interlocking a large proportion of oil which cannot be removed by cold pressing—would, by the test indicated, yield a result equal to, and parallel with, those obtained from scales of normal condition.

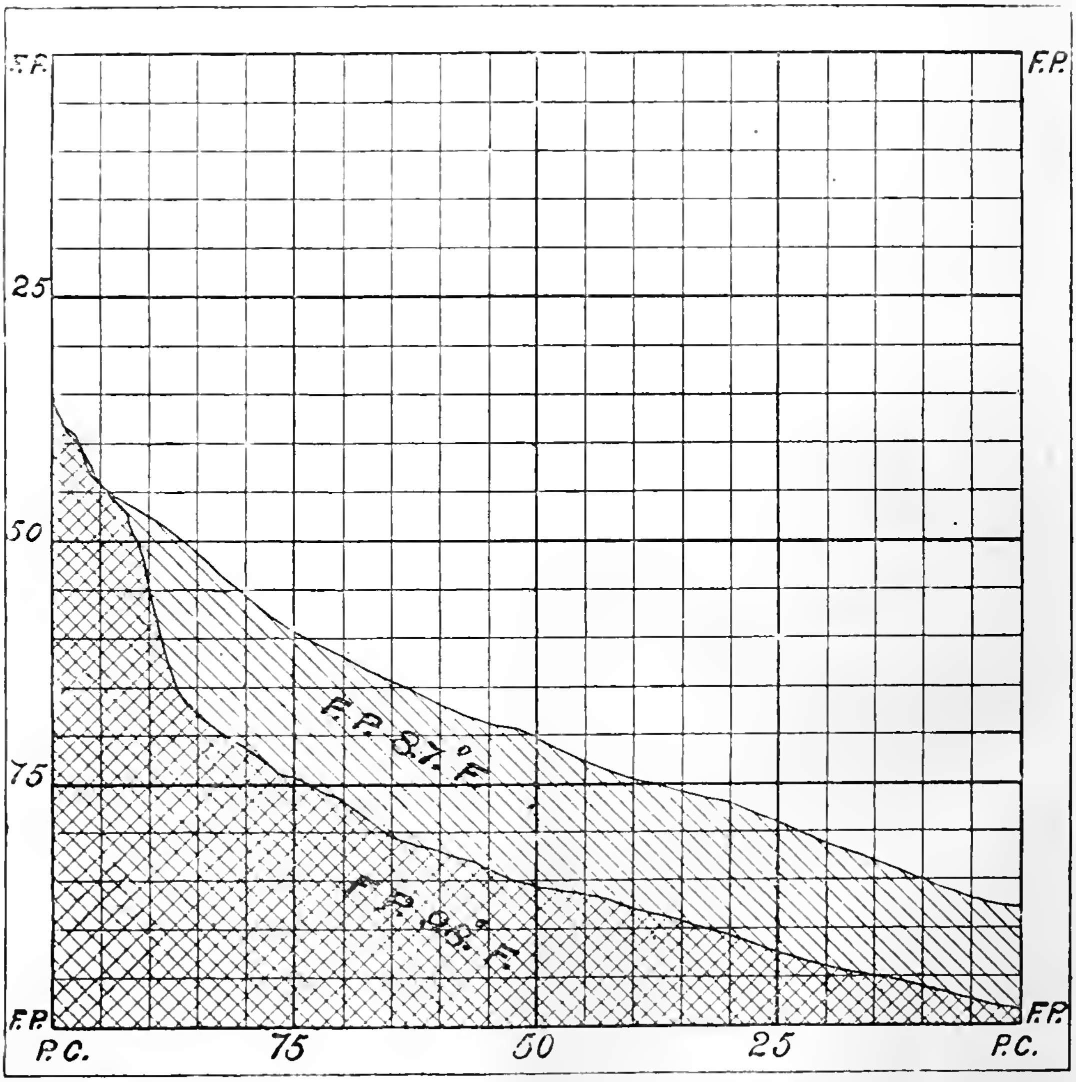

Diagram showing Per Cent. of Scale in Blue Oil and Corresponding Freezing Points.

Dr. Wallace said the previous speaker (Mr. Tervet) had given a very valuable contribution to the chemistry of scale testing. It was scarcely, however, a criticism on Mr. Sutherland's paper, but an entirely new idea—viz., that everything should be removed from the paraffin scale that was not required in the manufacture of candles. As far as he (the speaker) was concerned, he should be quite willing to test scale by any method which the manufacturer, on one hand, and the merchant on the other, had agreed upon: but, as was pointed out by Mr. Tervet, Mr. Sutherland and Mr. Redwood, this was not a strictly chemical test, or in any way like an analysis of potash salt or an iron ore, where the ingredients could be tested with perfect accuracy. It rather resolved itself into a question of the process adopted. The water and what was called the "dirt," or insoluble matter, could be determined quite accurately; but the estimation of the oil was a different matter, depending, as it did, on the process adopted and how much could be got out. For his own part, he had pursued for a number of years a course to which he had adhered and which he would have some difficulty in altering on account of the contracts running on between buyer and seller, and that was one reason why it was rather difficult to change processes. The press which he used was 5⅜in. in diameter, with a screw of 2in. in diameter and six threads to the inch. The cross-head, or lever, was 4ft. long, and was worked by an able-bodied man on each side. It might be pertinently asked, "How are you able to get men of equal strength every time you want them, and if you cannot get able-bodied men, how many others do you employ?" He had fixed upon a certain point with two strong men by having the screw of the press marked, and by this means the same amount of pressure was always approximately obtained. Taking 250 grains of the scale with the usual linen cloths, this was pressed for two minutes with five papers on each side, and afterwards for two minutes with two papers on each side, and an estimate was afterwards made of the water in the cake which was left. This was found to be quite sufficient, and the results were very consistent. He was quite aware, however, that when the temperature was advanced two or three degrees higher, or even one degree above 60, results were obtained considerably different. There seemed to be a general understanding between merchants and manufacturers of scale that a method such as this would be adopted when they sent samples of scale for analysis, and until these gentlemen could agree amongst themselves he feared that he would require to pursue the course he was doing, notwithstanding the improvements suggested by Mr. Sutherland and others.

Mr. Hamilton was afraid that Mr. Sutherland's ideas came rather late in the day. Six or eight months ago they might have been useful, but as affecting the analysis of Scotch oil companies there was, so far as he knew, only one small company producing scale for marketable purposes, and while the analysis of scale might be useful in the works as guiding the manufacturer of wax, still he did not believe that, as a commercial analysis, it was of any value now.

Mr. A. J. Liversedge brought before the Section several small tubes which he had used in connection with a small centrifugal testing machine in the testing of milk and other substances. This apparatus, which simply increased the action of gravity many times, had been found to answer the purpose for which it was originally introduced extremely well, and had given results sufficiently accurate for commercial purposes. It was suggested to him at the time Mr. Sutherland's paper appeared in the public press that this apparatus might be used for the purpose of facilitating the testing of paraffin scale, and with this object in view he procured some scale and made a series of experiments which seemed to be very successful so far as the test for water was concerned. The centrifugal action to which the melted scale was subjected in the machine did, as far as he could judge, render the separation of the water, dirt, and tarry matters both much more rapid and complete than separation by gravity unaided could accomplish in a reasonable time. One of the tubes submitted contained a crude scale showing the separation of water, etc., effected. He subsequently went further, to ascertain whether the apparatus could not be used for the purpose of separating the soft paraffin or oil. His idea was that it might be separated whilst in solution at a certain temperature and with a certain number of revolutions of the machine. He could not say that his success in that direction was very great—the separation of the so-called oil was obviously the most difficult part of the whole business. It appeared to him, however, that instead of endeavouring to ascertain the amount of water and dirt, and the amount of soft paraffin in a given sample of scale, the manufacturing process suggested by Mr. Tervet should be pursued—that is, find in any sample of scale the quantity of wax of the condition required by candle manufacturers. He had tried to see if the crude paraffin in a small quantity could not be rapidly refined, using the centrifugal machine to aid the operation, and the results thus ascertained in the course of a short time, instead of by the tedious process now adopted. He saw that a method of refining scale by macerating it with soapy water had been proposed, and as a matter of curiosity had made some experiments in this direction, and found that the scale was very much improved by the maceration in the water; but to what extent the soft paraffins were separated he had not been able to ascertain. He merely brought this centrifugal idea before the Section in a general way. It might suggest a new line of experiment, and if any members are disposed to pursue the question further in this direction he should be glad to lend him his assistance.

Mr. King, as a buyer of paraffin scale, considered that the main question was to arrive at a method of testing paraffin scale for oil, dirt, and water, which would please both buyer and seller. He was very dissatisfied, ever since scale was made, at the manner in which it was tested. He had to acknowledge that to Mr. Sutherland he was indebted for being amongst the earliest to adopt what might be called a sensible commercial test for paraffin scale. It had been said that the greatest difficulty was with the oil—*i.e.*, finding how much oil was in the scale. In his opinion the greatest difficulty lay in the discovery of the proper amount of water and dirt in the paraffin scale. The lever press employed by him was the same as used by Dr. Wallace, and if the screw was kept clean and well oiled the results would be, as in his case, invariably uniform. The *modus operandi* which he proposed should be as follows:—

For Oil.

1. Take 500 grains paraffin scale, free from dirt and water, crystallised by slow cooling, starting at 212° F., and coming down to 60° F.; the time occupied in the cooling process not to be less than 6 hours.

2. See that press is in good working order, screw clean, and well lubricated with good oil.

3. Temperature of press and atmosphere to be 60° F.

4. Place paraffin in press between single ply of finest linen, and 5 ply each side of white blotting paper (38lb. to the ream).

5. Screw up the press as fast as paraffin will allow without squeezing it out from between the discs.

6. Six minutes to be allowed from beginning to end of pressure, including the screwing down.

For Dirt and Water.

1. Weigh 1000 grains of paraffin scale and place it in a graduated glass tube, each division of same to indicate 10 per cent. of the whole.

2. Place tube containing paraffin in water, raised to and maintained at 190° F. until the dirt and water is perfectly settled to the bottom.

3. Pour off paraffin to within ¾in. to 1in. of the sediment at bottom of tube, refill with shale spirit, previously well washed in water, and let settle until dirt and water is again at bottom.

4. Pour off a second time, and refill again with shale spirit, mixing well and settling as before—read at bottom percentage of dirt and water.

5. The temperature of water in which the tube is immersed may be lowered when the shale spirit is introduced, and the reading taken at 60° F.

Mr. Sutherland, in replying, considered that it would be admitted that a subject which had elucidated perhaps, he might say, the longest discussion before this Section, could hardly yet have lost its importance to the chemical world, as Mr. Hunter and Mr. Hamilton would lead them to believe. Till candlemakers ceased using scale, and while scale, American or otherwise, was in the market, so long would it be necessary to test scale. He had to express his thanks to Mr. Boverton Redwood, Dr. Wallace, and Mr. Macadam, and to others who had written him of their willingness to adopt some standard method. Referring to Mr. Tervet's remarks, this gentleman had, he said, struck out on an original line of work. Having been associated with him for some years, he was aware that a practical test on working principles was his (Mr. Tervet's) *forte*. Regarding pressure of scale till weight constant, he held to Mr. Redwood's opinion, as, of course, it was obviously unfair to press too long, lest scale might be pressed into the cloths. Referring to the suggested temperature of 70 F., he thought it would be more difficult to maintain it than that of 60 F., but apart from this, the latter was the temperature in general use. Additionally at a high temperature, if there was a large percentage of oil, a very great deal of hard paraffin might be carried out in solution. As to Mr. Tervet's practical test, the limited time at disposal in a works, or more especially a public analyst's laboratory, would obviate any sweating test or other approach to the working process. With reference to another member who had suggested a mechanical means of separation of water and dirt, such was quite unnecessary, as in melting in his tube the entire amount settled out in fifteen or twenty minutes. The remarks of Mr. King, manager of Messrs. Robin & Houston, candlemakers, were satisfactory as showing, from even the buyer's point of view, the *short* test was acceptable. In conclusion, he trusted that the ventilation of the subject would do good.

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ADDENDUM TO MR. IRVINE'S PAPER ON EGYPTIAN PETROLEUM (THIS JOURNAL, VI. 130).

Mr. Irvine communicated to the Section that since reading the above paper he had received another letter from Captain Roberts, from whom he gathered that the quality of the oil varies, some samples being thick and viscid, others comparatively fluid. This pointed to evaporation or oxidation. So far, results did not point to Egypt becoming a rival of either America or Russia as a producer of petroleum.

Extract from Letter dated 9th March, 1887, at Suez:

"I regret that we are not able to report any important progress in the boring efforts at El Gemsah and Gebbel Teité. They have been working during some weeks; the bores are now in four different places, only a few yards from each other, and near the sea at El Gemsah; and I understand that the boring at Gebbel Teité is temporarily suspended. A fifth hole has been commenced about one-third of a mile inland of the four at El Gemsah, without results as yet. The workmen still believe that petroleum exists somewhere in the locality. It depends, however, on the decision of Government as to the duration of the work; they find the expenditure is becoming serious."

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ON THE DETERMINATION OF MINUTE PROPORTIONS OF IRON, WITH SPECIAL REFERENCE TO ALUM AND SULPHATE OF ALUMINA.

BY R. R. TATLOCK, F.R.S.E., F.I.C., F.C.S.

The demand, on the part of Turkey-red dyers and calico printers, for alum and sulphate of alumina, as nearly as possible iron-free, has stimulated the manufacture in a very pure condition, as regards that metal, of these articles; the result of which is that both are now to be had of so high a degree of purity that the methods hitherto employed for estimating iron in these goods are no longer available, and, in many cases, do not give even approximately correct results. Some notion of the quality required and attainable may be formed from the fact that goods stated to contain only 0·001 per cent. (10 parts per million) of metallic iron may be rejected if the selling sample contained half that proportion. None of the methods hitherto published or in use, so far as I can ascertain, are capable of determining such small quantities with exactness, and frequently they are totally inapplicable on account of mechanical impurities, which render the solutions opalescent, thereby masking the colour struck by the reagent, all of these processes being based upon colorimetric observations. Nothing seems easier than to apply one of the delicate reagents commonly employed for the detection of iron in the ferric state, such as potassium thiocyanate (commonly called "sulphocyanide of potassium") or the corresponding ammonium compound, and from the depth of tint produced deduce the amount of iron present by comparison with standard ferric solutions. The disturbing influences, however, are numerous and great, and, to say the least, the sample and the standard would require to be treated under rigorously identical conditions, and, even then, results of the necessary degree of exactness are far from attainable.

There are two methods commonly in use for the detection and estimation of very small proportions of iron. One of these is based upon the depth of blue or green colour produced by addition of potassium ferrocyanide, and the other upon the intensity of the red colour obtained by addition of solution of an alkaline thiocyanate to acidified solution of the substance under examination.

In applying these reagents to the detection of iron in alum or sulphate of alumina, I find it is not uncommon to add them to the finely-powdered sample. This may be very useful as an empirical test to a manufacturer or consumer, will give a fair indication of purity as regards iron, and will even enable him to ascertain whether the article is equal to his accustomed standards; but as the depth of colour depends to a considerable extent upon the degree of fineness, it is only an approximative test, even for the comparison of two samples. It is quite valueless for determining the absolute proportion of iron in any sample, as the addition of standard solution of iron to the pure iron-free alum used for comparison would coat the outside of the small crystals superficially, and would thus be all available for the reagent, whereas the iron in the sample being tested would be for the most part locked up in the crystals, and to that extent, would not be amenable to the reagent.

The application of ferrocyanide for the determination of iron is not at all desirable, for various reasons. The tint is very variable—between a bright green and a full blue, even for the same proportion of iron, even when the other conditions are as nearly as possible equal, and comparison of intensity is thereby rendered unreliable; there is often a difficulty in keeping the prussian blue formed in perfect solution, even when oxalic acid is added; the composition of the blue produced cannot always be relied upon as uniform; and, lastly, it is not desirable to employ a reagent of which iron forms an essential constituent. On these grounds the use of this reagent for quantitative purposes is not to be recommended.

The employment of thiocyanate of potassium ($KSCN$), or of ammonium (NH_4SCN), for the determination of small quantities of iron, particularly in commercial aluminium salts, is, of course, common to all laboratories. It has been practised for many years, both for scientific and technical purposes, and as is well known, depends on the formation of the red ferric thiocyanate ($Fe_2 6SCN$), soluble in water, alcohol and ether. It is often recklessly referred to as "the sulphocyanide process," without reference to the marked effect upon the results of alterations in the working conditions, such as amount of reagent used, proportion of free acid present, presence of oxidisers employed to convert ferrous into ferric iron, etc.; all of which must have been noticed by such as have had to use this method largely, and without attention to which one observer might easily report five, or even ten times as much iron as another. I have been unable to find any account of experiments systematically made with the object of fixing the limits of interference from these and other ordinary causes, and have, in consequence, undertaken a series, of which the following is a statement:—In the course of the work it was observed that the well-known solubility of the red colour in ether was accompanied not only by a brightening of the tint from red to crimson, but by an increase in its depth, the same volume of the ether solution showing at least three times the intensity of colour, for the same amount of iron, that the water solution did. It occurred to me that this fact might be taken advantage of to increase the delicacy of the reaction in determining iron in commercial products, such as alum; while at the same time the uncertainty due to opalescence from mechanical impurities and from slightly coloured solutions would be obviated. It seemed requisite, therefore, to carry out four series of experiments, namely:—

1st Series—Iron in water solution, without ether extraction.
2nd ,, ,, ,, ,, with ,, ,,
3rd ,, ,, alum ,, without ,, ,,
4th ,, ,, ,, ,, with ,, ,,

The purity of the reagents, as regards iron, had to be ensured, and an examination soon showed that these, sold as pure, for analytical purposes, were quite unreliable, as they all contained a sufficient proportion of iron to vitiate the results.

Thiocyanate of ammonium, which was found to be more free from iron than the corresponding potassium compound, was obtained practically iron-free by acidifying very slightly with hydrochloric acid, crystallising twice, and washing several times with ether.

Sulphuric acid (for acidification) was obtained pure by dissolving the anhydride in the purest oil of vitriol obtainable, and distilling at a gentle heat into water.

Iron-free alum was obtained by five successive recrystallisations of the best Turkey-red alum procurable.

The purified reagents tested under all working conditions gave no indication of the presence of iron.

In the following trials the iron is the only quantity which remains constant throughout. The amount fixed upon was 0·00001grm. of Fe, as being approximate to that likely to be found in 1 grm. of good alum, or 0·001 per cent. The iron employed was in the form of iron-alum.

1st Series: *Iron in Aqueous Solution, without Ether Extraction*—

TABLE I.—IRON AND WATER ALONE.

NH_4SCN Employed.	Vol. of Solution.	Result.
1 equiv. = 0·000041grm.	20cc.	No colour.
2 ,, = 0·000082 ,,	,,	,,
10 ,, = 0·000410 ,,	,,	,,
100 ,, = 0·004100 ,,	,,	,,
1000 ,, = 0·041000 ,,	,,	,,
10,000 ,, = 0·410000 ,,	,,	,,
20,000 ,, = 0·820000 ,,	,,	,,

From these results it will be seen that neutral thiocyanate in any practicable proportion, gives no colouration with ferric salt, at least when only a small amount of iron is present. The following table shows the effect of free acid, that employed being sulphuric, as it is the only one likely to be met with in aluminium salts:—

TABLE II.—IRON, WATER AND FREE ACID.

NH_4SCN employed.	Free $\frac{N}{1}H_2SO_4$	Vol. of Solution.	Result.
1 equiv. = 0·000041grm.	0·1cc.	20cc.	No colour.
2 ,, = 0·000082 ,,	,,	,,	,,
10 ,, = 0·000410 ,,	,,	,,	,,
100 ,, = 0·004100 ,,	,,	,,	Faint rose.
1000 ,, = 0·041000 ,,	,,	,,	Decided ,,
10,000 ,, = 0·410000 ,,	,,	,,	Strong ,,
20,000 ,, = 0·820000 ,,	,,	,,	Stronger,,

These results show that it is only when 100 times the theoretical amount of thiocyanate is used that any colour at all is developed, even when the fluid is very decidedly acid, the tint increasing with the proportion of that reagent, up to 20,000 equivs., the free acid being a fixed quantity. The following table shows the results with 10 times the amount of free acid, all other conditions being equal:—

TABLE III.—IRON, WATER AND FREE ACID.

NH_4SCN Employed.	Free $\frac{N}{1}H_2SO_4$	Vol. of Solution.	Result.
1 equiv. = 0·000041grm.	1cc.	20cc.	No colour.
2 ,, = 0·003082 ,,	,,	,,	,,
10 ,, = 0·000411 ,,	,,	,,	,,
100 ,, = 0·004100 ,,	,,	,,	Distinct rose.
1000 ,, = 0·041000 ,,	,,	,,	Strong ,,
10,000 ,, = 0·410000 ,,	,,	,,	Stronger ,,
20,000 ,, = 0·820000 ,,	,,	,,	Strongest ,,

It is thus clear that with 5 per cent. of the entire volume of normal sulphuric acid in excess, no colour is obtained until 100 times the amount of thiocyanate is used, which is theoretically sufficient to convert all the iron present into ferric thiocyanate, and that the effect increases up to 20,000 equivalents, and probably beyond it. As no very great intensity was apparent beyond the 10,000 equivalents, a series of trials was made with this amount as a fixed, and the acid as a varying quantity, the results of which appear in Table IV. given on following page.

It is apparent from these results that the maximum effect is obtained by employing the normal acid in the proportion of one-tenth of the entire fluid bulk, and that no advantage is gained by adding more.

These results clearly demonstrate (1) that water solution of ferric salt, containing a small proportion of iron, such as is likely to be met with in saturated cold solution of commercial alum, does not give any colouration with neutral thiocyanate, even when the latter is used in enormous excess. (2) That the same negative result is obtained when free sulphuric is present up to 5 per cent. of the total volume of fluid of normal acid, even although ten times the theoretical amount of the thiocyanate be used. (3) That the intensity of colour increases with the amount of thiocyanate employed for the same quantity of free acid. (4) That the proportions of the reagents which give the best results are 10 per cent. of the total volume of fluid of normal sulphuric acid, and 10,000 times the proportion of thiocyanate required theoretically to produce ferric thiocyanate.

TABLE IV.—IRON, WATER AND FREE ACID.

NH_4SCN Employed.		Free $\frac{N}{1}H_2SO_4$	Vol. of Solution.	Result.
10,000 equiv. =	0·110000grm.	0·1	20cc.	Strong rose.
,,	,,	0·5	,,	Stronger ,,
,,	,,	1·0	,,	Still stronger rose.
,,	,,	2·0	,,	Full rose.
,,	,,	3·0	,,	Same as preceding.
,,	,,	4·0	,,	,,
,,	,,	5·0	,,	,,
,,	,,	10·0	,,	,,

2ND SERIES: *Iron in Water Solution, with Ether Extraction.*—Three series of trials were made, identical in every particular with those under Tables I., II., and III., and the water solution in each case shaken up with an equal volume of ether. The results were precisely the same as in these cases, excepting, of course, that the colour of the ether solution was altered from pale red to crimson, and intensified three-fold.

Another series was carried out on the basis of Table IV., which showed that the rose was developed in the third experiment instead of in the fourth as in the case of the water solution.

3RD SERIES: *Iron in Alum Solution, without Ether Extraction.*—In order to determine whether the same intensity of tint was produced in alum solution as in water solution, two trials were made with the most favourable proportions in each case, of thiocyanate (10,000 equivalents), and of normal acid (5 per cent. of total volume), all the conditions being equal except that one of the portions contained 2grms. of iron-free alum. It was at once seen that only half the intensity was produced in the latter case.

A series of trials was then made in the same manner to test the effect of variable proportions of free acid with constant quantities of all the other ingredients, the 2grms. of iron-free alum giving as nearly as possible a saturated solution. This led to the conclusion that no proportion of the normal acid, at least up to 50 per cent. of the total volume, had any appreciable effect in intensifying the colour. It follows, therefore, that while alum prevents the development of half the colour, it acts as an acid, but the effect is not appreciably intensified by any proportion, within the limits stated, of free acid, as is the case in water solutions of iron. These trials were made precisely on the basis of those in Table IV.

4TH SERIES: *Iron in Alum Solution, with Ether Extraction.*—A series of trials was now made in order to determine the effect of free acid, if any, on alum solutions, when the red colour was extracted with ether, all other conditions being the same as in Table IV. The results showed, contrary to what I expected, judging from those obtained without ether, that free acid materially increased the colour in the ether solution, an effect which is no doubt due to the fact that free sulphocyanic acid must be formed before the colour is produced at all, and that the ether removes it and the iron from the bleaching influence of the aluminium compound. It was further observed that no intensification could be produced by free acid beyond one-twentieth of the total final volume of fluid employed.

Ether extraction of the red ferric thiocyanate, therefore, has the following advantages, under all working conditions: It develops the red tint to triple intensity, besides increasing its brilliancy. It obviates the difficulty too commonly met with, of comparing colours in solutions which are opalescent from mechanical impurities, and in solutions which have naturally a brown or yellow tinge. It admits of the concentration of the iron, by the extraction of a large volume of ferric solution with a small volume of ether, and in this respect it is to micro-iron-determination what distillation is to Nesslerising. Finally, it does away with the injurious effect which aluminium salts have of preventing the development of the red colour, and thus admits of iron being estimated in alum with precision, by comparison with standard ferric solution in water, without the necessity of employing an absolutely iron-free alum for comparison.

In the working out of these experiments, I found that the scale upon which they were made was rather large for convenience and rapidity of execution, and have consequently been led to adopt only half the quantities all round, and I have now no hesitation in recommending the following process, which for simplicity, certainty, and rapidity is unsurpassed, if equalled, by anything in quantitative analysis; while for accuracy it is enough to say that it is capable of estimating iron in alum with the greatest ease to a unit of the fourth place of decimals (=·0001) per cent., or one part per million, and, with a little more trouble, to a tenth or even a hundredth of that amount.

PROCESS.

1. Make a standard solution of iron-alum ($Fe_2 3SO_4, K_2SO_4 + 24H_2O$) by dissolving 8·606grms. and making up with distilled water to one litre. As the alum contained 11·62 per cent of Fe, this will give a solution containing exactly 1grm. of metal per 1000cc. This solution should contain no free acid, and it will keep clear for weeks. Weaker standards become turbid, hence they must be made from this when required.

2. Place 1grm. of the finely-powdered sample in an ordinary stoppered sample-tube of about 30cc. capacity, and having three file marks—at 7½, 10, and 20cc. respectively. Add 1cc. of normal iron-free sulphuric acid, and make up to the lowest mark with pure water. Dissolve the alum by shaking the tube for a few seconds in a beaker of hot water, and when dissolved cool the solution again by holding the tube in cold water for a few seconds more. Add now 0·2grm. of iron-free ammonium thiocyanate, and make up to 10cc. with pure water.

3. Place 1cc. of the standard iron-solution of 1 in 100cc. flask, and make up to the latter volume with distilled water. Now place 1cc. of this reduced iron standard in a similar stoppered sample tube to that of 2, add 1cc. of the normal acid, make up to the lowest mark with water, add 0·2grm. of the thiocyanate, and make up to the 10cc. with water.

4. Finally, fill up both tubes to the 20cc. mark with ether and agitate them thoroughly. As soon as the contents settle compare the tints, and, if unequal, of course one or more further trials are made with greater or less quantities of standard iron-solutions

as may be necessary. Water takes up about $\frac{1}{10}$th of its volume of ether, and it so happens that this retained ether holds its proportion of the ferric thiocyanate; but as this is equally the case with the sample and with the standard, it is of little consequence; but in all delicate experiments the ether solution should be drawn off into graduated cylinders after adding a washing with an equal volume of ether, and compared there in any way most convenient.

Precautions.—The necessity for iron-free reagents has already been referred to. The thiocyanate may be prepared pure enough for all ordinary purposes by twice recrystallising the best obtainable in a very feebly acid solution, and washing with ether till the washings are colourless. Although the product is not absolutely iron-free, it appears so under working conditions. The acid may be obtained pure enough by distilling into water at a temperature much below its boiling point, of the purest obtainable oil of vitriol. Of course in all cases the reagents will be tested collectively by a blank experiment. The same precautions must be observed with regard to the vessels employed; all must be thoroughly digested with strong hydrochloric acid, and thoroughly washed before use; they should be kept under a glass shade, and employed for nothing else.

The operations should be conducted with as little light as possible, and certainly never in direct sunlight, or even in strong diffuse daylight. Berzelius in his "Traité de Chimie," vol. iv. p. 212, says that, according to Grotthus, a solution of ferric thiocyanate becomes as colourless as water by being exposed to the sun's rays for a few hours. I have found much more striking results, however, as a water solution of a medium port-wine colour was entirely bleached in one hour by a March sun at mid-day. I may add that the ether solution is also rapidly bleached by the sun's rays, but unlike the water solution it returns spontaneously within an hour if kept in a moderate light, and this is another advantage in the use of ether.

Oxidisers should be avoided, particularly peroxide of hydrogen, which, even in small quantity, destroys the red colour. Of course they would be required for ferrous iron, even small amounts, if the ether-extraction were not adopted, but not otherwise, as when the ether is employed the iron is completely oxidised to the ferric state, probably by the ozonisation of the air with which the fluid is agitated. So completely is this the case that it is of no moment whether the standard iron solution be made from a ferrous or a ferric salt, provided it contains the same proportion of metal.

The results of the following experiments demonstrate the last observation:—

Two trials were made with 0·00001 and 0·001grm. of iron respectively, in the ferrous state, both without and with ether-extraction, with the following results:—

Fe employed.	Without Ether, Fe found.	With Ether. Fe found.
0·00001grm.	0·000005grm.	0·00001grm.
0·001 ,,	0·00003 ,,	0·001 ,,

The composition of the mother-liquor from green alum shows that the greater part of the iron is already in the ferric state. A sample gave the results which appear in table on the next column.

It is not necessary in carrying out the process to take into account any free acid that may be present in alum or sulphate of alumina, as any proportion ever met with cannot interfere. During the agitation with ether a considerable quantity of the alum or sulphate of alumina is precipitated, but this is of no consequence, as all the iron remains in the solution.

	Per cent.
Sulphate of Alumina	10·39
Persulphate of iron	7·67
Protosulphate of iron	2·18
Protochloride of iron	1·29
Chloride of manganese	0·18
Sulphate of lime	Trace.
Sulphate of potash	0·38
Chloride of sodium	2·09
Chloride of magnesium	2·90
Hydrochloric acid (HCl)	7·33
Arsenious acid	0·67
Phosphoric acid	0·19
Water	64·73
	100·00
Specific gravity	1·3126
Ammonia and titanic acid	Absent.

A sample of Turkey-red alum gave 0·0005 per cent. of Fe by the above method, while a sample of high-class sulphate of alumina gave 0·0010 per cent.

In conclusion, it should be noted that it is desirable to keep as nearly as possible to 0·00004grm. of iron in 10cc. of fluid, as that is a good proportion for accurate colour-reading.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Improvements in the Manufacture of Filters applicable for the Filtration of Water and other Liquids. J. R. Shearer, Stoke Newington. Eng. Pat. 734, Jan. 18, 1886. 8d.

THE improved filter consists of a hollow sphere or cylinder of unglazed porcelain contained in a case of the same form. The unfiltered water is admitted into the annular space between the septum and the case, and filters through into the interior of the septum. The surface of the septum is cleansed by means of a current of unfiltered water allowed to pass through the casing, a gyratory motion being imparted by suitably-shaped partitions.
—C. C. H.

Improvements in Apparatus for Cooling and Condensing Purposes. H. E. Newton, London. From E. Theisen, Leipsic, Germany. Eng. Pat. 2927, March 1, 1886. 8d.

THE object of this invention is the continuous use of a fixed quantity of cooling or condensing water for the purpose of refrigerating a liquid or condensing a vapour. This is effected by a modified form of "surface condenser," constructed of corrugated or convoluted tubes.

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* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.	½d.
Above 8d., and not exceeding 1s. 6d.	1d.
,, 1s. 6d., ,, ,, 2s. 4d.	1½d.
,, 2s. 4d., ,, ,, 3s. 4d.	2d.

The heat absorbed by the cooling liquid is got rid of by exposing a thin film of the liquid to the air, by means of continuous rotating discs, by a series of plates alternately immersed in the liquid and exposed to the air, and by various other similar devices described at length, the essence of all of which is the continuous exposure of films or thin surfaces of the cooling liquid to the atmosphere.—C. C. H.

Improvements in and in Apparatus for Distilling Water. A. M. Clark, London. From P. Oriolle, Nantes, France. Eng. Pat. 3326, March 9, 1886. 11d.

The improvements consist in arranging a group of heating and condensing apparatus so that steam generated in the first of the series serves for the evaporation of a further quantity of water in the second of the series, and so on in a similar manner to the well-known method employed in *triple effet* vacuum pans. Five of such units are usually employed, the original source of heat being a steam boiler. The construction of the different parts of the apparatus exactly resembles that of some forms of feed-water heaters, in which the circulation of steam is insured by means of a small annular pipe placed in a larger heating pipe, the latter having one free closed end. The different elements or units are connected with pipes and cocks for the collection of condensed water and the circulation of steam and sea water undergoing distillation.—C. C. H.

Improvements relating to the Purification of Water and to Apparatus therefor. C. W. Burton, Nogent, and F. T. Moison, Mouy, France. Eng. Pat. 3731, March 16, 1886. 11d.

This specification describes at length various mechanical contrivances for the addition of purifying or precipitating reagents to a water, and the separation of the precipitate resulting. This is primarily effected by means of an hydraulic balance, which measures the water undergoing purification, and by its oscillation tips a measured quantity of the reagent into the water thus measured. The precipitate is separated in a decanting apparatus, several forms of which are described at length.

—C. C. H.

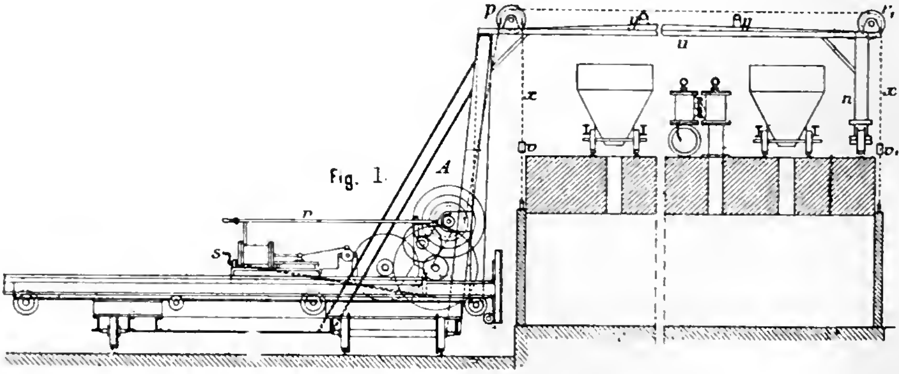


Fig. 1.

Improvements in Filtering Apparatus. H. E. Newton, London. From W. M. Deutsch, New Jersey, U.S.A. Eng. Pat. 16,994, Dec. 28, 1886. 11d.

The improvements refer to that description of filter which consists of a filtering bed of finely divided material placed in a cylinder, through which the water is forced, the impurities being removed from time to time by reversing the flow of water through the apparatus. They consist—(1) In dividing the lower part of the bed into four sections by vertical axial partitions, in order to concentrate the force of flow of the cleansing water. (2) Providing washing-out pipes for a reversal of flow at two or more different depths in the bed. (3) Providing a receptacle from which the incoming water can take up a precipitating material, such being regulated by holes in the outer periphery arranged in a "gridiron" fashion. The patentee makes fifteen claims.—C. C. H.

II.—FUEL, GAS, AND LIGHT.

Improvements in Coke Ovens. Dingl. Polyt. J. **262**, 520—523.

To facilitate the removal of the charge from horizontal coke ovens, Roechling Bros. have devised an arrangement (Ger. Pat. 35,407, Sept. 2, 1885) which admits of the simultaneous opening of both working doors of each chamber from one side of the oven. The contrivance illustrated in Fig. 1, is attached to the locomotive apparatus used for removing the coke from the oven. The drawing shows also that the ovens are charged by bringing the trucks, loaded with the material to be coked over the charging holes, and dropping the contents into the respective chambers by withdrawing the bottom of the truck. Quaglio (Ger. Pat. 36,097, August 29, 1885) has devised an arrangement consisting in loading each chamber from its side, a truck being used which is of the same length as the coking chamber, and travels on a railway facing the coke oven. The truck has two side flaps *a* (Figs. 2 and 3), a movable bed-plate *b*, and two movable ends *c* and c_1, forming a square box, the dimensions of which are somewhat less than those of the chambers. This box rests on a trolley *d*, worked by a winch *h*. The charge is compressed in the truck by a specially-constructed stamping arrangement, and is then loaded into the oven by bringing the truck in front of the chamber A, turning the flaps of the box aside, and drawing the box with its bed and contents into the chamber. The ends c and c_1 are then removed, and the furnace doors B lowered, sufficient space being, however, left for withdrawing the bed plate. In Fig. 2, C represents a coke ramp. To economise space the removal of the coke may be effected by the machine used for loading the charge, as illustrated in Fig. 4. Collin, of Dortmund, has patented a vertical coke oven (Ger. Pat. 36,518, Aug. 18, 1885), the essential feature being the production of firm coke in an apparatus which occupies but little space compared with its working power. In Figs. 5 to 7 the charge is introduced into the chambers O, through the openings F. The coke is removed by withdrawing the horizontal bed plates T. The gases from O proceed through the apertures *a* into the flue C; they then pass through the openings V, into the lateral flues, ascend in W in a spiral direction (see Fig. 7), and proceed through *v* into the upright passage H and the flues H, H_1, and thence into the main flue C. The air supply proceeds from the flue L, which is parallel to G, through the channels Z into V, where it mixes with the gases from C. By this construction of the flues the heat, which is radiated by the outer walls of the oven, assists the coking process to a considerable extent. To recover the bye-products from the distillation gases a condensing apparatus may be interposed between

Fig. 2.

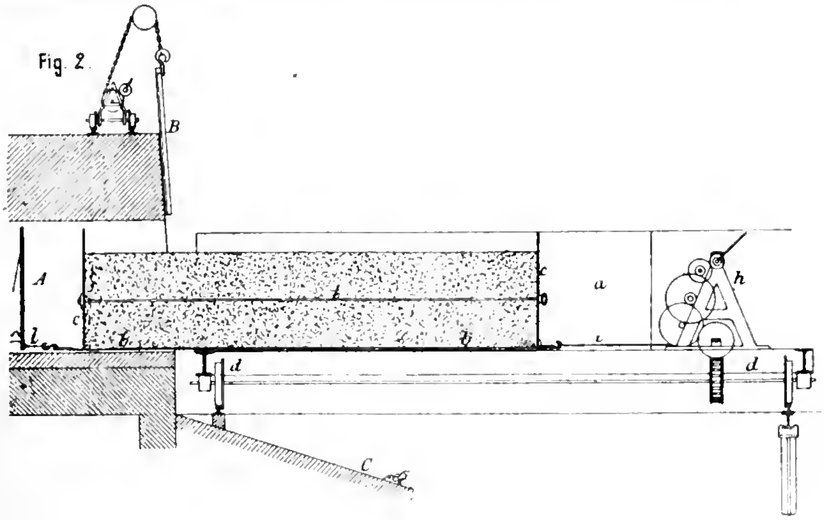


Fig. 3.

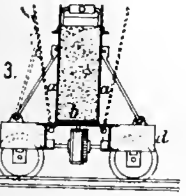


Fig. 4

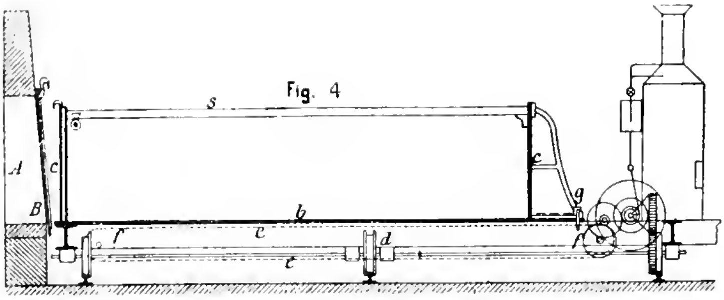


Fig. 13

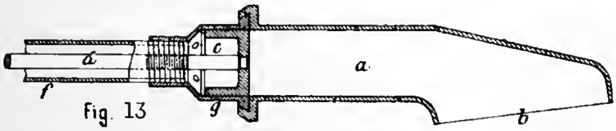


Fig 11

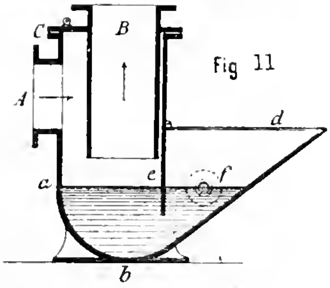


Fig. 9

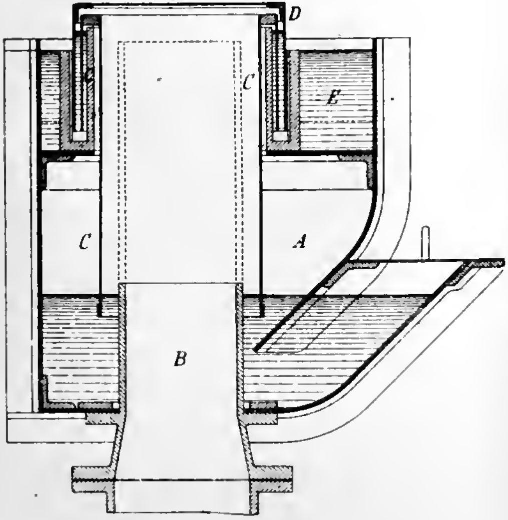


Fig. 12

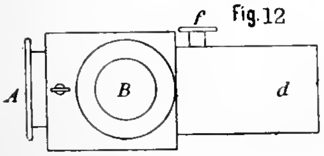


Fig 8

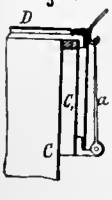
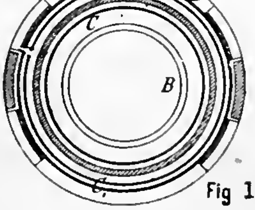


Fig 10



C and the subsequent system of flues. Quaglio has patented a water seal (Ger. Pat. 36,357, Nov. 7, 1885), for coke ovens with recovery of by-products, which is illustrated in Figs. 8 to 10. A pipe C is placed over the gas exit pipe B, the upper end of which is sealed by the water tank E, and the lower part by A. The top of C is closed by the cover D. When C is raised the exit pipe B is open, whilst on lowering it all communication with the coking-space is stopped. To prevent the possibility of leakage through tar, carbonaceous matter, or pitch, adhering to the plugs or seatings of gas stop-cocks, Schmalz (Ger. Pat. 37,182, April 14, 1886) has devised an arrangement represented in Figs. 11 and 12. A is the gas inlet, B leads to the condenser; the part ab is made round, so that the tar or pitch from A may be deposited in ab, and pushed forward to d, by introducing a long chisel through a plug screwed into the cover C; the seal effected by the partition e, and the water from A prevents the escape of gas at d, the excess of water being run off through f. When f is closed, the water from A rises to d, and thereby seals the pipe B. To repair the brickwork of the chambers of coke ovens without stopping the process, Kleist and Zeller recommend the use of an instrument illustrated in Fig. 13. It consists of a cylinder a, with mouthpiece b, the piston c, piston rod d, shaft f, and bush g. The cylinder is charged with mortar made of fire-clay, and placed with its mouthpiece b in or near the wall or joint to be filled up. The mortar is then pressed into the joint with the piston c.

—D. B.

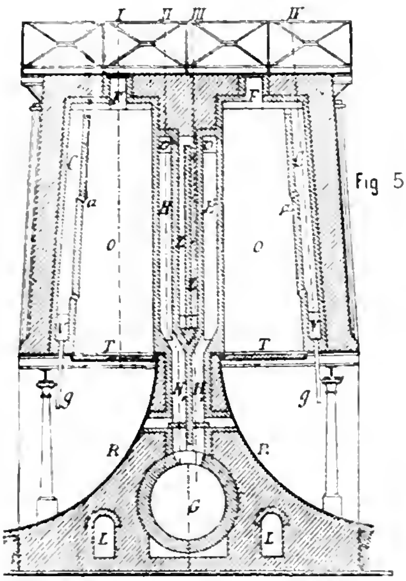


Fig 5

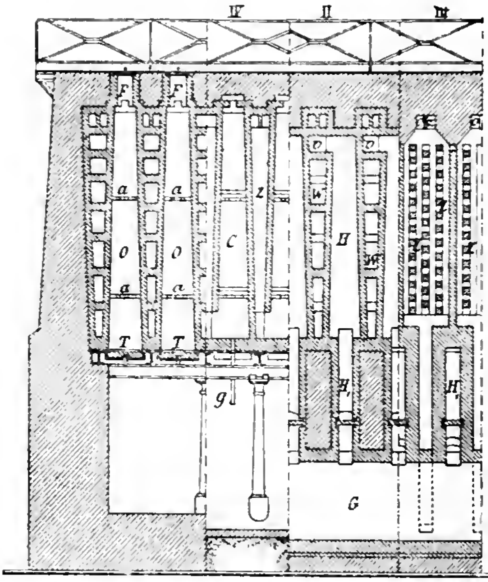


Fig. 6

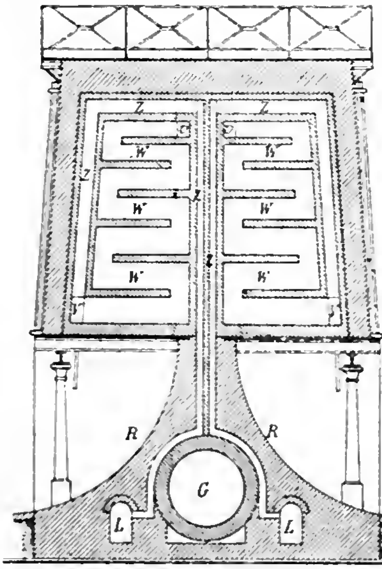


Fig. 7

Wolf's Safety Lamp. Oesterr. Ztschr. f. Berg. u. Hüttenw. 1886, 472—473.

This is a benzene lamp so contrived that it can be lighted whilst closed. The benzene used gives a bright light compared with oil, and just enough is added to saturate the porous material in the lamp. The flame can be regulated by a screw at the bottom of the apparatus, and extinguished at will. The great advantage of the lamp is that it can be lighted without opening it; this is done by a little friction machine in the lamp for firing caps, which are attached to a strip of paper and inserted in a coil. By touching a button under the lamp one of the caps is fired and so lights the vapours of benzene coming off from the wick of the lamp. The coil contains 75 caps, only costs a few pence, and the apparatus is practically perfect as regards safety. The lamps have been largely used with great success in several mines near Dortmund.—E. E. B.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Production of Light Hydrocarbons from Heavy Paraffin Oils, Crude Petroleum, Petroleum Residues, and the Tar obtained in the Manufacture of Oil Gas. Chem. Zeit. **10**, 1622.

This process, which is patented by Riebeck, consists in subjecting the above oils to distillation in cast-steel retorts under a pressure of several atmospheres, whereby the high boiling hydrocarbons are decomposed with formation of a large proportion of valuable light oils, the residue being used for the manufacture of lubricating oils or asphalt making. The pressure to be applied depends upon the character of the oil to be treated—*e.g.*, the tar oils from brown coal give the best results when subjected to a pressure of from 3 to 6 atmospheres, whilst petroleum and its residues requires a pressure of 2 to 4 atmospheres, and the tar from oil gas 4 to 6 atmospheres. The following are the results of some experiments made on a large scale to illustrate the advantages of this process. A dark-coloured heavy paraffin oil was used, having a sp. gr. of 0·912 at 17·5°, a viscosity of 2·5, and yielding only 15 per cent. of distillate below 300°. The oil was distilled at a pressure of 3 atmospheres. The distillate formed a brown mobile liquid having a sp. gr. of 0·800—0·820 at 17·5°, and yielding on rectification a colourless burning oil of high illuminating power, the sp. gr. of which was 0·815 and the flashing point 30°. The constitution of the distillate was the same whether 30 or 80 per cent. of the original oil was distilled off; the residue, however, varied with the percentage of distillate obtained. By taking off from 25—30 per cent. the residue formed a good lubricating oil of 0·930—0·950 sp. gr. and a viscosity of 7—10. When 50 per cent. of the oil was distilled off, the residue formed a black pitchy mass of 1·005 sp. gr., whilst in the case of 80 per cent. of distillate, a coky asphalt remained in the retort.

—D. B.

The Blue Colouration of Ammonium Sulphate. Frère. Les Corps Gras Industr. **13**, 161.

A BLUE colouration of ammonium sulphate is due to cyanides in the ammoniacal gas-liquor, and if a white-finished product is required the ammonia still must be connected with the acid tank by a leaden pipe. An iron pipe invariably gives a blue-coloured product. The acid itself rarely contains so much iron as to colour the finished product.—S. H.

Improvement in Petroleum Oils. E. Phillips, London. Eng. Pat. 5801, April 28, 1886. 4d.

THIS invention consists in tinting petroleum with a distinguishing colour by adding a small quantity of a dyeing material, preferably aniline scarlets and violets. Consumers are thereby enabled to ascertain at a glance the quality of the petroleum supplied to them, however small the quantity may be.—D. B.

IV.—COLOURING MATTERS AND DYES.

Researches on the Constitution of Azo and Diazo Derivatives. I. Diazo-amido Compounds. R. Meldola and F. W. Streatfeild. J. Chem. Soc. **1887**, 102—118.

IN a former communication the authors have shown that the hydrogen atom in the group $—N_2.NH—$ in diazo-amido compounds can be readily replaced by an alkyl radicle; they described the ethyl derivative of paradinitrodiazoamidobenzene as a type of these compounds. In the present paper the authors continue their investigations on other diazo-amido compounds, with special reference to the decomposition of these bodies by means of acids.

By the action of diazotised metanitraniline upon paranitraniline a substance was obtained crystallising from alcohol in yellow needles, melting with decomposition at 211°. The analyses gave results which agreed with the formula $NO_2C_6H_4.N_2.NH.C_6H_4NO_2$. In its general properties it agrees with the isomeric paradinitro-compound, although not of such an acid character. On complete reduction it gives a mixture of meta- and paraphenylenediamine. Decomposed with hydrochloric acid at 100°, a mixture of para- and metanitrochlorobenzenes, in addition to a mixture of para- and metanitranilines, was obtained. The ethyl derivative was prepared in a similar manner to the corresponding para compound, and was obtained in small yellow needles melting at 148°. On analysis it gave numbers agreeing with the formula $NO_2.C_6H_4.N_2.N(C_2H_5)C_6H_4NO_2$. Heated with hydrochloric acid to 100° it gave a mixture of meta- and paranitrochlorobenzene, also ethylmeta- and ethylparanitraniline.

By the action of one molecule of sodium nitrite upon two molecules of metanitraniline *metadinitrodiazoamidobenzene* was prepared (first obtained by Griess, *Ann. Chem. Pharm.* 121, *272*). It crystallises from alcohol in straw-coloured needles melting at 194° (195·5°, Griess). Analyses agreed with the formula $NO_2.C_6H_4.N_2.NH.C_6H_4.NO_2$. It differs from the para and the unsymmetrical derivative in being very much less acid in character. On decomposition with hydrochloric acid it gives metanitrochlorobenzene and metanitraniline. Nothing of a phenolic nature was obtained. The ethyl derivative was prepared and obtained in pale yellow needles melting at 119°. When decomposed with hydrochloric acid, ethylmetanitraniline and metanitrochlorobenzene were obtained. The authors find that the compound obtained by the action of diazotised paranitraniline upon metanitraniline is identical with that obtained by the action of diazotised metanitraniline upon paranitraniline, thus confirming the observations of Griess, Sarauw, and Nölting and Binder upon other diazo-amido compounds. From theoretical considerations the authors come to the conclusion that isomeric transformation may take place. In order to throw light upon this question, the authors have studied the action of diazotised nitranilines upon ethylnitranilines. Diazotised metanitraniline gives with ethylparanitraniline a yellow crystalline body, melting at 174—175°; isomeric with that obtained in an earlier part of the work, melting at 148°. Treated with hydrochloric acid it gives ethylparanitraniline and metanitrochlorobenzene. When diazoparanitrobenzene chloride acts upon ethylparanitraniline a compound is obtained which was recognised as paradinitrodiazo-ethylamidobenzene (*J. Chem. Soc. Trans.* xlix. 630). By the action of paranitraniline upon ethylmetanitraniline a body was obtained, crystallising from alcohol in orange-red needles melting at 187°. This body appears to be an amido azo compound, but is undergoing further investigation. Diazotised metanitraniline gives with ethylmetanitraniline a compound identical with that obtained by the direct ethylation of metadinitrodiazo-amidobenzene. By the action of benzyl chloride upon the potassium salt of paradinitrodiazo-amidobenzene, paradinitrodiazobenzylamidobenzene is obtained, crystallising from benzene in yellow needles melting at 190°. Heated with hydrochloric acid, paranitrochlorobenzene and benzylparanitraniline are obtained. Benzylparanitraniline crystallises from alcohol—in which it is very soluble—in golden-yellow leaves melting at 142—143°. It is a weak base. Treated with nitrous acid it gives a nitrosamine, crystallising from acetic acid in lustrous straw-coloured needles melting at 107·5°. The corresponding metadinitrodiazobenzylamidobenzene was obtained, after crystallising from alcohol, in pale-yellow needles melting at 142°. Decomposed with hydrochloric acid it gives metanitrochlorobenzene and benzylmetanitraniline; this last substance treated with nitrous acid gives a nitrosamine, which was obtained as an oil. The benzyl-derivative of the unsymmetrical dinitrodiazo-amido-compound was also prepared. It was obtained in microscopic yellow needles insoluble in alcohol, very soluble in benzene, and melted at 180°. Decomposed with hydrochloric acid it gives a mixture of benzylpara- and benzylmetanitraniline, with the corresponding nitrochlorobenzenes. In conclusion, the authors discuss briefly the bearing of the experimental evidence upon the constitution of the foregoing diazo-compounds, and propose to continue their investigations.—R. M.

Manufacture of the Eosin Colouring Matters. O. Mulhäuser. Ding. Polyt. J. **263**, 49—58 and 99—107.

THE author gives a long and detailed description of the preparation of these dyestuffs, of which the following is a summary:—

Fluorescein.—This body, which itself has little tinctorial value, is the starting-point of all the eosin colouring matters, which are derived from it by replacement of hydrogen by Br, I, NO_2, etc. It is prepared by heating together resorcinol and phthalic anhydride with or without addition of zinc chloride.

(*a*) 17½kilos. of phthalic anhydride are added with stirring to 25kilos. of melted resorcinol contained in an enamelled pot set in an oil bath, which is heated to about 160°. After heating for about 1½ hours at 180°, the reaction commences, and lasts for about 40 minutes, the melt boiling vigorously. The heating is continued for 23—30 hours at 200—205°, with occasional stirring. The crude fluorescein thus obtained is boiled in a tub with 500 litres of water and 50kilos. of aqueous $NaOH$ of 36° B. The volume of the solution is made up to 1000 litres and filtered. The fluorescein is precipitated from the filtrate by addition of 90kilos. of hydrochloric acid, washed by decantation, and dried. The yield is about 36kilos.

(b) 8kilos. of powdered zinc chloride are quickly added to a fused mixture of 25kilos. of resorcinol and 17kilos. of phthalic anhydride heated to 180°. The pot is covered up and stirred with an iron rod for about 5 minutes. The reaction then sets in, and the mixture becomes nearly solid. The heating is continued for about 10 hours at 190—200 , and the product is purified as in *(a)*.

Tetrabromofluorescein.—The sodium and ammonium salts of tetrabromofluorescein come into commerce under the names of *Eosin A*, *Eosin B*, *Soluble eosin*, etc.

(a) 32kilos. of bromine are dissolved in 60kilos. of aqueous $NaOH$ (36° B.) diluted with 150 litres of water, and the solution boiled to decompose hypobromite. 16kilos. of fluorescein are dissolved in 25kilos. of aqueous $NaOH$ (36° B.) diluted with 150 litres of water. The two solutions are mixed in the cold, treated with 140kilos. of hydrochloric acid, and heated to boiling. The precipitate of tetrabromofluorescein is washed by decantation and dried. The yield is about 30kilos. It is converted into the ammonium salt by spreading it out on trays and exposing it to the action of dry ammonia gas until a test dissolves in water to a clear solution (yield : 31·8kilos. from 30kilos. of the acid). The sodium salt is prepared by adding exactly the right quantity of $NaOH$ solution (determined by experiment) to 60kilos. of tetrabromofluorescein, suspended in 210kilos. of boiling alcohol. On cooling, the pure sodium salt crystallises out (yield = about 57kilos.).

(b) 24kilos. of bromine are slowly run into 10kilos. of fluorescein, suspended in 80kilos. of cold alcohol. The bromination is complete in 15 minutes; the pans are then covered up and allowed to stand for three or four days. The precipitate is washed with alcohol and dried. The yield of tetrabromofluorescein by this method is about 17kilos. It is converted into the sodium or ammonium salt in the manner described above.

Dibromofluorescein (eosin-orange).—10kilos. of fluorescein are suspended in 80kilos. of cold alcohol and treated with 12kilos. of bromine. The dibromofluorescein remains dissolved in the alcohol, and is precipitated by addition of about 100 litres of water. The precipitate, after being washed, is dissolved in 200 litres of water and 20kilos. of aqueous $NaOH$ (36° B.), and when cold re-precipitated by 40kilos. of hydrochloric acid. The yield of washed and dried dibromofluorescein amounts to 15½kilos. It is converted into the sodium salt by exact neutralisation with $NaOH$, and evaporated to dryness (yield = 17kilos.).

Ethyltetrabromofluorescein.—The potassium salt of this acid is used for silk-dyeing under the names of *Spirit-eosin*, *Primrose à l'alcool*, *Eosin à l'alcool*, *Rose J.B. à l'alcool*, etc. It is prepared by brominating fluorescein in boiling alcohol, by which means it is simultaneously ethylated. 52kilos. of bromine are allowed to run, through a glass tube dipping below the surface, into 20kilos. of fluorescein suspended in 80kilos. of boiling alcohol (96 per cent.) contained in a steam jacketed enamelled pressure vessel provided with a leaden cohobator and mechanical stirrer. As soon as all the bromine has been added, which takes about 50 minutes, the two cocks are closed, and the mixture heated under a pressure of 1½ atmospheres for three hours. When cold the precipitate is separated, washed with alcohol, then with water, and finally exactly neutralised with KOH in hot 36 per cent. alcohol (40kilos. of alcohol + 68kilos. of water). On cooling, the pure potassium salt crystallises out, whilst a certain amount of accompanying tetrabromofluorescein remains in solution. The yield of pure spirit-eosin is about 25kilos.

Dibromodinitrofluorescein.—The alkaline salts come into commerce as *Eosin scarlet*, *Ros des Alpes*, *Safrosin*, *Lutécienne*, *Daphnin*, etc. It is prepared by simultaneous nitration and bromination of fluorescein in alcoholic solution, or by nitration of dibromofluorescein in acetic acid or aqueous solution.

(a) To 7kilos. of fluorescein finely suspended in 60kilos. of alcohol 7kilos. of nitric acid (40° B.) are slowly added, and directly afterwards 7¼kilos. of bromine. After standing till next day the precipitate is washed with 30kilos. of alcohol, boiled with water two or three times and dried. Yield = 12½kilos.

(b) 4kilos. of finely-ground sodium nitrate is stirred into a paste composed of 30kilos. of tetrabromofluorescein and 25kilos. of glacial acetic acid. The mixture is heated on a water-bath. At 70—80° the reaction sets in, and is completed by six or eight hours' heating. The product is boiled for 10 minutes with 500 litres of water, and the precipitate washed by decantation. Yield = 29kilos.

(c) A cold, previously boiled, solution of 12kilos. of bromine in 20kilos. of aqueous $NaOH$ and 50 litres of water is mixed with a cold solution of 10kilos. of fluorescein in 13kilos. of aqueous $NaOH$ (36° B.) and 200 litres of water. The mixture is acidified with 40kilos. of sulphuric acid (40 B.) and 30kilos. of nitric acid (40° B.) slowly run in. Finally, the mixture is heated to boiling on a water-bath for five or six hours. The yield of washed and dried precipitate is 19½kilos. The product obtained by either of these processes is converted into the ammonium salt by means of gaseous ammonia, or into the potassium or sodium salt by neutralisation with a rather insufficient quantity of KOH or $NaOH$, by which means the impurities remain undissolved.

Tetra-iodofluorescein.—The sodium and ammonium salts are used for silk, cotton, and paper dyeing under the names of *Erythrosin B*, *Pyrosin B*, *Iodeosin B*, *Dianthin*, *Rose B à l'eau*, *Primrose soluble*, *Blue shade eosin*, etc. 6kilos. of fluorescein are dissolved in a hot mixture of 8kilos. of aqueous $NaOH$ (36° B.) and 60 litres of water. 24kilos. of iodine are dissolved in 27 to 28 kilos. of $NaOH$ (36° B.), diluted with 60 litres of water, and the solution boiled. The two solutions are mixed and acidified with 25kilos. of acetic acid. The mixture is boiled, neutralised with 17kilos. of aqueous $NaOH$ (36° B.), and re-precipitated by adding 25kilos. of hydrochloric acid diluted with 25 litres of water. The precipitate is boiled, separated, boiled several times with dilute HCl, lastly with water alone, and dried. The yield is about 15kilos. It is converted into the ammonium salt by dry ammonia gas.

Di-iodofluorescein.—Erythrosin G or Dianthin G, which consist chiefly of the di-iodo-derivative, is prepared in the same way as the preceding, except that only 16kilos. of iodine are used for 6kilos. of fluorescein. The yield is about 13kilos.—A. G. G.

On the Industrial Production of Resorcinol. Dr. Otto Mühlhauser. Dingl. Polyt. J. **263**, 154.

THE author gives a detailed account both of the method and plant employed for the production on a large scale of resorcinol. Benzene monosulphonic acid is first prepared by treating 60kilos. of pure benzene (free from thiophen) with 300kilos. of sulphuric acid of 67° B. in a cast-iron pan, provided with an agitator and a leaden reflux condenser. To bring about the reaction, the mixture is continuously stirred and a very gentle heat applied. After ten hours the reaction ceases. For the purpose of preparing the disulphonic acid, the monosulphonic acid is treated with an excess of sulphuric acid, and run into another cast-iron pan, similarly furnished with agitator and condenser, which, however, is turned downwards. The mass is mixed with 85kilos. of powdered and perfectly dry sodium sulphate, and heated in an oil-bath, so that the temperature of the mixture remains for eight hours at 225°. At first, benzene distils over and is collected, while sulphurous acid is evolved. The sodium salt of the sulphonic acid is then prepared in the usual manner and thoroughly dried. The yield is about 200kilos. 250kilos. of caustic soda and 10kilos. of water are now melted over the direct flame in a cast-iron pot, until the molten mass is so hot as not to solidify on the addition of the sodium salt. When a little common salt thrown in, dissolves rapidly with a hissing sound. the needed temperature has been reached, and after setting the agitator in motion, 125kilos. of the dry sulphonate are quickly introduced. When the mass has become brown and almost ceased to work, it is cooled, broken up and acidified with hydrochloric acid. The resulting liquor is now extracted four times with 100kilos. of purified amyl alcohol. After distilling off the latter with steam, the residue is evaporated to dryness in enamelled pans. To purify the resorcinol thus obtained, it is distilled in vacuo; water and phenol going over first. At about 190° the pressure should be decreased to 630mm. On heating further, the resorcinol begins to boil and distils over. The yield is 20—23kilos. of the pure product, or, from the numbers the author gives, about fifty per cent. of the theoretical yield on the benzene employed.—A. R.

Manufacture of a Yellow Dyestuff from Gallic Acid. Dingl. Polyt. J. **263**, 205.

THE dye, which can be fixed on the mordanted fibre like alizarin, and which has been termed "Galloflavin," is obtained by the action of air—*i.e.*, oxygen—on alkaline solutions of gallic acid. The process of oxidation depends on the amount of alkali present, for whereas it proceeds too quickly if the alkali be used in excess, the oxidation can be moderated by diminishing the quantity of alkali. In practice, 5 parts of gallic acid are dissolved in 80 parts of alcohol of 96° Tr. and 100 parts of water. The cooled solution is gradually mixed with 17 parts of a potassium hydrate solution of 30° B., stirring all the while, and never allowing the temperature to rise above 10° C. It is then exposed to the action of oxygen, either by blowing air through it or agitating it briskly. The progress of the oxidation shows itself by the liquor assuming at first an olive-green or greenish-brown colour, until finally a crystalline precipitate separates out. When the amount of this precipitate no longer increases, the operation is finished. The mass of crystals is quickly filtered, dissolved in warm water, decomposed with hydrochloric or sulphuric acid, and boiled, when the dye is precipitated in the state of glittering greenish-yellow plates. These are washed, and can then be applied for dyeing or printing. Galloflavin dyes cotton mordanted with alumina greenish yellow, which turns into a very brilliant yellow by the treatment with tin crystals. The chromium-lake of galloflavin is distinguished by being especially proof against soap, air or light.—S. H.

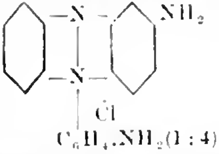
Constitution of Safranine. O. N. Witt. Ber. **19**, 3121—3124.

THE two formulæ lately proposed for this colouring matter, $C_6H_5.N\begin{array}{l} C_6H_3-NH_2Cl \\ \quad | \\ \quad N \\ \; / \\ C_6H_3-NH_2 \end{array}$ by Andresen, and $C_6H_5.\underset{Cl}{N}\begin{array}{l} C_6H_3-NH_2 \\ \qquad \diagdown N \\ \diagdown C_6H_3-NH_2 \end{array}$ by Bernthsen, are both open to the objection that being symmetrical they do not explain the unquestionable existence of pairs of isomeric mono- and (tertiary) di-alkylised derivatives. They are also both based upon the assumption that the third amine group becomes attached to the first-formed di-*p*-amidodiphenylamine by removal of both hydrogen atoms from its NH_2 group. This the author considers to be contrary to analogy with what generally takes place in such reactions, the hydrogen usually being removed half from the nitrogen and half from the carbon of the entering amine. Applying this view, leuco-safranine would be formed thus:

$$\begin{array}{lcl} H_2N.C_6H_3 & \boxed{H \quad H} & NH \\ \qquad | & & \; | \\ H_2N.C_6H_4.N & \boxed{H \qquad H} & C_6H_4 \end{array}$$

$$= \begin{array}{l} \qquad\quad H_2N.C_6H_3-NH \\ \qquad\qquad\qquad\; | \qquad\quad | \\ H_2N.C_6H_4.N\text{———}C_6H_4 \end{array} + H_4.$$

This gives for phenosafranine an unsymmetrical formula:



which admits of isomeric alkylised derivatives. Like the formulæ of Bernthsen and Andresen, it represents safranine as an azine, and only differs from these formulæ with respect to the position of one NH_2 group.—A. G. G.

Constitution of Safranine. R. Nietzki. Ber. **19**, 3163—3166.

THE author supports Witt's formula for this body. The non-identity of the two dimethylsafranines, (*a*) from *m*-dimethyl-*p*-phenylenediamine and 2mols. of aniline, (*b*) from *p*-phenylenediamine, dimethylaniline, and aniline, is shown by a microscopic examination of their crystalline nitrates. If, as is assumed in the formulæ of Andresen and Bernthsen, in the third amine the NH_2 only takes part in the reaction, all the homologues of aniline should give safranines with equal ease; this, however, is not the case. By oxidation, in conjunction with *p*-di amidodiphenylamine, safranines were obtained from the two xylidines $C_6H_3(NH_2)(CH_3)_2$(1 : 2 : 4) and (1 : 3 : 4), and from solid cumidine $C_6H_2(NH_2)(CH_3)_3$ (1 : 2 : 4 : 5): whilst xylidine (1 : 2 : 3) gave only a trace and the other three xylidines (1 : 2 : 6), (1 : 2 : 5), and (1 : 3 : 5), together with isocumidine (1 : 3 : 4 : 5) and mesidine (1 : 2 : 4 : 6) gave none. Thus the position of the methyl groups in the nucleus greatly influences the reaction.—A. G. G.

Pyrogenetic Formation of Phenazine. A. Bernthsen. Ber. **19**, 3256—3258.

IN a previous communication (this Journal, 1886, 317) reference was made to the formation of a basic oil when the vapour of aniline is passed through a tube heated to redness. Attempts to convert this base into phenazine, a compound of the constitution $C_6H_4\!<\!\begin{array}{c} N \\ | \\ N \end{array}\!>\!C_6H_4$, were, however, unsuccessful, probably owing to the want of information concerning the distinctive properties of this substance. Further researches having shown that phenazine is possessed of characteristic properties (this Journal, 1886, 661), the author thought it expedient to reinvestigate the product formed by passing aniline vapour through a red-hot tube. The basic mixture thus obtained was heated with successive portions of dilute hydrochloric acid, the solution precipitated with ammonia, the precipitate extracted with ether, and the extract digested with dilute hydrochloric acid. The ethereal solution was evaporated, the residue dissolved in hydrochloric acid, and the solution precipitated with ammonia. On subliming the precipitate, light yellow lustrous needles were obtained, possessing all the properties which characterise phenazine. This result, therefore, proves the possibility of obtaining phenazine from aniline by a reaction analogous to the pyrogenetic formation of anthracene from toluene.—D. B.

Improvements in the Manufacture of Azo-dyes and Benzidine and Tolidine Monosulphonic Acids. J. Y. Johnson, London. From the Actiengesellschaft Farbenfabriken vorm. F. Bayer and Co., Elberfeld, Germany. Eng. Pat. 3198, March 6, 1886. 6d.

IN order to prepare the new monosulphonic acid described in this specification, benzidine or benzidine-sulphate is heated with two parts of monohydrated sulphuric acid to 170° for about 1½ hours. The product is diluted with water and the sulphonic acid thus precipitated collected by filtration and purified by solution in alkali, filtration, and reprecipitation by acid. The acid is nearly insoluble in water, and differs from the other sulphonic acids of benzidine in that its salts are decomposed by acetic acid. The tetrazo compound of the new acid is said to differ from that of the benzidine-disulphonic acids in being soluble in water and giving azo-dyes of a bluer shade than tetrazodiphenyl. The preparation of the azo-dyes is conducted in the usual way, yellow colouring matters being produced by the action of the tetrazomonosulphonic acid upon aniline, toluidine, xylidine, mesidine or their sulphonic acids; phenol, resorcinol, the naphthols and their sulphonic and carboxylic acids give colours varying from red to violet. As examples of the method of manufacture, the inventors describe (1) the preparation of an alizarin-like red, suitable for cotton, formed by the action of one molecule of the tetrazosulphonic acid upon two molecules of β-naphthylamine-β-monosulphonic acid, and (2) a bluer shade of red formed by the action of one molecule of the tetrazosulphonic acid upon one molecule of β-naphthylamine, and then upon a second molecule of β-naphthylamine-β-monosulphonic acid.—R. M.

Improvements in the Manufacture of Colouring Matter. T. Maxwell, Govan, and J. Young, Milton-of-Campsie. Eng. Pat. 4687, April 3, 1886. 4d.

This invention relates to improvements in the manufacture of colouring matters adapted for dyeing fibrous substances by the dry process. The dyes used are coloured native earths, such as raw sienna or native earths, which assume a coloured state by calcining, or mechanical or chemical treatment, as burnt sienna. Inorganic coloured precipitates or lamp black may also be used. These colouring matters are, when necessary, reduced to a fine powder, and mixed with a non-saponifiable or other oil by stirring until the whole mass is as homogeneous as possible. The mixture is then sifted to free it from grit, the action at the same time furthering the more equal diffusion of the oil amongst the coloured particles. —D. B.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Improvements in Treating and Preparing Tussur and other Wild Silk Cocoons, and in the Application of the Silk obtained therefrom to the Manufacture of Lace, Knitted Warp, and other Fabrics. H. Birkbeck, London. From T. F. Peppé, Shahabad, Bengal, India. Eng. Pat. 3937, March 20, 1886. 6d.

The improved treatment consists in heating the cocoons under pressure in a solution containing glycerin and carbonate of soda, whereby they are rendered soft. During this operation they are kept separate by wrapping them in cloth-paper or wire gauze. The threads are then conducted to the pliers of a spinning frame, on which they are wound. The inventor claims that by his process, Tussur and similar silks can be made so fine as to render them suitable for making lace of the finest description.—E. J. B.

The Mechanical and Chemical Treatment and Preparation of the Plant botanically termed Bauhinia Vahlii. J. H. Wilson, Camberwell. Eng. Pat. 12,532, Oct. 2, 1886. 4d.

The inventor separates the fibres by passing the dried stems through rollers of peculiar construction. They are then treated with chlorine gas or alkaline hypochlorites. —E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Improvements in Dyeing Fabrics and in Apparatus used for that Purpose. W. G. White, London. Eng. Pat. 1750, Feb. 5, 1886. 8d.

The inventor refers to Eng. Pat. 3047, 1879, and 14,020, 1884, where he describes a system of colour printing, in which the printing block employed is built up of suitably prepared materials, containing the various colours required by the design, and imparts a portion of its own substance to the fabric to which it is applied. The present invention applies this system of printing to the dyeing of fabrics in plain colours. For this purpose the colouring material is cast on to a number of rollers, so as to form a cylindrical coating round each of them. The rollers are then mounted in bearings and driven at one speed. The fabric to be dyed, after being mordanted and moistened with a suitable damping liquid, is laid round one of the colour rollers so as to bring one surface of the fabric in contact with that roller, then round the next roller so as to bring the other surface of the fabric in contact with that roller, and so on for as many colour rollers as are employed. To ensure that the whole surface of the fabric be brought into contact with each roller, a scraper or bar is caused to bear against the fabric where it passes around the roller, thus giving a slight friction to the cloth, and rubbing into it the colour which has been imparted to its surface. To apply damping liquid to the cloth before it passes on to the colour rollers, the inventor employs a finely perforated metal drum, mounted horizontally and with the lower part of its circumference dipping into a trough containing the liquid, whilst the cloth is led over the upper portion of its circumference. The cloth after being mordanted is made up into a roll and passed over the damping drum, which is situated between the roll and the standard carrying the colour rollers. From this it passes under and around the various colour rollers, after which it is led through nipping rollers, and is rolled off or batched at the back of the machines. The roll of cloth when taken from the machine may afterwards be steamed and heated in any way which may be requisite, according to the nature of the colouring material which has been applied.—J. H.

Improved Means for Producing Ozone and Hydrogen suitable for Bleaching Purposes. J. H. Johnson, London. From E. Hermite, Paris, France. Eng. Pat. 3956, March 20, 1886. 8d.

Improved Means for Producing Chlorine Compounds suitable for Bleaching Purposes. J. H. Johnson, London. From E. Hermite, Paris. Eng. Pat. 3957, March 20, 1886. 8d.

See XVIII., "Electro-Chemistry," p. 299.

Improvements in Dyeing Cotton, Silk, Wool, and other Textile Materials, either in the Raw State or in the Form of Yarn, or as Cloth in the Manufactured State, and in Apparatus therefor. J. Smith, Heywood. Eng. Pat. 6988, May 25, 1886. 1s. 1d.

The object of this invention is to overcome the disadvantage of having any slack or folds in the materials or fabrics, when in the tank or cistern containing the dye liquor. The material to be operated upon is first soaked in the dye liquor, and then passed by a wince on to a system of travelling lattices or rollers, in such a manner that it will accumulate and lie thereon in even continuous rows or piles. By this means a large quantity of material may be treated at once, and may also be delivered from the first set to a second, third or fourth set of travelling lattices. After being thus treated, the material is repassed over suitable rollers through the dye liquor, and again treated as above described, repeating the process as many times as may be desirable. The dyeing goes on as well during the travelling of the material as when being passed through the dye liquor.—J. H.

Improvements in Dyeing Apparatus. L. Weldon, Amsterdam, New York, U.S.A. Eng. Pat. 16,412, Dec. 14, 1886. 8d.

The inventor places the fabrics in a cylinder which revolves in a trough containing the dye liquor. This cylinder is divided into compartments with perforated sides so as to allow the passage of the dye liquor through the fabrics. The compartments are V-shaped, one side being solid and forming part of the outer edge of the cylinder.—R. L. W.

VII.—ACIDS, ALKALIS, AND SALTS.

*Pyrites.** Herbert J. Davis. Abstracted from "Mineral Resources of the United States, 1885." Division of Mining Statistics and Technology.

New Hampshire.—The ore comes from the Milan Mines, Coos County, and is of excellent quality. It is now sorted into two grades. No. 1 grade contains about 46·0 per cent. sulphur; copper, 3·7 per cent.; iron, 40·0 per cent.; silica, 6·2 per cent.; zinc, 4·00 per cent. The other grade gives about 35·0 per cent. sulphur; copper, 5·0 per cent.; iron, 30·5 per cent.; silica, 25·5 per cent.; zinc, 8·0 per cent. Smelting works for the extraction of copper and silver have also been erected, owing to the increased amounts of these metals found in some parts of the ore. The low grade sulphur ores burn very readily, and no difficulty has been experienced in finding buyers for them: the No. 1 grade, however, being in special favour.

Vermont.—No mines are at present being worked, both because the price of copper is very low, and also because the sulphur in the ores is valueless for burning purposes, the ores being, in the main, magnetic pyrites.

Massachusetts.—The only mines in this State are the Davis Mines in Franklin County. The deposit is of great extent and purity, and is of uniform quality throughout. A large reserve stock of lump, broken, and smalls is always kept on hand, usually averaging 10,000 tons. About 30,000 tons of ore were mined in 1885, its composition being—Sulphur, 49·3 per cent.; copper, 1·5 per cent.; iron, 45·3 per cent.; silica and insoluble matter, 3·8 per cent. It is intended to connect the mines to the nearest railway.

New York.—About 2,000 tons of ore were raised from the mines at Hermon, County St. Lawrence. The ore is very hard, and makes few smalls. Its analysis shows—Sulphur, 38·0 per cent.; copper, 3·0 per cent.; iron, 34·0 per cent.; silica and insoluble matter, 25·0 per cent. Another mine in Ulster County was worked for some time, until stopped by an inrush of water. The ores from this mine gave—Sulphur, 39·1 per cent.; copper, a trace.

Virginia.—In this State, the only mines are in Louisa County, and are the Arminius Copper Mines Co. and the Sulphur Mines Co. The Lennig Mines have not been worked during the year. Analysis shows the ores to contain—Sulphur, 49·5 per cent.; copper, 0·5 per cent.; iron, 43·5 per cent.; silica and insoluble matter, 6·4 per cent. New machinery for the extraction of copper, and for underground pumping, has been added. The united output of the two companies was 13,000 tons.

North Carolina.—A mine in Mecklenburgh County is being successfully worked for the extraction of gold from the pyrites, the value of the gold obtained being about 7 dollars per ton of ore. The sulphur is not utilised, the pyrites being too much mixed with rock.

Georgia.—The mines near Dallas, in Paulding County, are supplying the vitriol works at Atlanta, Georgia, and also at Nashville, Tennessee.

Tennessee.—Enormous deposits of pyrites occur, but since they are the magnetic pyrites, are of no use for acid manufacture. They have, however, been worked for copper during the last 35 years. The ores contain—Sulphur, 35·0 per cent.; copper, 5·0 per cent.; iron, 40·0 per cent.; silica, lime, alumina, 20·0 per cent.

Alabama.—The deposits have not been worked from lack of railway and other means of transportation.

Foreign Deposits.

Canada.—The output from the Albert Mine and the Oxford Copper and Sulphur Company's mines was about 35,000 tons. The mines belonging to the Canadian Sulphur and Copper Co. were idle throughout the year. The ores burn readily, and contain a workable amount of copper, and about an ounce of silver for each per cent. of copper extracted from the matte. Their average composition runs—Sulphur, 40·2 per cent.; copper (wet assay), 5·1 per cent.; dry assay, 3·8 per cent.; iron, 35·2 per cent.; silica, 19·4 per cent.

Newfoundland.—The main deposits are on the North-eastern shores, and are hence inaccessible during the greater part of the year. About 2,500 tons were raised, but did not give satisfaction.

The author then gives several tables, from which the various results for the year 1885 are extracted and subjoined:—

WORKS BURNING PYRITES, AND QUANTITY BURNED IN THE UNITED STATES.

Districts.	Number of Works.	Consumption. (Long Tons.)
Boston and Eastern District	6	25,800
New York District	7	44,600
Philadelphia District	2	11,500
Baltimore and Southern States......	3	7,500
Western District	1	2,000
Total	19	91,400

PYRITES MINED, IMPORTED, AND CONSUMED IN THE UNITED STATES.

Year.	Mined.	Imported.	Total	Consumed.	Stock on Hand Dec. 31.
	Long Tons.	Long Tons.	Long Tons.	Long Tons.	Long Tons.
1885	49,000	47,500	96,500	91,400	49,500

Of the stock in hand on December 31, there were 28,500 tons at the works, and 21,000 tons at the mines.

(*a*) Copper contents (see table at top of following page)—these are "dry assays"—1·30 per cent. less than actual (wet) assays. The Spanish ore imported has contained an average of only 1·25 per cent. copper (wet assay). Newfoundland ore contained about 3·0 per cent. (wet assay).

(*c*) All the figures for 1885 are estimated. This has been rendered necessary by the practice of some of the custom-houses not keeping pyrites separate from iron ores.

The Spanish and Portugese ores were mainly shipped as ballast in vessels carrying fruit, the rate of freight per ton to United States ports being from 2 to 3 dollars. Of these ores, about 10,000 tons contained over 3·5 per cent. copper; the remainder containing about that amount or less.

The total amount of pyrites consumed throughout the world was about 1,200,000 long tons, of which Great Britain absorbed rather more than one-half, the United States taking 91,000 tons, and France and Germany 350,000 tons.

The use of sulphuric acid is steadily on the increase in the States, a large proportion of the make, about 45 per cent., being used in the manutacture of artificial fertilisers, of which about 1,000,000 tons were prepared in this year; and there is every reason to believe that this amount will be exceeded in the future. Large quantities of the acid are also being used in the manufacture of explosives.

The imports of brimstone during the past five years average about 100,000 tons per annum, and if this amount be taken as representing the consumption in 1885, and to this be added the 91,400 tons of pyrites consumed, their sulphur contents being expressed as brimstone, the returns show an increase of 300 per cent. over those of 1878.

A considerable increase in the number of pyrites burners is also to be noted, especially amongst those already using these furnaces, the forms most in favour being the Spence mechanical furnace and the ordinary shelf burners, for burning smalls. These new furnaces are mainly congregated around New York and in New England, though several are now being built by works in the West.

Preparation of Ore.—The ore is now broken by the American producer, and sorted into the most suitable

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* See this Journal, 1886, 97—98.

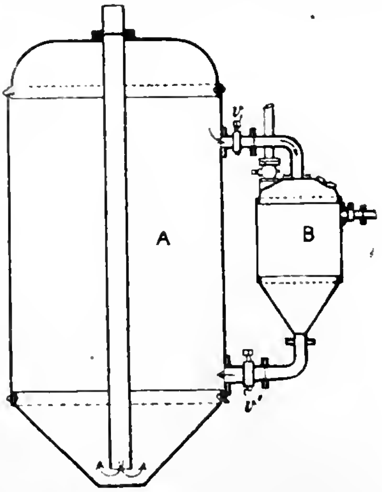
IMPORTS OF PYRITES INTO THE UNITED STATES.

Fiscal Year Ending June 30.	CANADIAN.					Newfoundland.	Spanish and Portuguese.	Total.
	Quantity (Tons.)	Copper Contents (a).		Value.	Duty.			
		Per Cent	Pounds					
1885 (c)	34,123	3·85	2,949,363	280,189	73,734	2,500	16,600	53,223

sizes for the burners of the consumers—viz., into pieces "not larger than three inches or smaller than one inch in diameter." The smalls are screened through a quarter-inch mesh screen. Amongst the deposits in the States, it seems more than probable that the auriferous pyrites of the Rocky Mountains will be largely employed at a future date, both as a source of gold and for the supply of sulphur, inasmuch as it contains gold in quantities which, together with the burning of the sulphur, would leave a profit after paying all expenses.—S. G. R.

Improvements in the Manufacture of Sodium Carbonate by the Ammonia Process. H. Schreib. Chem. Zeit. **10**, 1585.

Nearly all the patents taken out for the production of hydrochloric acid in connection with the ammonia soda process require the ammonium or calcium chloride in a solid state. To attain this end by evaporating the liquors is out of the question, owing to its great expense. The object of this invention is the production of solid ammonium chloride in a cheap manner. The process depends on the difficult solubility of ammonium chloride in brine. If a saturated solution of ammonium chloride of 1·0765 sp. gr., which contains 288grms. NH_4Cl per litre be shaken with solid sodium chloride, the latter is dissolved and ammonium chloride is precipitated. The liquor then shows a sp. gr. of 1·1790 and contains per litre 186grms. NaCl and 177grms. NH_4Cl. If ammonia or ammonium carbonate be passed into the solution a further deposition of ammonium chloride takes place, while still more sodium chloride is taken up. This peculiarity of the ammonium chloride is made use of in the following manner. The liquor resulting from the carboniser of the ammonia soda process, and chiefly containing ammonium chloride is treated with solid sodium chloride and ammonium carbonate—*i.e.*, ammonia and carbonic acid in the apparatus shown in the diagram. The cylinder A contains the liquor, and is in connection with a smaller vessel B, which holds on a perforated bottom a supply of sodium chloride. If the valves v and v_1 are open, the liquor in A comes in contact with the salt. The large pipe in A serves for the admission of carbonic acid gas and ammonia, during which treatment the temperature in A must be kept as low as possible. The following figures show the progress of the decomposition:—



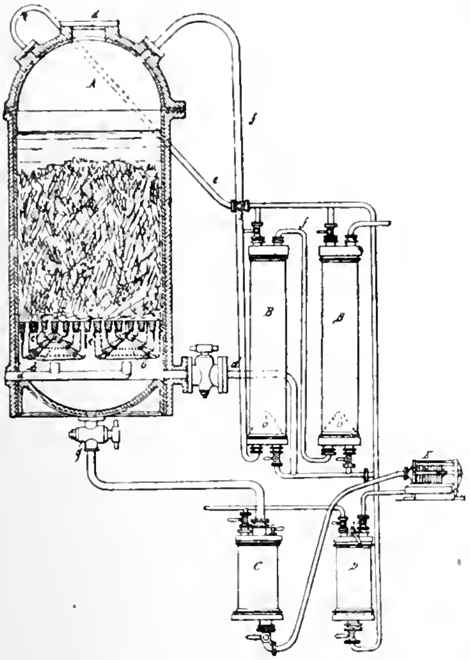
		Vol. per cent.—*i.e.*, grms. per 100cc.	
		NaCl.	NH_4Cl.
No. 1.	The liquor from the carboniser contains	9·4	19·8
No. 2.	The same liquor after the treatment with ammonium carbonate and sodium chloride cooled to 12° C.	19·3	9·0
No. 3.	The same liquor as No. 2, cooled to 10° C., and treated longer with sodium chloride	23·1	5·9
No. 4.	The same liquor as No. 3., cooled to 5° C.	25·5	4·1
No. 5.	The liquor was then separated from the solid salt and the carbonisation finished in the usual manner when the liquor tested	9·1	20·7

The liquor at the end of the operation had, therefore, practically the same composition as that used to begin with, the application of the new process not having interfered in any way with the main reaction. The ammonium chloride precipitate is washed, pressed, mixed with crushed limestone and heated for the production of ammonium carbonate, which is again passed into the cylinder A. It is claimed for this invention:

1. The ammonium or calcium chloride is obtained in a solid form.
2. The loss of sodium chloride is very small; a great deal smaller than in the usual mode of working, where the excess of salt runs away with the waste liquors.
3. The ammonia being passed into the liquor as ammonium carbonate, only one molecule of carbonic acid need be introduced into the apparatus, consequently less pumping is required. The dry distillation of ammonium chloride also requires less fuel.
4. No waste liquors.—S. H.

An Improved Method of Producing Lead Salts generally, and especially Carbonate or Oxycarbonate of Lead (White Lead). A. M. Clark, London. From O. Eyckens, Paris. Eng. Pat. 1832, Feb. 8, 1886. 8d.

This invention is based on the following reactions: A solution of lead nitrate converts metallic lead into hydrate, the oxygen required being taken from the nitrate, which is thereby reduced to nitrite. The nitrite, on a prolonged action of lead, parts with another equivalent of oxygen, forming another molecule of lead hydrate and nitrogen dioxide, which latter is reoxidised by the oxygen of the air to a mixture of nitrous and nitric acid. These two acids form lead nitrite and nitrate with the lead hydrate, and the solution of these compounds is again in a state to oxidise and dissolve metallic lead. But, apart from these neutral lead salts, polybasic lead salts are formed by the combination of lead hydrate with lead nitrite, and the patentee found that carbonic acid has the power of returning polybasic solutions of lead nitrite to a neutral condition by precipitating the excess of base in the form of lead carbonate mixed with lead hydrate, thus:—$[(NO_2)_2Pb.3PbO] + 2H_2O + 2CO_2 = Pb(NO_2)_2 + H_2O + 2PbCO_3 + Pb(OH)_2$. It will, therefore, be seen that a relatively small quantity of lead nitrite, which is constantly regenerated, converts an indefinite quantity of lead into white lead. The accompanying drawing represents an arrangement for carrying out the process in practice. The lead, after being reduced to shavings, is placed in a chamber, A, at the bottom of which is a pipe *a* for the supply of the gases required; *b* is a gas-distributor, *c* a grating for the support of the lead, *e* the inlet pipe for the liquids, and *f* an outlet pipe for the gases. As soon as A is two-thirds filled with lead and a solution of lead nitrite, a mixture of air and carbonic acid, heated to a suitable temperature is injected into the converter A, whence the gases are conducted to a series of towers, B, filled with solutions of polybasic lead nitrite, which retains all the nitrous acid which they may carry with them. The polybasic nitrite has a great affinity for nitrous acid, being thereby converted into lead nitrite. By means of a pump the liquids are frequently transferred between the converter and the towers. The white lead collects at the bottom of the converter A, where it is drawn off through *g* as fast as it is produced, in order to be filter-pressed and washed.—S. H.



Improvements in Obtaining Ammonia, Chlorine and Hydrochloric Acid from Ammonium Chloride. L. Mond, Northwich. Eng. Pat. 3238, March 8, 1886. 6d.

In previous specifications (Eng. Pat. 1886, Nos. 65, 66, 1048 and 1049; this Journal, 1887, 140. 216 and 217), the patentee described a process for obtaining ammonia, chlorine and hydrochloric acid by passing over certain oxides at an elevated temperature the vapour of ammonium chloride, and, subsequently, a current of air or steam. After the first of these two operations, some ammonia remains in the apparatus which would be destroyed by the action of air or chlorine at an elevated temperature, and it is now proposed to recover the ammonia left in the apparatus by the aid of a vacuum, or to fill up the apparatus several times with an inert gas, and exhaust it repeatedly by means of a vacuum. Instead of iron retorts which were previously recommended, the use of iron, enamelled, or lined inside with fireclay, graphite, carbon, etc., is now proposed, it having been found that the vapour of ammonium chloride gradually destroys the iron retorts. The latter may also be made of nickel or cobalt, or, better still, of cast or wrought iron, lined with nickel or cobalt, or an alloy of these metals.—S. H.

Nordhausen Oil of Vitriol Mixtures. M. Gerstner. Chem. Zeit. **11**, 3.

It frequently happens that an oleum of a certain percentage of sulphur trioxide is to be mixed with concentrated sulphuric acid in order to produce an acid with a smaller percentage of sulphur trioxide. This can be readily accomplished by the following formula:—$x = 100\frac{b-a}{a-c}$, where x represents the quantity of sulphuric acid, which must be added to 100 parts of the strong acid; a is the total sulphur trioxide in 100 parts of the acid desired; b is the total sulphur trioxide in 100 parts of the acid, which is to be diluted, and c is the total sulphur trioxide in 100 parts of the sulphuric acid to be used for diluting. The following table shows the values of a and b respectively:—

100 parts contain per cent. SO_3.		100 parts contain per cent. SO_3.		100 parts contain per cent. SO_3.		100 parts contain per cent. SO_3.	
Uncombined.	Total.	Uncombined.	Total.	Uncombined.	Total.	Uncombined.	Total.
0	81·6	15	84·1	30	87·1	45	89·9
1	81·8	16	84·5	31	87·3	46	90·1
2	82·0	17	84·7	32	87·5	47	90·3
3	82·2	18	84·9	33	87·7	48	90·4
4	82·4	19	85·1	34	87·9	49	90·6
5	82·6	20	85·3	35	88·0	50	90·8
6	82·7	21	85·5	36	88·2	51	91·0
7	82·9	22	85·7	37	88·4	52	91·2
8	83·1	23	85·8	38	88·6	53	91·4
9	83·3	24	86·0	39	88·8	54	91·6
10	83·4	25	86·2	40	89·0	55	91·7
11	83·6	26	86·4	41	89·1	56	91·9
12	83·8	27	86·6	42	89·3	57	92·1
13	84·0	28	86·8	43	89·5	58	92·3
14	8·42	29	86·9	44	89·7	59	92·5
						60	92·6

Supposing there is an acid of 25·5 per cent. SO_3 and a sulphuric acid of 98·2 per cent. SO_4H_2, and an acid of 19·0 per cent. SO_3 is required:—

Acid of 19·0% SO_3. Acid of 25·5% SO_3. Sulphuric acid of 98·2% SO_4H_2.

$$a = 85·1 \qquad b = 86·3 \qquad c = \frac{98·2 \times 80}{98} = 80·1$$

$$x = 100\frac{b-a}{a-c} = 100\frac{86·3-85·1}{85·1-80·1} = \frac{120}{5} = 24.$$

By mixing 100 parts of acid of 25·5 per cent. SO_3 with 24 parts of sulphuric acid of 98·2 per cent. SO_4H_2, an oleum is obtained containing 19 per cent. SO_3. A direct titration showed 18·5 per cent. and 18·9 per cent. SO_3.
—S. H.

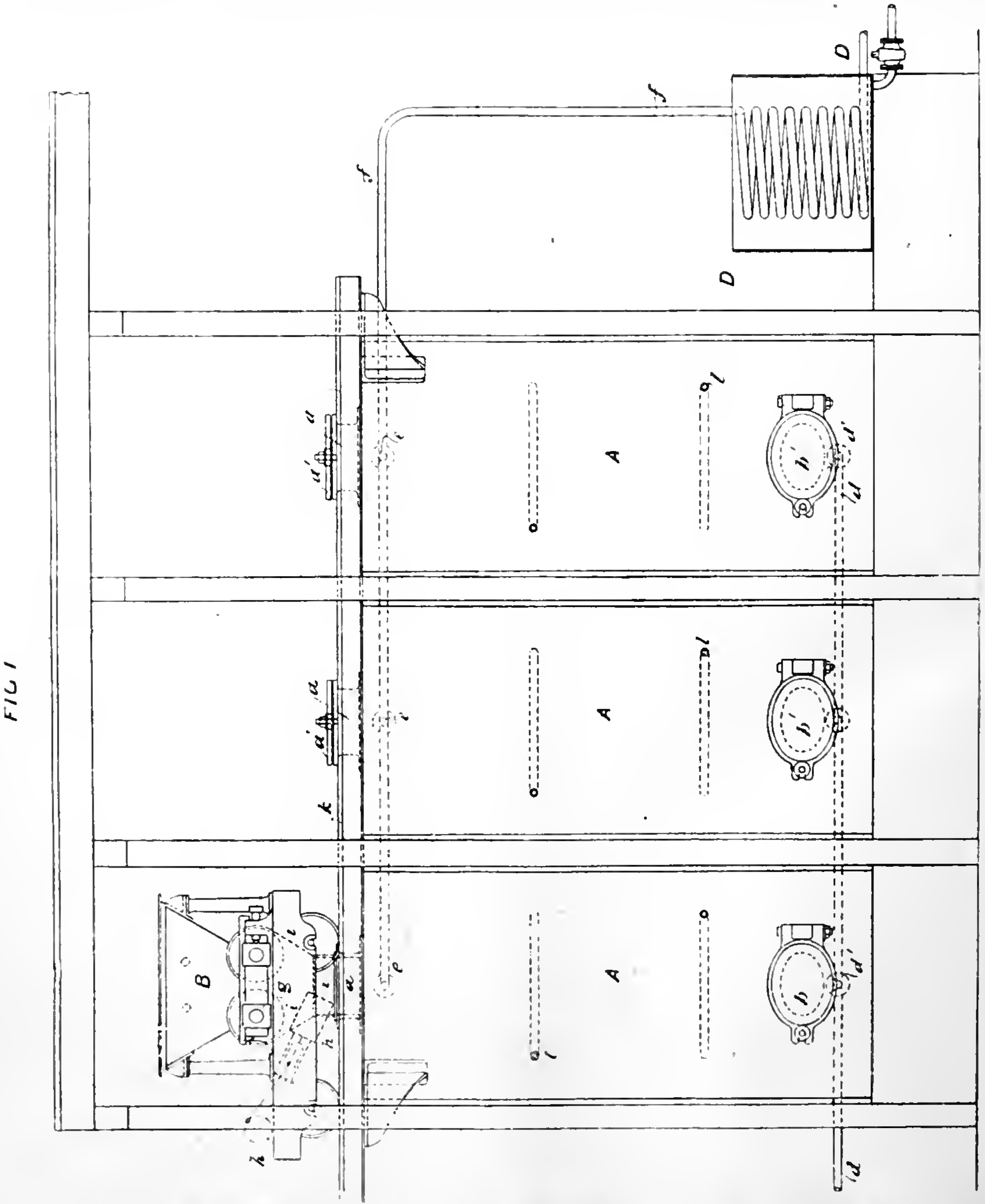
Treating Tersulphides or Polysulphides of Barium and Strontium, so as to recover the Barium and Strontium, and obtain other Products. H. L. Pattinson, Felling-on-Tyne. Eng. Pat. 4742, April 5, 1886. 6d.

In a previous specification (Eng. Pat. 16,989, 1884; this Journal, 1885, 745), the patentee described a process in which a residual liquor was obtained consisting of a solution of polysulphide of barium, or of strontium together with a little barium or strontium hydrate. It is now proposed to work up this liquor as follows :—The barium or strontium present is precipitated with sodium sulphate. The precipitate is filtered and the filtrate treated with sulphur dioxide, whereby free sulphur and a solution of sodium thiosulphate is obtained, which is evaporated and allowed to crystallise.—S. H.

A Method for Purifying Crude Carbonate of Soda, termed Black Ash, and the Recovery of Ammonia therefrom. T. Mathieson and J. Hawliczek, Liverpool. Eng. Pat. 5456, April 20, 1886. 11d.

THE black ash, manufactured by the Leblanc process, contains certain impurities, notably cyanogen and sulphur compounds, which cause much inconvenience and expense in the further treatment for the manufacture of sodium carbonate or hydrate. This invention consists in treating the black ash with superheated steam at 600° to 900° F., whereby the cyanide is decomposed, and ammonia formed therefrom, which is condensed in the usual manner. After this decomposition has taken place, the mass is treated with superheated steam of a higher temperature, when the sulphide is destroyed, giving off sulphuretted hydrogen. The formation of cyanide in the black ash is due to the presence of nitrogen in the mixing slack, and this fact is utilised in connection with the recovery of ammonia, by employing a mixing slack, containing a high percentage of nitrogen. In carrying out this invention, the black ash is broken into lumps of about three inches diameter, by the travelling crusher B (Figs. 1, 2, 3), which stands on the top of the "decomposer" A, just above the charging hole *a*. The drawings show three cylindrical decomposers A, which are provided with close-fitting charging doors *a*, and discharging doors *b*. They also contain a bed *c* (Fig. 3) for supporting the material, the bed being formed by interspaced bars. *d* are

FIG I



steam pipes, through which the steam enters the decomposers, pipes *e* being the escape pipes for the gases given off, which are conveyed to the condenser D. The travelling crusher fills the decomposers *seriatim.* When one decomposer is charged, the door *a* is closed, and steam of 600° to 900° F., passed into it. It rises through the mass, decomposing the cyanides, and escapes together with the ammonia formed through the pipes *e*. After decomposing the cyanides, steam of 1000 to 1200° F., is allowed to pass through the mass, when the sulphides are destroyed. The residue in the decomposers, now completely free from impurities, is worked up in the usual manner.—S. H.

FIG 2

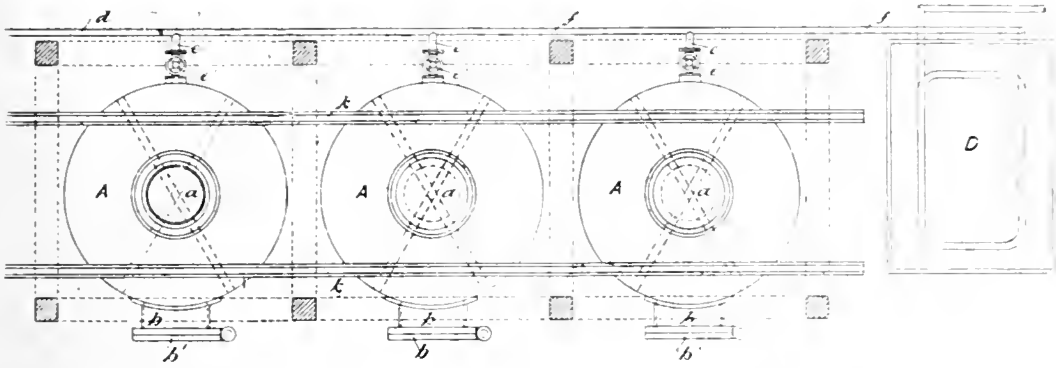
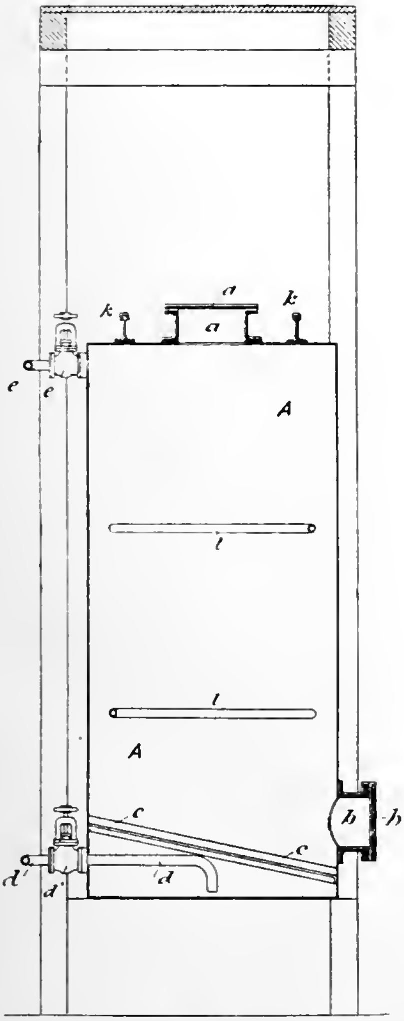


FIG. 3.



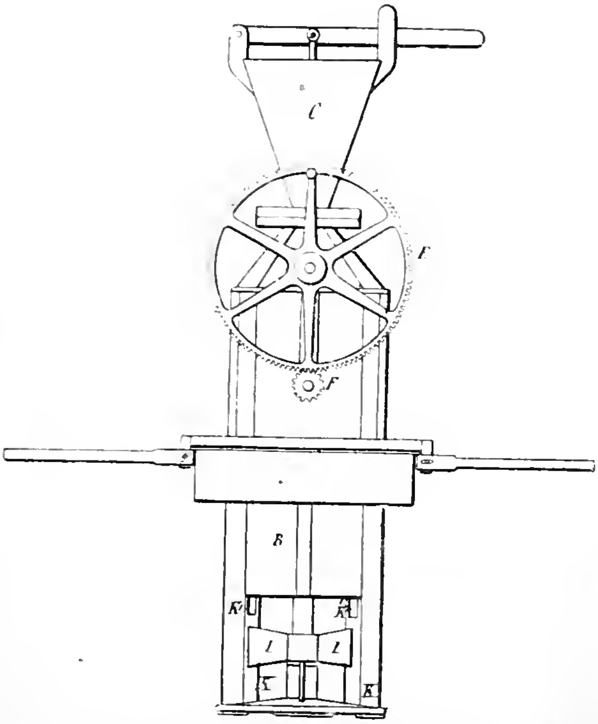
Improvements in the Manufacture of White Lead. J. Warwick, Newcastle-on-Tyne. Eng. Pat. 5820, April 29, 1886. 8d.

THE process of manufacture, as patented, consists :—1. In a method of bringing the lead to be carbonated into a state of fine division. 2. In exposing the finely-divided lead to the action of acetic acid, carbonic acid, air and moisture. 3. In an arrangement for separating the finer particles of dry white lead, in a state of very fine powder. 4. In a method whereby the separation of the remainder of the white lead is effected from any particles of lead which may have remained unconverted. In the first stage of the process, melted lead is dropped upon a rapidly-revolving disc, fixed on a vertical shaft, so that the disc revolves in a horizontal plane. The centre of the disc is slightly raised, so as to make its upper surface a very obtuse cone. The lead, thus reduced to very fine particles, is rapidly cooled. A circular chamber, fitted with a central vertical shaft, carrying upon it a series of circular horizontal shelves, serves for the conversion of blue lead into white lead. Fixed shelves are attached to the walls of the chamber, and placed between each of the revolving shelves, by which arrangement the passage of any solid material or gas through the chamber must be by a very circuitous route. On the under surface of the shelves, a series of scrapers is fixed, which cause the material on the shelves to slowly move towards the centre or circumference, in such a manner as is required to pass gradually through the chamber, from top to bottom, and over every shelf. On its way downwards, the mass meets with a current of carbonic and acetic acid, air and moisture moving in the opposite direction. The material from the carbonating chamber is emptied into a revolving drum, placed horizontally, where it is broken up by granite balls. The shaft on which the drum is hung, is hollow and perforated within the drum, so that air may be blown into the drum, whence it escapes into a large dust chamber. The air carries with it the finest particles of white lead, which collect in this chamber, as a very fine and pure preparation. With a view to preventing the loss of this light powder, the same air is made to circulate over and over again. After all this light white lead is removed, the remainder is thrown into water and ground under edge runners, to completely separate the white from the blue lead.—S. H.

Improvements in the Manufacture of Bleaching Powder and in Apparatus for Effecting the Same. J. Brock and T. Minton, Widnes. Eng. Pat. 7199, May 28, 1886. 8d.

THE object of this invention is the absorption and conversion into bleaching powder of the residual chlorine gas, which remains in the atmosphere of the bleaching powder chamber, and is not absorbed by the almost saturated lime. The inventors propose the treatment of the chlorine with lime in the form of a fine powder suspended in the atmosphere of the chamber, or in other words, the atmosphere of the chamber is to be charged with dust of lime, which readily absorbs the chlorine. If the amount of lime is in proportion with the chlorine in the atmosphere of the chamber, the resulting product is of the same strength as the bleaching powder made by the ordinary process. The apparatus for carrying out this process consists of a box or casing B (Figs. 1 and 2) which is inserted into an aperture of the chamber roof A. C is a hopper at the top of the casing, which is charged with quicklime in fine powder. D is a valve at the bottom of the hopper, and is worked by a lever arrangement in order to regulate the rate of flow. The tooth gearing E, F, G gives motion to the shaft H, which is armed with blades I, forming a fan, or distributor. Bearings for the shaft are provided upon the casing. The lower bearing is supported by the tubes K, which are ranged around the fan. The tubes are open at the bottom, and there are apertures in them at K', directed inwards, so that an upward current is maintained through the tubes and out through the apertures K' whenever the fan is in motion. This current meets the lime descending from the hopper, passes with it to the fan, and then issues all around between the tubes K, thus causing the finely divided lime to pervade every part of the chamber. Three of these machines will be found sufficient for a chamber of 100ft. length.—S. H.

Fig 1



Improved Process, or Means for Expelling Sulphuric Acid in Excess from Sulphates and Bisulphates. J. H. Johnson, London. From J. L. Kessler, Clermont, France. Eng. Pat. 5016, April 10, 1886. 6d.

It is proposed to roast the bisulphate with certain reducing agents at a low red heat, only the "free sulphuric acid" being thus decomposed. A neutral sulphate remains.—S. H.

An Improved Process for Obtaining Crystallised Sulphate of Calcium. E. A. and E. M. Arthur, Tiverton-on-Avon. Eng. Pat. 4070, March 23, 1886. 4d.

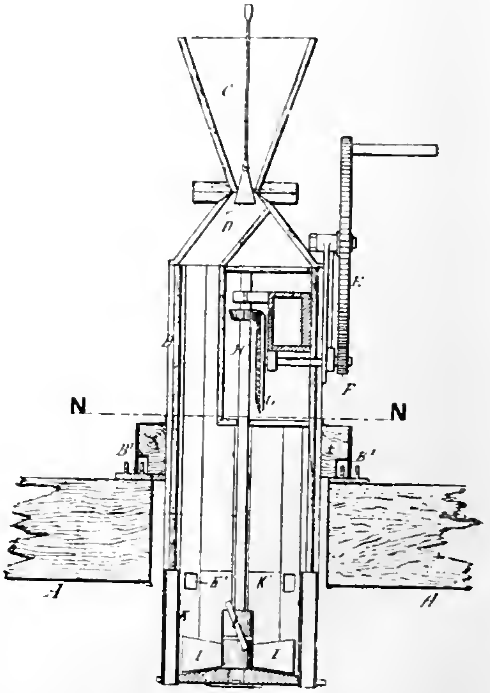
A SOLUTION of calcium chloride, "resulting from any process of manufacture of soda involving the use of ammonia," is converted into calcium sulphate, which is known commercially as pearl-hardening.—S. H.

IX.—BUILDING MATERIALS, CLAYS, MORTARS AND CEMENTS.

Delune's Drain Pipes, made of Cement Concrete. Rev. Indust. 1886, 76.

The pipes consist of two parts, each part being composed of different materials. The lower is made of hard watertight concrete, with a perfectly smooth inner surface. It serves as the gutter. The upper portion consists of very permeable concrete, consisting of 8—10 parts broken stones and 1 part cement, which latter must be of a very perfect description.—A. R.

Fig. 2



Improvements in the Manufacture of Fire Bricks, Retorts, Crucibles, and other Fire-Ware Goods. S. J. Payne, West Thurrock. Eng. Pat. 3391, March 10, 1886. 4d.

The goods are manufactured from a mixture of either clay, ganister, graphite, millstone grit, flint, sandstone, sand, loam, spent lime from gasworks, etc. (burnt or unburnt), or of several of these materials with Portland cement and "slurry." The mixture, brought to a proper consistency, is moulded by hand or machinery, and kilned.—E. G. C.

Improvements in Compounds for Coating and Finishing Walls and the like. E. A. Bronson, Nebraska, U.S.A. Eng. Pat. 16,926, Dec. 24, 1886. 4d.

The object of this invention is to provide a composition for coating and finishing walls, which shall be entirely free from lime, and will not shrink, crack nor expand. The constituents of the compound are plaster-of-Paris, sand, Keene's cement, glue and marble dust; a suitable colouring matter being added if desired. In applying the compound to the wall or ceiling, a groundwork or base of plaster-of-Paris, sand, whiting and glue is first applied and allowed to set. By the use of this composition, it is stated that a wall or ceiling is rendered rat and vermin proof, as well as impervious to moisture and frost. —E. G. C.

Improvements in the Manufacture of London Artificial Asphalt. W. E. Constable. Eng. Pat. 3832, March 18, 1886. 4d.

Hard limestone, preferably Derbyshire limestone, is crushed by edge runners or other suitable machinery, and heated to 120—130° F. in order to remove moisture. It is then mixed with refined distilled tar (freed from oil, creosote and water), and the material thus prepared should be stored for about three months. The approximate proportions are—1 ton crushed limestone and 12 gallons distilled tar. For the preparation of artificial asphalt, the base material so prepared is mixed with bitumen, lime and sulphuric acid.—E. G. C.

An Improved Mode of, and Apparatus for, Continuously Manufacturing Portland Cement. W. Sonnet, Boeckum, Germany. Eng. Pat. 17,098, Dec. 30, 1886. 8d.

The raw materials, properly mixed and finely ground, are sifted upon a sieve of 900 meshes to the square centimetre, and carried at once, by means of a conveying worm, into a serpentine channel-shaped furnace of peculiar construction, and there burnt. The "burning" furnace is heated to from 2500° to 3000° C., and the raw material, during its passage through the conveying worm, is heated to from 100° to 150°. By the use of this invention the burning of the cement proceeds continuously, moistening, forming into slabs, drying the slabs, the setting-in of the same, and the drawing-out of the cement-mass while hot from the furnace (as in the old process), are all dispensed with. The entire mass to be burnt is conveyed automatically to the furnace, and 75 per cent. of the burnt mass is carried out automatically, leaving only 25 per cent. to be removed from the furnace, "and that easily by hand labour from outside." The cement produced, will be free from remaining portions of fuel and raw cement material. Also, the cost of manufacture is considerably diminished, while the workmen are much less exposed to dust and heat than in the processes heretofore employed. The construction of the serpentine "channel-furnace" is detailed in the specification.—E. G. C.

X.—METALLURGY, Etc.

The Influence of Silicon on the Properties of Iron and Steel. Part I. Thomas Turner. Jour. Chem. Soc. **1887**, 129.

This paper is really a continuation of the author's previous work on cast-iron (*Jour. Chem. Soc.* 1884, p. 260; 1885, pp. 474, 577, 902; 1886, pp. 130, 215, 493; *Jour. Iron and Steel Inst.* 1886, Part I.; this Journal, 1886, p. 289), though the present contribution marks a new departure, and has to do with wrought-iron and steel as distinct from cast-iron. A brief outline of the work of other observers is given, and it is concluded that the present state of our knowledge on this subject is probably as follows:—

1. *In Ingot Iron.*—Silicon promotes soundness; it resembles carbon in increasing the tenacity and hardness; it should not exceed 0·15 per cent. in metal which has to be rolled; in some cases it produces brittleness when cold.

2. *In Steel Castings.*—Silicon promotes soundness: it is, however, regarded as a necessary evil, and excess should be avoided, as tending to brittleness and low extension; about 0·3 per cent. is generally recommended.

3. *In Crucible Steel.*—A few hundredths per cent. is necessary to produce soundness; it is generally agreed that considerable quantities of silicon may be present without injury.

4. Manganese appears to be capable of neutralising the ill effects due to silicon. The effect of carbon in presence of silicon is doubtful, but is probably detrimental.

The author has examined the effect of silicon on the purest iron obtainable in commerce. For this purpose metal was taken from the Bessemer vessel, at the end of the blow, just before any addition of ferromanganese was made. This contained 0·0098 per cent. of silicon, and was mixed with different proportions of silicon pig-iron, containing 10·3 per cent. Si. The mixture remained quiet in the mould when only a few hundredths per cent. of silicon were added. The metal was originally red short, especially at a dull red heat, though it worked well at a welding temperature: the red shortness was increased by silicon. The metal was tough cold, and welded well, silicon having little or no influence. Silicon increased the elastic limit and tensile strength, but diminished the elongation and contraction of area, a few hundredths per cent. having a remarkable influence in this respect. The appearance on fracture changed from finely silky to crystalline, while the hardness increased with the increase of silicon, but appeared to be closely connected with the tenacity. With 0·4 per cent. of silicon a steel was obtained, difficult to work when hot, but tough when cold, capable of being hardened in water, and giving a cutting edge which resisted hard usage.

The author is indebted for assistance in his work to Professor Kennedy, Mr. Harbord, and Mr. Walton.

On the Manufacture of Crucible Steel. F. C. G. Müller. Stahl u. Eisen, **1886**, 704.

It is generally admitted that the best steel for making tools should not contain any impurities besides carbon; mere traces of phosphorus, sulphur and copper being especially objectionable. These are not especially affected by the crucible process; but, on the other hand, silicon is here of fundamental importance, as it is always taken up by the steel, except when basic crucibles are used. The fear with which some metallurgists regard this element is excessive, considering that the best English cast-iron may contain as much as 0·5 per cent. of it. It has been proved, in the Bessemer and Martin processes, that the addition of a small quantity of silicon prevents the liberation of the hydrogen, which is always present in iron. The reduction of the silica may be effected by carbon or by manganese, according to local circumstances. Manganese should not be used when raw steel containing very little of it has to be fused in crucibles rich in carbon. On the other hand, it is advantageous to use manganese, when steel for tools has to be made from raw Swedish iron, since it refines the iron without loss of carbon or of gas, and eliminates an excess of manganese from the steel. The part played by the manganese is all the more important when there is but little carbon in the clay used in making the crucibles, for this often does not contain sufficient to reduce enough silica: hence the necessity of adding some manganese. The steel for tool-making manufactured in some of the most renowned English works contains as much as 0·25 to 0·35 per cent. manganese, and this can only have been added in the form of alloys or readily reducible compounds of manganese, when working with rich Swedish pig-iron. —E. E. B.

Improvements in the Manufacture of Castings from Wrought-iron and Steel. T. Nordenfelt, London. In part from C. G. Wittenström, Stockholm, Sweden. Eng. Pat. 8269*, July 8, 1885. 4d. Amended Specification.

The emendation consists in the deletion of the clause stating that the aluminium may be added at a period earlier than "when molten and shortly before it is to be poured."—W. G. M.

Improvements relating to the Uniting of Platinum or Silver and Nickel, or Alloys of these Metals. H. H. Lake, London. From La Société de Laminage du Nickel, Paris, France. Eng. Pat. 1473, Feb. 1, 1886. 6d.

To produce compound plates or wires of platinum or silver, or their alloys, with nickel or its alloys, the two surfaces to be united are exactly fitted to ensure perfect contact throughout; they are then sprinkled with a flux (one surface may be electro-plated with a metal which will act subsequently as a solder), heated to a sufficient temperature, and welded by hammering or rolling. To prevent oxidation of the nickel during the heating process, the plates are wrapped air-tight in thin sheet-iron envelopes lined with an earthy substance to prevent adhesion of the contained metals, these cases being removed finally by scaling or scouring.—W. G. M.

Improvements in the Method of and Means for Extracting the Tin from Tinned Sheet Metal Cuttings by Means of Hydrochloric Acid Gas. F. Bosshardt, Manchester. From S. Montagne, Nantes, France. Eng. Pat. 2865, Feb. 27, 1886. 8d.

THE cuttings are heated to 150–160° C. by steam in a closed vessel, into which hydrochloric acid gas is led from an adjacent generator; by this means the tin is completely converted into stannous chloride, the latter being washed away by water pumped into the vessel from above, and distributed through a rose jet. The solution of chloride is treated with zinc, or in any convenient manner for separating the tin. The scrap iron, denuded completely of tin, may be worked up into bars.
—W. G. M.

Improvements in the Manufacture of Open Hearth Steel. W. Penrose and W. Hackney, Swansea. Eng. Pat. 4536, April 1, 1886. 8d.

THE object of this patent is to lessen the time required to work an open-hearth charge, by facilitating the oxidation of the metalloids. This is effected by granulating the pig-iron, mixing with it a suitable proportion of an oxide ore, and introducing the charge, with or without admixture of lime, through apertures in the furnace roof. The quantity of oxide must be so calculated that the decarbonisation shall be complete at the moment when the metal is melted and at the requisite temperature for tapping.—W. G. M.

A New Manufacture of Fibrous Iron. A. de Laude Long, Stockton-on-Tees, and R. Howson, Middlesbrough. Eng. Pat. 5527, April 21, 1886. 6d.

MILD steel with any suitable percentage of carbon is granulated, then balled up in a furnace with a cinder bottom, squeezed and subsequently treated as puddled iron. During the working of the slag hearth, a portion of the slag becomes worked into the metal, and thus a fibrous iron or steel may be prepared from a mild steel.
—W. G. M.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

Improvements in the Preparation of Emulsions of Vegetable, Animal, and Mineral Oils, of Solid Paraffins, Waxes, and Fatty Substances, and of Liquids which are insoluble or but partially or slightly soluble in Water. A. Blackie, Wadhurst. Eng. Pat. 3266, March 11, 1886. 6d.

FOR vegetable or animal oils, and for chloroform and similar liquids slightly soluble in water, the patentee prepares a solution of gelatin or size, containing 4oz. dry material to the gallon, and in 12 parts by weight of this, 1 part of an alkaline carbonate or phosphate is dissolved. With this, when cool enough, from 24 to 36 parts of the oil or other liquid are incorporated. For mineral oils—benzoline, naphtha, etc., 1lb of soft soap is dissolved in a gallon of water, and 6oz. of size are added. The use of alkaline sulphides, or of arsenic dissolved in glycerin, in connection with these emulsions when used for destroying parasites, is also claimed.
—W. L. C.

An Improved Lubricating Composition. B. J. Hicks and J. Kirkwood, Middlesbrough. Eng. Pat. 3518, March 12, 1886. 6d.

IN order to absorb the heat of friction in the bearings of heavy machinery, whereby the lubricant is often reduced to a thin wash, the patentees mix a large quantity of decaying vegetable matter, such as cabbage or potatoes, with the ordinary lubricants employed for such purposes, such as animal fat, pitch, etc., with or without plumbago and whitening.—W. L. C.

Improved Means Applicable for Use in Extracting Oils by Volatile Solvents. A. W. MacIlwaine. Eng. Pat. 3644, March 15, 1886. 4d.

To avoid the deterioration in colour produced in some oils, especially rape-seed, by the use of iron vessels and pipes for this operation, the patentee claims the use of vessels made of or lined with lead or other suitable metal or alloy.—W. L. C.

Improvements in Apparatus for Separating Mineral or other Oils from Oils or Substances of different Specific Gravities. A. F. Craig, Paisley, A. Nelson, and J. Snodgrass, Inkermann, N.B. Eng. Pat. 3749, March 17, 1886. 8d.

THIS apparatus is of the centrifugal class, and comprises a rotating vessel having impermeable sides, which may be placed with its axis in any position, though the vertical is preferable. The oleaginous mixture to be operated upon, may be supplied so as, when thrown by the centrifugal action against the sides of the vessel, to proceed either upwards or downwards. An annular channel is arranged by the flaring of the sides of the rotating vessel at the larger end with one or more outlet passages. Further description would be unintelligible without the drawing given.—W. L. C.

An Improved Lubricating Compound. T. L. Wade, Glasgow. Eng. Pat. 4404, March 29, 1886. 4d.

CASTOR OIL, sperm oil and mineral oil, are mixed in varying proportions, and heated by steam in an air-tight tank provided with a low level air inlet and an air outlet. Air is exhausted from the surface of the oil, and this causes a violent current of air to pass through the hot oil, thus removing all traces of moisture.—W. L. C.

XII.—PAINTS, VARNISHES, AND RESINS.

New Caustic Powders for the Removal of Paint and other Deposits, applicable also for Cleansing and Disinfecting Purposes. Baron de Liebhaber, London. Eng. Pat. 4737, April 5, 1886. 6d.

THESE powders, designated under the generic name of "Tologen" consist essentially of lime and alkaline compounds. (1) Caustic Tologen: Ground quicklime in sufficient quantity is evenly distributed in a strong sodium hydrate solution, and the mass heated. On cooling it becomes solid and pulverulent. (2) Sodic Tologen: It consists of a mixture of sodium carbonate and quicklime in suitable proportions. (3) Oxalic Tologen: It is prepared by mixing potassium bioxalate with quicklime, to which some sodium carbonate may be added, if its action is desired to be less energetic. (4) Chlorinated Tologen: It is obtained by mixing quicklime with a solution of sodium or potassium hypochlorite. (5) Prussic Tologen: It is a mixture of quicklime with potassium cyanide solution.—S. H.

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

Improvements in the Manufacture of Tannin and Similar Vegetable Extracts, and in Apparatus Employed therein. A. Morand, Philadelphia, U.S.A. Eng. Pat. 4392, March 29, 1886. 8d.

THE patentee cuts the wood at an angle across the grain into slices 3mm. thick, which are removed from the cutting machine by a blower which granulates the wood and drives it through a tube to a series of bins, from which it can be dropped into tanks. These, which may be from ten to twenty in number, are made with false bottoms and provided overhead with sprinklers. In these the wood is placed and extracted by percolation, the liquor from the first tank being pumped over the next, and so on, till in the last it percolates through fresh wood and passes away, of maximum strength. The water used is at a temperature of 90°, and a small percentage of sulphuric or hydrochloric acid is added, either to the fresh water or by sprinkling in one of the tanks. One tank is continuously out of use whilst being emptied of refuse and refilled, and when the first tank is exhausted comes into use as the strongest of the series. The liquor is next neutralised by an alkaline solution of casein (one part carbonate of soda to fifty parts casein), which is thus precipitated as a fine flocculent precipitate carrying down with it the impurities. It is next forced through a filter press and evaporated in vacuo to 25 or 30°. Any similar clarifying agent may replace the casein—*e.g.*, albumen.—R. L. W.

An Improved Leather Polish. J. H. G. Langenhagen, Leipsic, Germany. Eng. Pat. 17,026, Dec 29, 1886. 4d.

Mineral fats or mixtures of mineral fats and wax, being little absorbed by leather, whilst vegetable and animal fats turn rancid, the patentee proposes the following mixture, the speciality of which is the use of oil of turpentine to secure absorption and preserve gloss:—40 per cent. Carnauba wax, 1 per cent. steatite, 30 per cent. oil of turpentine, 5 per cent. aniline (nigrosine), 2 per cent. Congo-black, 8 per cent. almond oil, 4 per cent. beeswax and 10 per cent. ozokerit.—R. L. W.

XIV.—AGRICULTURE, MANURES, Etc.

Treating Barley with Sulphurous Acid. H. Eckenroth. Chem. Zeit. **11**, 110.

When old barley is treated with sulphurous acid it assumes a fine yellow colour, and can be mistaken for new barley. Such treatment is injurious to the germinating power, but has recently been practised to a considerable extent in Germany, inasmuch as 60 per cent. of the samples examined contained sulphur. They were tested by steeping the barley for a quarter of an hour in hot water, and adding zinc and hydrochloric acid to the aqueous extract, the presence of sulphur being soon indicated by the evolution of hydrogen sulphide.

—D. A. L.

Value of Superphosphate for Sugar-Beet. A. Nautier, Bied. Centr. **15**, 742—744.

These experiments were instituted to investigate the value of manuring with superphosphate on certain soils. On a soil containing per cent.:—P_2O_5, 0·34; N, 0·17: K_2O, 0·53, and which had received a dressing of 35,000 kilos. of farmyard manure per hectare in the autumn, eleven plots were arranged; one remained unmanured, three received 75kilos. of nitrogen per hectare, in the form of Chili saltpetre, ammonium sulphate, and oil-cake respectively. On six other plots the same series of nitrogenous manures was twice repeated; once with addition of 75kilos., and once with 150kilos. of soluble phosphoric acid per hectare. The eleventh plot received phospho-guano equivalent to 75kilos. of soluble organic nitrogen and 75kilos. soluble phosphoric acid per hectare. An increase in the weight of crop was obtained with the phospho-guano on all the nitrate of soda plots and also on the ammonium sulphate plots, except where the 150kilos. of phosphoric acid was used in addition. On the other hand, the quality of the roots as regards sugar was so poor that only in one case (where nitrate of soda had been used alone) did the increase in value even cover the cost of the manure. The superphosphate, in fact, proved valueless in these experiments. Experiments on a poorer soil containing per cent:—P_2O_5, 0·08; N, 0·17; K_2O, 0·42, gave different results, for in all cases phosphoric acid, either as soluble, citrate soluble, or insoluble, although it did not give such heavy crops as in the above experiments, improved the quality to such an extent as to more than cover the cost of manure. For example—with 75kilos. of phosphoric acid per hectare as superphosphate the gain was 64·2 francs, with 75kilos. as natural insoluble phosphate 81·0 francs, and with 225kilos. as natural insoluble phosphate, the quantity equivalent in money value to the 75kilos. of phosphoric acid as superphosphate, the gain was 49·0 francs.

—D. A. L.

Manurial Experiments with Basic Slag and other Phosphates on Rye Crops. M. Sievert. Bied. Centr. **15**, 744—745.

Four plots of equal extent were manured with 30 pounds per morgen (0·255 hectare) of phosphoric acid in four different forms and 10½ pounds per morgen of nitrogen as ammonium sulphate, or in the case of bone-meal the nitrogen already present was made up to 10½ pounds with ammonium sulphate. Comparing the harvest results, and taking the yield from basic slag at 100, bone-meal yielded 111·06, superphosphate 120·09, curacao-phosphate 113·04. The profit per mark outlay for this increase in crop was in the case of bone-meal 3·6 marks, of superphosphate 3·2 marks, of curacao-phosphate 6·2 marks.—D. A. L.

Losses in Wheat Cultivation by the injudicious use of Copper Sulphate as a Preventative against Mildew. P. Grassman. Bied. Centr. **15**, 766—774.

To prevent mildew in wheat, it is customary to treat the seed with copper sulphate. Kühn has given directions for the application of this salt, but in practice, in spite of these directions, the quantities of sulphate employed and the mode of treatment, vary considerably; consequently the success of the treatment, in many cases, becomes very questionable. The author has taken the matter in hand, and from the standpoint that the object in view is the destruction of the mildew fungus without injury to the vitality of the wheat, has investigated the effect of the strength of copper sulphate solution employed and the result of delay in sowing after the seed has been treated:—1. On the germinating energy or rate of germination. 2. On the germinating power or total proportion of germinating seeds. 3. On the proportion of sickly seedlings. And it is seen that any increase in strength of the solution, or any delay in time of sowing the treated seed, weakens the germinating energy, decreases the number of germinating seeds and increases the proportion of sickly seedlings (rootless or with diseased roots). Even with one pound of copper sulphate to 30 centners of seed wheat (one centner = 100 pounds), the germinating energy is reduced 2·25 per cent., and the sickly seedlings increase 0·25 per cent.; with 20 pounds to 20 centners, the germinating energy is nil, whilst all seedlings are sickly. It is, therefore, recommended not to use more than three pounds of copper sulphate per 20 centners of seed grain, and to allow the grain to soak from 12 to 16 hours, removing any floating grains, as diseased grains are always light; finally, to sow the macerated seed without much delay; if possible, within 24 hours.—D. A. L.

Development of the Sugar-beet. A. Girard. Compt. Rend. **102**, 1324—1327, 1489—1492, 1565—1567; **103**, 72—74, 159—162.

Numerous observations have been made on the development of the different parts of the sugar-beet plant, and of the composition of the plants at various stages of growth during the period of moist active vegetation. A table is given, showing the relation the weights of the leaves, stem, root and rootlet, to the weight of the whole plant at the various stages of growth. On June 8 the proportion per cent. was:—Leaves, 83·1; stem, 6·8; roots, 10·1; then follows a period when the proportion of the roots decreases, whilst the leaves increase considerably, and the stem steadily, so that on July 15, the leaves form 68·5, the stem 29·5, and the roots and rootlets, 2·0 per cent. During the last two months, the weight of roots and rootlets, and of the leaves, increases only very slightly, especially the latter, whilst the stem increases considerably, hence on October 1, the proportion stands: leaves, 35·2; stem, 63·3; roots and rootlets, 1·5. Under normal meteorological conditions, however, the increase of these various parts and also of their various constituents (woody fibre, soluble organic and mineral matters) is generally regular. But under certain climatic conditions, the roots become quickly woody, and then this is accompanied by a rapid increase in the weight of the stem and considerable fluctuation in the quantity of sugar in the leaves, although the sugar already stored does not decrease. From the earliest stages, the sugar-beet plant contains sugar: even when it weighs scarcely 1grm. it contains 1·5 per cent., and during active growth, under the influence of sunlight, sugar forms in the leaves, passing through the stem to the root, while mineral matters and water taken from the soil by the rootlets, travel up the stem to the leaves.—D. A. L.

An Improved Process of Treating Phosphatic Earths and Rocks for the Manufacture of Fertilisers therefrom. N. B. Powton, Kingston, Jamaica. Eng. Pat. 5034, April 10, 1886. 6d.

PHOSPHATIC MINERALS, which are mainly composed of phosphates of iron and alumina, have thus far not been successfully worked up as superphosphates, owing to the fact that the product of the treatment with sulphuric acid remained in a sticky, gummy state, which would not dry, and could not be ground. This process converts the alumina into alum, and combines the phosphoric acid with lime, whereby the mass is rendered dry and granular. The mode of proceeding is as follows:—The ground mineral is mixed with water, and an alkaline base, such as soda, potash or lime. Sulphuric acid is then added, and the mass stirred for some time. After thoroughly mixing, the mass is poured out, when it will dry naturally, and granulate in a fine powder, owing to the formation of an alum and calcium sulphate, both of which combine chemically with the water present in the fertiliser.
—S. H.

XV.—SUGAR, GUMS, STARCHES, Etc.

Extraction of Sugar Cane by means of Diffusion. Dingl. Polyt. J. **262**, 478—479.

THIS paper is an extract from a report on methods and machinery for the application of diffusion to the extraction of sugar cane, by H. W. Wiley, who has recently inspected several sugar works in France and Spain for the United States Government. The beet diffusion works at Abbéville in France, being regarded as one of the best of the kind, are described in detail in the report, which is illustrated by a number of useful diagrams of the plant and machinery employed. With regard to cutting-machines, it is shown that the best results are obtained with cane chips, which are from 2 to 3mm. in thickness, being at the same time nicely grooved. This is done by adjusting the edges of the knives in a certain manner. At the works at Almeria, the diffusion battery consists of 14 vessels, each vessel holding 25 hectolitres and containing a charge of 1215kilos. of cane chips. From these 13·5 hectolitres of juice are obtained, or 111 litres from 100 kilos. of canes. During the diffusion process, a temperature of 80—90° is maintained in all the vessels, which is said to facilitate the extraction, without injuring the colour of the juice. The exhausted chips are exposed to the atmosphere until putrefaction sets in. They are then used for manuring purposes. To use them as fuel would necessitate partial drying. Experiments have shown that almost all the sugar present in the sugar cane can be readily extracted by diffusion. With a properly constructed cutting machine and a sufficient number of vessels, the treated chips should not contain more than 0·1 to 0·2 per cent. of sugar, whilst the crushed cane, from which the juice has been extracted by pressure, contains about 3·63 per cent. of sugar. At Tore del Mar the juice is expressed from the canes, and the bagasse subjected to diffusion. The exhausted bagasse is placed into manure pits one metre in depth and then made up in heaps two metres above the surface of the ground, and covered with earth and the refuse from a distillery in connection with these works. After a year a valuable manure is obtained, which is sold to farmers.—D. B.

The Applicability of Condensed Steam from Sugar Works for Steam-boiler Purposes. C. Stammer. Dingl. Polyt. J. **263**, 189—193.

DR. CLAASSEN (*Deutsche Zuckerindustrie*, 1886, No. 10) expressed his opinion that the presence of sugar in water used for feeding steam-boilers caused corrosions of the boiler plates, owing to the formation of fatty acids as products of the decomposition of the sugar. He collected a brown powder from a boiler of a sugar works, that was fed with condensed steam, and found it to contain 11 per cent. organic matter, 6 per cent. of which were of an acid nature. The acid had entered into combination with iron. Without examining these organic acids any further, Claassen concluded that they were products of decomposition derived from the sugar, although a direct test of the feed-water with Fehling's solution showed the absence of sugar. Stammer cannot but condemn results which were obtained in this unscientific manner. He does not deny the corrosion, but thinks that the acids were more likely fatty acids which found their way into the boiler from the lubricators used for the steam cylinder, packing, and so forth. If condensed steam could be kept free from fatty matter, it is certainly the best kind of water for steam boiler purposes, but as fatty matter is only too likely to be carried into the boiler, a counteracting agent must be introduced along with it, in order to avoid injury to the plates. The addition of sodium carbonate, lime or lime water can be highly recommended as cheap and effective. The author does not contend the possibility that sugar or its products of decomposition may be injurious to boiler plates, but he thinks it rash to blame sugar for corrosions if it cannot even be detected in the feed-water.—S. H.

Improvements in the Manufacture of Caramel. C. W. N. Wallace, Southwark, and C. J. H. Barry, Camberwell. Eng. Pat. 4679, April 3, 1886. 4d.

THESE consist in heating a mixture of sugar and dilute acid at about 200° F. for some hours, adding a slight excess of sodium carbonate, and evaporating to the required consistency.—G. H. M.

XVI.—BREWING, WINES, SPIRITS, Etc.

Studies on Diastase. C. H. Lintner. J. Prakt. Chem. **34**, 1886, 378—394.

THE author has endeavoured to isolate pure diastase. The various methods used for preparing it were accompanied by a quantitative determination of the efficiency of the diastase obtained, as the degree of sacharification must be looked upon as an important criterion, both of the value of the method and of the purity of the substance. To determine the efficiency of the diastase, Kjedahl uses starch made soluble by extract of malt at 50°. The author, however, finds that this solution gives no reliable results, and replaces the malt by hydrochloric acid. In order to obtain 100cc. of the test solution, 2grms. air-dried potato starch are weighed into a bottle, mixed with 10cc. of a $\frac{1}{10}$th p.c. hydrochloric acid solution, and about 60cc. water, and the corked bottle heated at 100° in the water-bath. After the lapse of half-an-hour the starch dissolves, and though the solution is opalescent, it is perfectly mobile and hardly reduces Fehling's solution, thus comparing favourably with Kjedahl's starch solution. The acid is exactly neutralised with 10cc. of a $\frac{1}{10}$th per cent. caustic soda solution, and the solution made up to 100cc. If a large number of determinations is to be made, it is advisable to prepare large quantities of soluble starch, and weigh off the amount required in each case. To this end, a certain quantity of best potato starch is mixed with hydrochloric acid of 7·5 per cent. strength, so that the acid layer covers the starch. After standing seven days at the ordinary temperature of the air, or three days at 40°, the starch loses its power of forming a paste. It is washed by decantation with cold water until absolutely freed from acid, the water drawn off completely, and the residue dried. This starch is easily soluble to a clear fluid in hot water. Two per cent. solutions remain clear or slightly opalescent for several days. Concentrated (10 per cent.) solutions gelatinise on cooling. Fehling's solution is hardly reduced. To determine the diastatic action of malt, 25grms. of finely-powdered cured malt or well-macerated green malt are brought on a filter and extracted with 500cc. water, and the filtrate cleared by pouring back three or four times on to the filter. Into each one of 10 test tubes 10cc. of the test solution—viz., 2grms. starch in 100cc. water—are introduced, and into each consecutive test tube 0·1, 0·2, 0·3, etc., to 1·0cc. extract of malt solution are respectively added; the diastase is allowed to act for one hour. 5cc. Fehling's solution are now brought into each test tube, all of which are then placed in boiling water for 10 minutes. The tube in which all cupric oxide has just been reduced is then selected, and the diastatic value of the above extract determined; the fermentative power of a malt extract may be taken at 100, when, under the above circumstances, 0·1cc. of an extract of 25grms. malt with 500cc. water reduces 5cc. Fehling's solution.

Preparation of Diastase.—Green malt from barley is most suitable for obtaining diastase. Air-dried malt may also be used. Cured malt is not practicable. The author recommends the following as the best method of preparing diastase:—1 part green malt from barley or sifted air-dried malt is treated with 2—4 parts of 20 per cent. alcohol for at least 24 hours; the extract in the filtrate is precipitated by adding 2—2½ times the volume of absolute alcohol; the diastase is quickly filtered, macerated with absolute alcohol, again filtered and washed with the latter, then macerated with absolute ether, and after filtering dried in vacuo over sulphuric acid. After thoroughly drying the diastase in this manner, it is obtained as a loose yellowish-white powder of great efficiency. Before using, it must be well macerated with a little water. To prepare *pure* diastase the latter raw product is dissolved in water, precipitated and allowed to stand some time with alcohol, when it is washed with ether and dried, this process being repeated several times, in order to render the albuminous substance insoluble. Inorganic substances adhere most persistently to diastase; even after six precipitations, there were still 10 per cent. of the former, consisting chiefly of neutral calcium phosphate. Five per cent. were removed by dialysis; the remaining five consisted of pure calcium phosphate. Certain interesting relations existing between the quantity of nitrogen and the diastasic action of various substances are given.

The author, contrary to Payen and Persoz, shows diastase to be a nitrogenous body. No higher percentage than 10·4 (calculated on substance free of ash) is it possible to reach by purifying the ordinary diastase. An analysis gave numbers which show that the composition of diastase differs considerably from that of the albuminous substances (C=46·66, H=7·35, N=10·41, and S=1·12 per cent. respectively) (calculated on the substance free from ash). But the composition is similar to that of other ferments, such as pancreatic ferments, invertin, and emulsin. From this it may be concluded that chemical ferments belong to a special class of protein substances.

Diastase gives almost all the reactions of albuminoids but the one so characteristic of peptones—viz., the biuret reaction. One reaction, which no other protein body shows, diastase gives most distinctly—viz., the reaction with alcoholic guaiacum tincture. One drop of a solution of diastase causes an intense blue colouration, which appears within a few minutes, even if traces are present. In conclusion, the author thinks that though differing in composition, diastase shows considerable similarity to the albuminous bodies. Since the largest amount of diastase is produced during germination, and the latter process must, to a certain extent, be looked upon as one of oxidation, it does not seem improbable that diastase is an oxidation product of certain protein substances.—A. R.

Improvements in Apparatus and Mode of Holding or Containing Bicarbonate of Soda for Generating Carbonic Acid Gas, to be used in Aërating and Causing to Flow from the Barrel Draught Ale or other Beverages. W. A. How, New Malden, Surrey. Eng. Pat. 4194, March 25, 1886. 8d.

A CYLINDRICAL stoneware jar contains an inverted bell jar, to the top of which a tap is fixed for the admission of air and the escape of any gas generated. The bell-jar contains an arrangement for holding in its place sodium bicarbonate in a bag of textile material, or a separate holder with perforated sides.—S. H.

Improvements in the Manufacture of Yeast. W. S. Squire, London. Eng. Pat. 5457, April 20, 1886. 4d.

THE yeast is grown in a mixture of a solution of "peptonised maltose" (Eng. Pat. 11,935, 1885; this Journal, 1886, 542) and spent wash and wort, prepared by boiling maize, buckwheat or rice with water containing a little acid. The acid is neutralised with an alkali, the grain, together with the water in which it has been boiled, added, to either ground malt alone or ground malt mixed with ground raw grain, and mashed at 140° F. for an hour and a half. The clear spent wash from a previous distillation is added to this in such a proportion that the mixture shall have a sp. gr. of 1·040.
—G. H. M.

Improvements in the Manufacture of Aërated or Gaseous Waters or Beverages. J. C. Mewburn, London. From E. Bourcond, Madrid, Spain. Eng. Pat. 5834, April 29, 1886. 4d.

THIS invention consists in the employment of nitrogen gas in the manufacture of aërated beverages. The nitrogen is obtained from the air by the withdrawal of oxygen therefrom by means of phosphorus. The gas is first purified by passing through a weak solution of sodium hydrate, and then injected at a suitable pressure into the water or liquid to be aërated or rendered gaseous.—S. H.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(*A*) CHEMISTRY OF FOODS.

Improvements in the Treatment of Rennet. C. Hansen, Copenhagen, Denmark. Eng. Pat. 2909, March 1, 1886. 6d.

THE rennet ferment is precipitated in such a manner as to contain substances, such as pepsin or peptonised matters, which are themselves inert and protect the rennet subsequently from the effects of the atmosphere. After admixture with salt, sugar or other substance which is both inert and soluble in water, the precipitated material is pressed into a solid mass of such a size that each piece shall contain a fixed quantity of rennet, the necessity of weighing being thus dispensed with. The requisite number of pieces are dissolved in water prior to being added to the milk.—C. C. H.

Poisoning Sheep by Sorrel. Biermann. Bied. Centr. **15**, 858.

OUT of twenty sheep put to graze on an oat-stubble field, where there was a considerable growth of sorrel (*Rumex acetosa*), seven were taken ill, and of these two died.—D. A. L.

Simple Method of Preserving Hay or After-Math. W. Wagner. Bied. Centr. **15**, 860.

THE author recommends ensiling under pressure. He adds that the sweet silage is eaten readily by cattle, whereas sour silage increases the yield of milk.
—D. A. L.

Nutritious Value of some Edible Fungi. C. T. Moerner. Zeits. für Physiol. Chem. **10**, 503—516.

In these investigations only those parts of the fungus usually eaten were experimented upon. The fungi employed and the scope of the experiments will be seen from the following table of results:

Latin Name.	Common Name.	Nitrogen per cent. Dry Matter.						
		Soluble in		Albuminoid.			Extractive or Non-Albuminoid.	Total.
		Pancreatic Juice.	Gastric Juice.	Digestible.	Not Digestible.	Total.		
Agaricus procerus Scop.	Mushrooms	0·28	2·71	2·99	1·27	4·21	2·02	6·23
„ campestris (Hut.)		0·35	3·29	3·64	1·17	4·89	2·19	7·38
„ campestris (Fuss)		0·10	2·78	2·88	1·09	4·01	1·98	6·02
Lactarius deliciosus		0·21	1·20	1·41	1·05	2·51	0·60	3·11
„ torminosus Fr.		0·17	0·79	0·96	1·00	1·91	0·58	2·52
Cantharellus cibarius Fr.	Cantharellus	0·08	0·71	0·79	1·46	2·29	0·40	2·69
Boletus edulis Bull	Boletus (various)	0·16	1·91	2·10	0·65	2·73	1·14	3·87
„ „ (Fuss)		0·11	1·62	1·76	0·67	2·35	0·95	3·30
„ scaber Fr (Hut.)		0·18	1·48	1·66	0·85	2·51	0·58	3·12
„ „		0·12	0·87	0·99	0·62	1·71	0·48	2·19
„ luteus		0·22	0·48	0·70	1·06	1·77	0·74	2·51
Polyporus ovinus Fr.	Polyporus	0·08	0·12	0·50	0·84	1·35	0·45	1·80
Hydnum imbricatum	Hydnum	0·08	0·77	0·85	0·76	1·59	0·96	2·55
„ repandum		0·15	1·08	1·23	1·55	2·78	0·74	3·52
Sparossis crispa	Sparassis	0·09	0·37	0·46	0·40	0·97	0·21	1·18
Morchella esculenta	Edible Moril	0·22	1·97	2·19	1·90	4·18	0·81	4·99
Lycoperdon Bovista Fr.	Common Lycoperdon	—	3·13	3·13	2·70	5·79	2·40	8·19

In the digestive experiments, the substance was first treated with gastric juice, then the insoluble residue was treated with pancreatic juice, the finally insoluble portion being the indigestible matter. The average percentage of albuminoids present in the dry matter is 15·7, of which over half (8·7 per cent.) is digestible, and therefore on this basis, the nutritious value of these fungi is very near that of cabbage with 13·5 per cent. of albuminoids in the dry matter, and much below that of most other fresh articles of food, whether animal or vegetable. —D. A. L.

(*B*) SANITARY CHEMISTRY.

Microscopic Flora in Sulphur Springs. L. Olivier. Compt. Rend. **103**, 556—559.

Organisms have been observed in all cold or warm sulphurous spring waters examined by the author, even in those of a temperature of 55°; in fact, the organisms can withstand a temperature of nearly 70°. In cold waters, the organisms are Leptothrix, in filaments of colourless cells; whilst in warm water, they consist of uni-, bi- or, at the most, quadri-cellular bacilli. Some are elongated, some resemble bacteria; their membranes contain an iron salt. They form in a somewhat slimy, flocky, grey or colourless mass, which adheres to the stones, and contains microscopic crystals of sulphur and other inorganic matter. Both the warm and cold-water organisms contain granules of sulphur in their cells, and exert a reducing action on the sulphates present in the waters. The form of the warm-water organisms varies with the physical conditions, hence they appear longer at lower temperatures. In an experiment with the slimy matter from warm sulphur springs, long filaments were developed in 20 days at the ordinary temperature, consequently the elements of Leptothrix cells are present in the slimy matter.—D. A. L.

A New or Improved System of Treatment of Sewage. F. H. Daachell, Maidstone. Eng. Pat. 2439, Feb. 19, 1886. 6d.

The sewage is defecated, the resulting sludge filter-pressed, and, lastly, carbonised in retorts. If not sufficiently rich in carbonaceous matter, substances such as sawdust, peat, blood or offal, etc., are previously mixed therewith. The carbon, after carbonisation, the patentee terms "charcoaline," and proposes to use it either for the purification of sewage or the decolouration and purification of water, sugar, vinegar, etc.—C. C. H.

Improvements in Treating Sewage and Making Cement. J. B. Hannay, Glasgow. Eng. Pat. 3217, March 8, 1886. 4d.

Lime or carbonate of lime is added to the sewage in conjunction with clay; the resulting sludge is dried by evaporation, heated to redness, cooled, and ground. —C. C. H.

Improvements relating to the Purification of Water. C. W. Burton, Nogent; F. T. Moison, Mony, France Eng. Pat. 3730, March 16, 1886. 6d.

Calcined dolomite is employed, either in conjunction with or without carbonate or oxalate of baryta, for the removal of carbonate or sulphates held in solution in a water.—C. C. H.

XVIII.—ELECTRO-CHEMISTRY.

Improvements in the Method of Depolarising Electric Batteries. A. C. Henderson, London. From E. Bazin, Paris, France. Eng. Pat. 3577, March 13, 1886. 11d.

In order to prevent polarisation, the inventor makes use of carbon discs mounted upon a rod, suspended in bearings over the cells at such a height, that part only of the discs dips into the battery solution. The rod is made to rotate by means of an electro-motor, driven by the current from two or three of the elements, and by its rotation it brings fresh surfaces of carbon into contact with the liquid.—B. T.

Improvements in Electro-plating Apparatus. A. F. Harris, Walsall. Eng. Pat. 3674, March 16, 1886. 4d.

To prevent the suspending wires or hooks of electroplating baths becoming coated with a metallic deposit, the inventor covers these wires with an insulating varnish of enamel, indiarubber or other suitable insulator. —B. T.

Improved Means for Producing Ozone and Hydrogen suitable for Bleaching Purposes. J. H. Johnson, London. From E. Hermite, Paris, France. Eng. Pat. 3956, March 20, 1886. 8d.

The patentee has found that when sulphate of soda, sulphate of potash, caustic soda, potash or baryta, either pure or in a state of mixture, are subjected to electrolysis, using an unattackable or in-corrodible positive electrode such as platinum or carbon with a negative electrode of mercury or an amalgamated metal such as copper, tin, zinc or iron, an amalgam of the metal set free is obtained at the negative pole, while ozone or ozonised oxygen is obtained at the positive pole. If the passage of the current be interrupted, or the apparatus short-circuited, the water is decomposed by the amalgam with abundant evolution of nascent hydrogen. The inventor applies these reactions to bleaching purposes by utilising this ozone and nascent hydrogen, and makes use of an apparatus constructed and arranged as follows:—A layer of mercury at the bottom of a tank or cistern is connected with the negative pole of an electric generator: at a short distance from the layer of mercury is situated the positive electrode, constituted by one or more plates of platinum or carbon perforated with holes to facilitate the escape of gases. The trough is afterwards filled up with a solution of any of the substances before referred to. The materials to be bleached are immersed in this solution, where they are acted on by the ozone, the ozonised oxygen or the nascent hydrogen produced, the alkaline or earthy alkaline metals produced being absorbed by the mercury in the process of electrolysis. Other modifications are described.—J. H.

Improved Means for Producing Chlorine Compounds suitable for Bleaching Purposes. J. H. Johnson, London. From E. Hermite, Paris. Eng. Pat. 3957, March 20, 1886. 8d.

The inventor employs an apparatus similar to the one described in Eng. Pat. 3956 (preceding abstract) for the electrolysis of chlorides of the alkali or alkaline earth metals. An amalgam of the alkali with the mercury is formed at the negative pole, while chlorine compounds are obtained at the opposite pole. The goods are immersed as in the previous patent, and are bleached by the oxygen compounds of chlorine evolved.—J. H.

Improvements in Galvanic Batteries. A. Dun and F. Hasslacher, Frankfort-on-the-Main, Germany. Eng. Pat. 5731, April 27, 1886. 6d.

In this improved two-cell battery, a carbon negative element is immersed in aqua-regia contained in one cell, and a positive element of zinc, or other soluble metal, is used in the other cell, which contains soda-lye. The hydrochloric acid of the aqua-regia may be replaced by chromic acid or a chromate, and ferric chloride may be used in addition.—B. T.

Improvements in Incandescent Electric Lamps. B. J. B. Mills, London. From W. Holzer, Harrison, New Jersey, U.S.A. Eng. Pat. 5979, May 3, 1886. 8d.

To overcome the difficulty caused by the breakage of a filament when incandescent lamps are placed in series, the leading-in wires pass in close proximity through a double-barrelled glass tube, or through two glass tubes bound together. If the filament breaks, an arc forms which burns down the leading-in wires until a point is reached at which they are close enough for the melted ends to coalesce, thus metallically completing the circuit. —E. T.

Improvements in Electric Secondary or Storage Batteries. W. Taylor, London. Eng. Pat. 6287, May 10, 1886. 8d.

To produce a very light electrode, a leaden frame is used with several vertical partitions; the spaces between these are bridged across by numerous horizontal leaden bands, corrugated so as to hold firmly the active material, which is placed between them. A small space is left near the top of the frame to allow expansion by sulphating to go on without injury. The active material may, when formed, be perforated, to allow of free circulation of the liquid, and reduce the weight of the electrode. A short piece of copper is soldered to the electrode for a terminal; suitable copper bars are let into opposite sides of the top of the box, and to these the terminals of the electrodes are soldered.—E. T.

An Improved Form of Galvanic Cell for Bell Ringing and other Purposes. G. H. Bays, jun., Wakefield, Yorks. Eng. Pat. 6604, May 17, 1886. 4d.

This element consists of a porous cell contained in a non-porous earthenware jar, the space between the two vessels being packed with fine gas-retort carbon, with or without the addition of manganese dioxide. A rod of carbon is packed in with the broken carbon to serve as the negative electrode. The porous cell contains a rod of zinc immersed in a solution of a suitable salt, such as chloride of sodium; dilute sulphuric or hydrochloric acid, etc., may be employed.—B. T.

An Improved Regulator combined with a Portable Battery for Controlling the Light of Incandescent Electric Lamps used for Surgical and other Purposes. J. B. Medland, London. Eng. Pat. 12,779, Oct. 7, 1886. 8d.

Round a piece of insulating material is wound a spiral wire of high resistance. Surrounding, but insulated from it, is a metal cylinder, having a slot along its under side. A ring, sliding on this, has a projection, which, passing through the slot, makes contact with the wire inside. The current, entering at one end of the wire, reaches the ring and passes thence to the outside cylinder, which is joined to the rest of the circuit. —E. T.

XIX.—PAPER, PASTEBOARD, Etc.

On the Strength of Paper as influenced by Sizing, Satining and the Amount of Wood-Fibre contained in it. A. Martens. Dingl. Polyt. J. **263**, 120—124.

According to the author, paper which has been sized with *animal* gluten (gelatin) is very considerably improved in every respect as compared with paper only treated with vegetable glutin. The strength, however, does not increase with the number of times the paper is sized, not more than two treatments being, in fact, advantageous. With an increase of the amount of woody fibre contained in paper, the strength is notably diminished. Paper sized with resin shows lower values in the "tearing length," tension and modulus of work, than paper sized with animal gluten or unsized paper.

Soil, which is frequently added to weight the paper, has a most injurious effect on the strength. Even such papers, however, are considerably improved by twice sizing with animal gluten. It is furthermore stated that satining increases the "tearing length," no matter in which direction the strip experimented upon is cut from the sheet of paper, or in which direction it is satined. This increase, however, varies according to whether the strip of paper has been cut parallel or at right angles to the course of the machine. In the latter case it is about 13 per cent., in the former only 5 per cent. The medium tension is hardly altered. The thickness of the paper decreases by satining, the weight does not change appreciably. It is important to notice that the paper experimented upon was made of linen and cotton fibre, and the results cannot, therefore, apply equally to paper of a different manufacture.

For all practical purposes the author thinks that different kinds of paper, whose strength ("tearing length" and tension) does not differ by more than ±5 p.c., may be regarded as of equal quality, other properties and peculiarities of the papers being equal.—A. R.

Improvements in Manufacturing or Preparing Asbestos for use as a Non-Conductor of Heat and otherwise. W. Finlayson, Glasgow. From R. H. Martin, New York, U.S.A. Eng. Pat. 10,891, Aug. 26, 1886.

The sheets or coverings may be of various forms, and are composed of superimposed "slivers," or fleeces of asbestos fibre. The asbestos is not pulped, as in the manufacture of paper or millboard, but is cast through a carding machine—the fleece so formed, being deposited in even layers upon an apron or table, or coiled upon a rotating cylinder until a sufficient thickness is obtained. Water, or a sizing substance (preferably a solution of silicate of sodium), is uniformly applied to the asbestos, at some convenient stage between its raw condition and its deposition in layers. No felting operation is employed, but pressure, regulated according to the required density, is applied by means of a roller or otherwise. For some purposes hair, wool, mineral wool, finely-divided clay, infusorial earth, etc., may be mixed with the asbestos fibre. The sheet or covering, when dried, forms a flexible elastic material resembling felt, is non-conducting, and may easily be made waterproof. It may be bent and adapted to slightly curved or irregular surfaces.—E. G. C.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

The Pepsins of Commerce. C. Schlickum, Brit. and Col. Druggist, March 12, 1887 (Zeit. Oestr. Ap. and Ver.).

Numerous varieties of both "concentrated" pepsins, prepared by precipitation according to Scheller's process, for "scale" pepsins are manufactured, the digestive strengths of which are much higher than that of the officinal saccharated pepsin. The author has examined the strengths of several of these pepsins of higher digestive power, by digesting them for six hours at a constant temperature with a known weight of albumen, and then determining the amount of undissolved albumen. The results show that the "concentrated" pepsins have on the whole a greater digestive power than the "scale" pepsins, while the claims made by the manufacturers of both varieties are greatly at variance with their true digestive powers.—C. A. K.

On Magnolia-Bark. J. U. and C. G. Lloyd. Pharm. Rundsch. **4**, 266.

Commercial *cortex magnoliae* comes from the mountains of North Carolina, and is collected from *magnolia glauca, umbrella* and *macrophylla*. The bark was extracted with alcohol, the latter evaporated, resinous matters being left behind, which apparently were a mixture of three different resins. The residue was taken up with water, which, after a few days, gave colourless crystals, which were recrystallised from alcohol. They were then dissolved and boiled with dilute sulphuric acid, the solution neutralised with barium carbonate, and filtered. The filtrate reduced Fehling's solution, and it is, therefore, very likely that the crystals represented the magnolia glucoside. Experiments for obtaining an alkaloid from the resinous residue were unsuccessful, although the usual reagents for alkaloids pointed to the presence of an alkaloid.—S. H.

Asiminin, a New Alkaloid. J. U. and C. G. Lloyd. Pharm. Rundsch. **4**, 268.

The alkaloid was obtained from the seeds of the fruit of *Asimina triloba*. The powdered seeds were extracted with alcohol, the latter mostly driven off, the residue mixed with water to separate the essential oil, and after acidifying with acetic acid, put aside for twenty-four hours. The mass was filtered, rendered slightly alkaline with ammonia, and the precipitate repeatedly shaken with ether. On evaporating the latter, the alkaloid remaining behind was dissolved in alcohol, and converted into the hydrochloride, which was recrystallised several times. The free base was then precipitated with ammonia. It is amorphous, colourless, tasteless and without smell, insoluble in water, and easily soluble in alcohol and ether. Nitric acid colours asiminin and its salts at first carmine-red, then deep violet. Chlorine water does not act upon the free alkaloid, but the hydrochloride is precipitated. The hydrochloride crystallises in colourless plates and cubes. The composition of the alkaloid has not yet been definitely ascertained.

—S. H.

Improved Process for Manufacturing Tannic Acid in Crystals or Grains. Dr. H. Byk, Berlin, Germany. Eng. Pat. 15,436, Nov. 26, 1886. 4d.

The patentee prepares a granulated tannic acid by dissolving it in a suitable solvent, and adding 5 per cent. alcohol containing 0·05 per cent. glycerin. This solution is evaporated down and spread out to dry on sheets of zinc or other metal from which it can then be detached in semi-transparent grains. The glycerin may be replaced by gum or carbohydrates.—R. L. W.

Cholestrin in Carrots. A. Arnaud. Compt. Rend. **102**, 1319—1322.

In investigations with carrots, the author obtained an impure cholestrin, which he found to be identical with Husemann's hydrocarrotin. The impure substance was purified by repeated treatment with alcohol, until the melting point was constant. The cholestrin obtained in this manner has the composition $C_{26}H_{44}O$, it is insoluble in water, slightly soluble in cold but readily in boiling alcohol, from which solution it crystallises on cooling in leaflets with 1mol. H_2O. It is also very soluble in ether, carbon bisulphide, chloroform, light petroleum and oils, from which solutions it is deposited in anhydrous needles. It is not attacked by alkalis nor by acids. It is lævo-rotatory, the rotatory power of the chloroform solution being $[\alpha]_D = -35°$. It melts at 136·5, losing the 1mol. H_2O. It will be observed that the cholestrin from carrots is identical with that obtained by Hesse from Calabar beans and from peas, and differs only very slightly from animal cholestrin.—D. A. L.

Occurrence of Cholestrin in Vegetable Fats. E. Heckel and F. Schlagdenhauffen. Compt. Rend. **102**, 317—319.

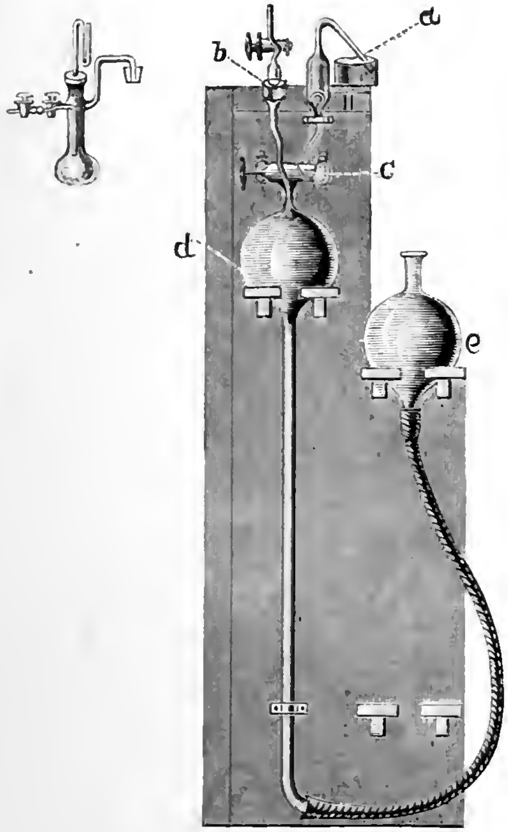
The authors have isolated cholestrin from the seed-oils from *Gynocardia odorata, Giulandina, Bonducella* (chick stones), *Cæsalpinia Bonducella, Abrus precatorius* (wild liquorice), and from the fat and wax extracted from the leaves of *Erythoxylum hypericifolium* (Hypericum-leaved red-wood). Two modes of investigation were followed. In one the oil or fat was boiled with alcohol and the alcoholic extracts allowed to crystallise; when, after about a month, they deposited leaf-like crystals melting at 134—138°. In the other a portion of oil or fat was saponified, and the soap extracted with ether; on evaporating the ether extract, rhombohedral tables or fine needles melting at 135—138° were deposited. In both cases the crystals had the physical and chemical properties of cholestrin, giving the colouration with sulphuric acid, chloroform and ferrous chloride, etc.

—D. A. L.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

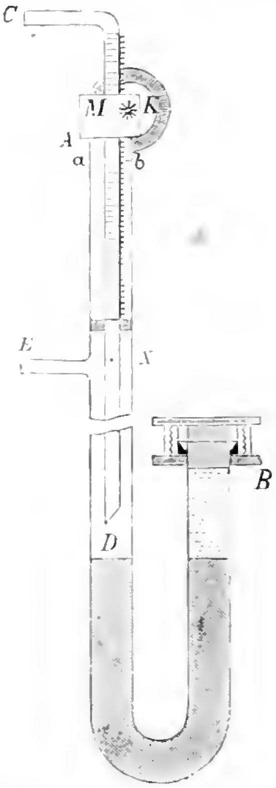
Mercury Air-Pump. Greiner and Friedrichs. Chem. Zeit. **10**, 277.

The apparatus is a modification of Geissler's pump. The principal novelty is a new form of three-way tap *c*, consisting of two passages, which are bored obliquely to the axis of the plug. All the taps are also fitted with a mercury lute. The working of the pump is very simple. The tap *c* is connected with *a*, and the reservoir *e* is raised until mercury enters the tube *a*. The connection of *c* and *a* is then interrupted, *e* is lowered and *d* connected with *b*. Air thus enters *d*, which is then driven out through *a*; a vacuum is again formed by lowering *e*, and so forth.—S. H.



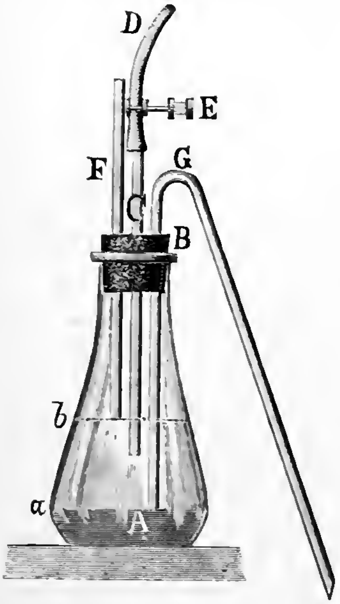
Thermo Regulator. G. W. A. Kahlbaum. Ber. **19**, 2860—2862.

THE author has constructed a thermo regulator similar to Andreae's. The U tube A B, open at both ends, has a short side tube E, the gas exit tube, blown on the longer limb. The mouth of this limb is closed with a brass cap M, through which passes a narrow graduated tube bent at right angles and carrying a toothed rod. This tube can be raised or lowered by means of the wheel K. It also carries a small piston, with which the large tube is made air-tight. On the under side of this the tube C D has a small hole X, and the lower end is cut off obliquely. The large U tube A B is filled with mercury to within 4cm. of the end B, and 2cm. of a liquid. This end is closed by means of a cork, which is kept in its place by a brass screw cap. If, before putting in the cork, the tube A B be sloped until the liquid rises to the edge, the cork may be put in without any air being between it and the liquid. When now the lower part of the regulator is heated above the boiling-point of the liquid, the mercury *niveau* is regulated by the elastic force of the vapour of the liquid, and not by the mere expansion of the liquid itself. The mercury rises and partly or wholly covers the mouth of the narrow tube C D. Should the mouth become entirely closed, a small jet of gas still remains, the small hole X supplying this. It is, therefore, only necessary to put suitable liquids in the end B, and the regulator may be used for all temperatures between —40° and +360° C. The author found it to keep temperatures constant to 0·1° C. The graduation of the tube C D enables the operator to fix the tube exactly in the same position again after being put away, thus being sure of starting again with the same temperature.—J. W. L.



A Simple Apparatus for Washing Precipitates Automatically. A. Wahl. Chem. Zeit. **11**, 4.

THE apparatus consists of a flask A, an indiarubber stopper B with 3 holes, a feed-pipe C with the screw-slip E on the indiarubber tube D, an air-tube F and a siphon G. The long leg of the siphon is placed above



the filter to be washed. The washing liquor runs into the flask from above through the pipe C, the flow being regulated by the clip E in such a manner that the rise of level from *a* to *b* takes a little more time than is required for the washing on the filter to run through it. As soon as the level *b* is reached, the air can no longer escape through F; the siphon is thus made to run until the level has sunk to *b*, when it stops of itself. The liquor in A then rises again, and the play of the siphon is repeated. If it be desired to wash the filter with hot liquor, the flask A may be heated in any convenient manner.—S. H.

Apparatus for Chemical Laboratories. Dr. T. Walter. J. Prakt. Chem. **34**, 1886, 427–432.

THE condenser recommended by the author is constructed on a principle the reverse of Liebig's—*i.e.*, while in the latter the vapour is condensed from the outside, the author passes the condensing water through the inner tube, the cooling from outside being effected merely by the air. With the intention of making the condenser as short as possible without influencing its efficiency, the condensing surface is increased by blowing five, eight, or more bulbs on one outside tube. Fig. 1 represents such a condenser suspended in a flask; when experimenting on a small scale the dimensions are: diameter of round-bottomed flask 90mm., diameter of neck 20mm., and length 180mm. The condenser consists of a glass tube 5mm. wide, on which the small bulbs, 16mm. in diameter, are blown; to the tube at *c* a somewhat wider tube is attached, and to this the side piece *d* is fused. To construct the thin tube (1·5—2mm. wide), which reaches to the inside of the lowest bulb, a piece of tubing is chosen which fits easily in the upper tube *c*. This is then drawn out and the wider part *f*, which has not been drawn out, is passed down through *c* as far as possible, and the two tubes joined by caoutchouc tubing or fused together. To one of the upper and lower bulbs three small glass buttons are fused at *v*, to prevent the cold condensing surface from touching the hot neck of the flask. The water enters either at *d* or *f*. In the apparatus ether may be boiled vigorously (the temperature of the water used for condensing being 13°) without the slightest loss. The small bulb condenser is either suspended by the side piece *d*, or slung, by means of a wire round *c*, to the neck of the flask. Should noxious gases be evolved during the reaction, these may be drawn off by putting a tube bent at right angles in the open neck of the flask and attaching the other end of the tube to an ordinary air-pump. The author also describes some improved apparatus for distilling substances that attack caoutchouc or cork (Figs. 2 and 3). The latter arrangement is used when the vapours are not readily condensed. The condensers here shown are straight, but it is better to employ bulb-condensers. The retort neck is ground and fitted into the receiver at *c*. With the apparatus

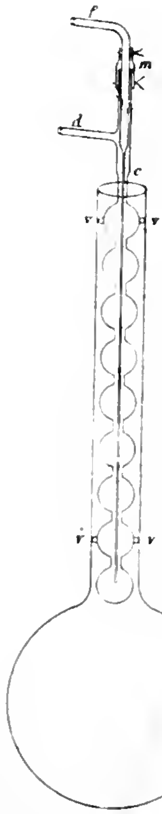


Fig.1.

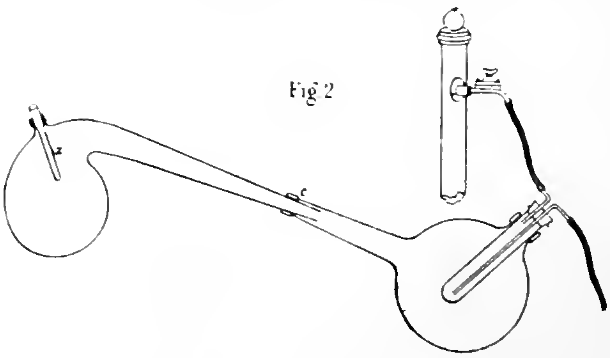


Fig.2

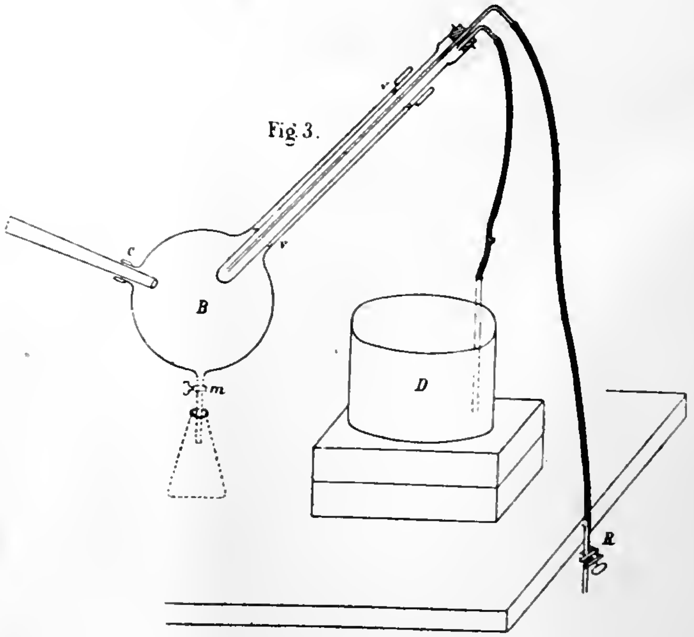


Fig.3.

Fig. 3, the distillate can also be drawn off fractionally, if to the receiver a tube *m* be jointed, furnished with a glass stop-cock. If the condensing water is to be very cold, the vessel D is filled with ice and water; the condensing tube, as will be seen in the figure, forms one limb of a siphon, and is previously filled with water. The flow of the water is regulated by the screw R. A method is also given for working with condensing water of −15°. In Fig. 2, *z* is a glass tube closed below and ground into the tubulus of the retort; it serves for holding the thermometer and a little mercury. To combine the operations of heating with reflux condenser and then distillation, flasks of the shape shown in Figs. 4 and 5 are recommended. Bulb condensers (omitted in the sketch) are suspended in the upper part of the tube, or Liebig condensers are attached. For heating with reflux action the side tube is turned upwards and closed with a stopper, or merely by a small glass rod, fitting tolerably well into the tube. For distilling, the flask is turned 180° on its axis; the side tube now has the position shown by the dotted lines in Fig. 4, the fluid which previously returned over the brim of the inner tube into the flask, now flows out. If a narrowing of the tube is objectionable, the construction of a flask (Fig. 5) is useful, particularly when solid bodies, such as PCl_5, are to be brought into the flask. This is effected by means of a funnel having a long and wide tube reaching into the flask. The last-named arrangements are impracticable for substances with low boiling points. They are peculiarly adapted in cases where the distillate solidifies readily—*e.g.*, acetanilide. In many cases air is amply sufficient for condensing purposes when the bulb-condenser is employed; when fractionating, air is even preferable, the current of air being drawn through the apparatus by an ordinary air-pump.—A. R.

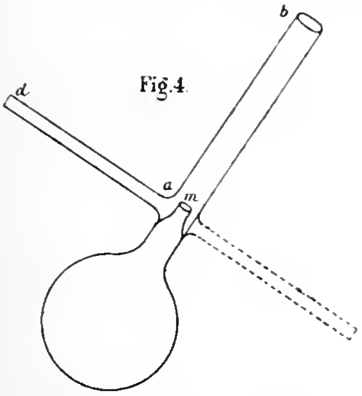


Fig.4.

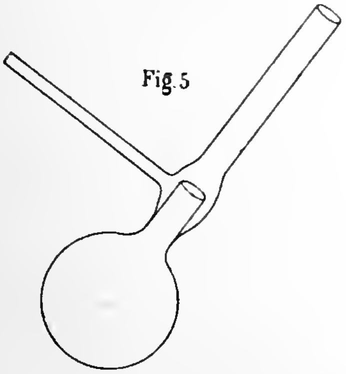


Fig.5

Apparatus for Extracting Aqueous Solutions. E. Grauer. Dingl. Polyt. J. **262**, 475—477.

This apparatus is intended for the extraction of substances contained in a solution, in a finely-divided or soluble condition, by means of a solvent of higher or lower specific gravity. Fig. 1 represents the apparatus used for extracting aqueous solutions with a solvent of higher sp. gr., such as, for instance, carbon bisulphide. The tank A contains the solvent, and B the aqueous solution. The solvent is run into the apparatus C at *d*, to the level of *a*; the valve *b* is then opened, and the aqueous solution allowed to proceed through the apparatus. The solvent being heavier than the aqueous solution, remains in the lower part of the spiral pipe of C, so that the solution in ascending the apparatus is brought into intimate contact with the solvent, resulting in a complete extraction of the substance to be separated. The saturated solvent is then removed to D, through the pipe *a*, and may be recovered by distillation, whilst the extracted solution passes through *c*, and is collected in E. The apparatus illustrated in Fig. 2 is used for the extraction of aqueous solutions, with a solvent lighter than water. In this case, the solution in A is introduced into C, at *d*, whilst the solvent enters the apparatus at *b*. The saturated solvent is run off at *c*, and the treated solution at *a*.—D. B.

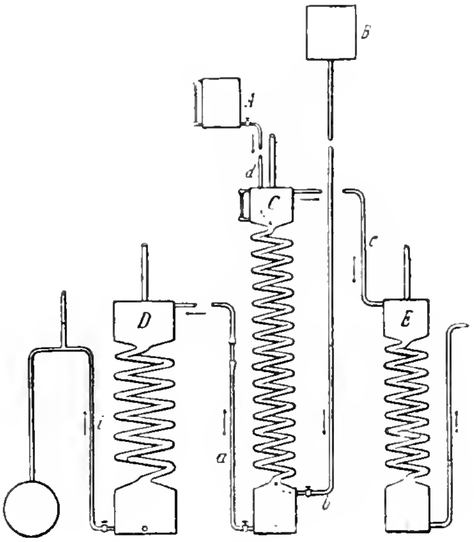


Fig. 1.

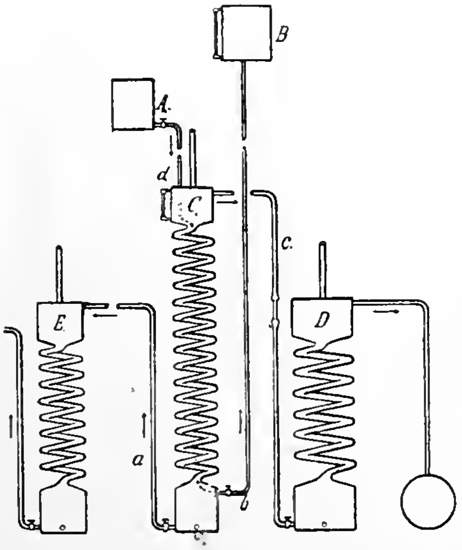


Fig. 2.

Sensitive Reagents for Detecting Minute Quantities of Active Oxygen. C. Wurster. Ber. **19**, 3195–3205.

IN the course of some researches on the influence of the natural and artificial climate of habitation and clothing on the circulation of the blood, it was found needful to study the condition of the blood in proximity to the skin of the body, various observations made by the author having shown that oxidation takes place in the skin, and that certain secretions of the body and skin possess powerful oxidising properties. Attempts to detect ozone or hydrogen peroxide in animal tissues by the ordinary tests having been unsuccessful, the author instituted a series of experiments, the object being to discover if possible some reagents which would admit of the ready detection of active oxygen. It was found that the methyl derivatives of phenylenediamine produced delicate colour reactions with active oxygen, tetramethylparaphenylenediamine being the most sensitive reagent, producing an intense blue colouration with oxidising agents. This base does not undergo any change on exposure to the atmosphere, and resists energetically the action of acids, alkalis, and reducing agents. The author has experienced no difficulty in detecting minute traces of active oxygen both in a free and combined form by employing this reagent. With paper rendered sensitive by impregnation with a solution of tetramethylparaphenylenediamine he has succeeded in proving the presence of ozone in air, in the proximity of a flame and in the sap of plants. He has also detected active oxygen on the surface of the skin of the human body.—D. B.

A New Method of Determining the Flashing Point of Petroleum. Th. Rosenbladt. Chem. Zeit. **10**. 1587.

THE Abel-Pensky apparatus, which is the only contrivance universally adopted for the determination of the flashing point, requires at least from 75 to 100cc. of petroleum for a test. If only a smaller quantity is at disposal, the test cannot be performed, and in those cases the author recommends the following method:—A flask is filled with water to two-thirds of its capacity, and closed with an indiarubber stopper, fitted with two holes, through one of which goes a Welter's safety tube, luted with a little mercury, and through the other a bent glass tube. A Woulf's bottle of 100 to 150cc. capacity contains 12·5cc. (10grms.) of the petroleum to be tested, and the same amount of distilled water. One opening of this bottle is closed with a stopper, into which is inserted a tube, which reaches nearly to the bottom, where it is drawn out to a fine point (1½mm.). This tube is connected with the flask. The Woulf's bottle is covered with cloth, to protect it from cooling. The second opening is connected with the condensing tube of a Liebig's condenser, the other end of which dips in a dry measuring tube of 5 to 6cc. capacity, divided into 20ths of a cc. The contents of the flask are then boiled, until 5 to 5·1cc. have collected in the measuring tube, when the latter is exchanged for another, and the distillation continued until a further distillate of 5cc. has condensed. The liquid in the tubes is allowed to cool to 15° C.; both the total volume and the oily layer on the top are read off, and their proportion noted down. The following table shows some of the results obtained in this manner:—

Petroleum having the Flashing Point at			Proportion of Aqueous to Oily Liquid (Factor).
20° C.	From the works of Messrs. Tagieff.	Baku.	1 : 0·697
21° ,,			1 : 0·673
22° ,,			1 : 0·650
23° ,,			1 : 0·626
21° ,,	From Messrs. Mirsoeff.		1 : 0·598
25° ,,			1 : 0·572
26° ,,	From Messrs. Kokoreff.		1 : 0·549
27° ,,			1 : 0·526
30° ,,	From Messrs. Nobel Bros.		1 : 0·461
45° ,,	American Petroleum.		1 : 0·328

It will be noticed that the factor varies nearly in proportion with different flashing points, and although this method does not claim absolute accuracy, the result does not differ from that obtained with the Abel apparatus by more than ± 1. In order to avoid mistakes due to the variation of barometric pressure, it is important to distil some normal standard petroleum at the same time, under the same conditions, and to make the necessary corrections accordingly.—S. H.

Detection of Lead in Zinc Preparations. Chem. Zeit. **11**, 18.

THE testing of zinc oxide for lead, according to the direction of the German Pharmacopœia—viz., adding sulphuretted hydrogen to the solution of the zinc compound in acetic acid—is not sufficiently delicate for the detection of minute quantities of lead. Mylius now publishes a method by which the smallest traces of lead can be detected. The zinc oxide is dissolved in warm dilute sulphuric acid. An absolutely clear solution shows *a priori* the absence of lead, but in most cases the solution will be turbid. It is filtered, and the precipitate well washed. The filter is then digested in a warm 20 per cent. solution of ammonium acetate for several hours, whereby any lead sulphate present is converted into lead acetate and dissolved. The solution is then filtered, and traces of lead can be detected in the filtrate by sulphuretted hydrogen or potassium bichromate. This method is far more sensitive than that of the Pharmacopœia.—S. H.

Estimation of Phosphoric Acid in Thomas Slag. C. Brunnemann. Chem. Zeit. **11**, 19.

TEN grammes of slag are digested in a beaker with about 40cc. of water, 90cc. of hydrochloric acid, 50cc. of nitric acid and 10cc. of sulphuric acid. The beaker is then covered and heated over a flame for about three-quarters of an hour. The hot solution is then poured into a litre flask, which contains about 400cc. of hot water, and the beaker rinsed with hot water. The flask is then shaken, in order to dissolve all the calcium sulphate, filled up to the mark, and allowed to cool. The insoluble matter consists of silica and carbon. 50cc. of the clear solution are then evaporated on the water-bath, the hydrochloric and nitric acid is driven off, and the free sulphuric acid neutralised with dilute ammonia (1 : 5). The mass is then evaporated to dryness and heated to 110° C. for ten minutes, to render the silicic acid insoluble. The residue is stirred with 10cc. of strong nitric acid, and 50cc. of hot water then added to dissolve the calcium sulphate. The solution is filtered from the silica and the filter washed with hot water. The phosphoric acid in the filtrate is then precipitated by ammonium molybdate. This method also converts the iron phosphide into phosphoric acid, but this is fair to the consumer, as Jensch has shown that the phosphide soon changes in the soil to phosphoric acid.—S. H.

Treatment of Tin Ore. W. Hampe. Chem. Zeit. **11**, 19.

TIN ORE is usually rendered soluble for analytical purposes by fusion with alkali-hydrates or sodium carbonate and sulphur. The following method gives excellent results and is more convenient:—The finely-powdered mineral is placed in a porcelain boat and strongly heated from one to two hours in a combustion tube, dry hydrogen being passed over it all the while. The water given off during reduction is absorbed and weighed in the usual manner. After cooling, the contents of the tray are dissolved in warm dilute hydrochloric acid, and the solution filtered from the residue. The tin is precipitated with sulphuretted hydrogen, and both precipitate and filtrate are treated in the usual manner. If the mineral is finely powdered, all the tin is rendered soluble. The process has the further advantage of removing the insoluble silicates and aluminates at once, which may then be examined separately.—S. H.

Wiborgh's New Colorimetric Test for Sulphur. Jüptner. Oesterr. Zeits. f. Berg. u. Hüttenw. **34**, 805.

THE author examined Wiborgh's method (*Chem. Zeit. Repert.* **10**, 92) as regards accuracy, and highly recommends it for practical work. He adds that it can be applied in all those cases where sulphuretted hydrogen is expelled by boiling or the addition of an acid—*e.g.*, in the determination of sulphur in mineral waters, black ash, slag, etc. By converting combined sulphur into an alkaline sulphide, the method can be made still more generally applicable. It may also be mentioned that Wiborgh's colour-scale must be kept in the dark.

—S. H.

Analysis of a Copper Slag of a Bright Red Colour N. A. Berry. Amer. Chem. Journ. **8**, 429—430.

No doubt this slag is familiar to all copper smelters engaged in the process of refining copper, in which process it is occasionally produced. It is very tenacious and hard, has a conchoidal fracture with splintery edges, and has, scattered throughout its mass, small spherical cavities and very minute metallic beads; it is opaque, and its colour varies from bright to darker scarlet. Sp. gr. = 2·987; hardness = nearly 6. The portion insoluble in acids, consisting of silica and a pale yellow powder, was fused with soda and examined separately.

			Molec. ratio.
Soluble in acids :			
Copper	2·50		—
Cuprous oxide	27·05	..	18·95
Ferrous oxide	0·25	..	0·34
Alumina	0·13	..	0·12
Insoluble in acids :			
Cuprous oxide	8·64	..	6·05
Ferrous oxide	11·69	..	16·24
Silica	49·24	..	82·07
	99·80		

From the oxygen ratio for bases and silica 1 : 4, it appears that cuprous oxide can combine with a surplus of silica, as do the alkalis in petalite or orthoclase. It is also of interest to note the pale yellow colour of the insoluble silicate, which contains so large a percentage of iron and copper, probably presenting the effect of mixture of the complementary colours, green and red, which would belong respectively to the simple ferrous and cuprous silicates.—J. T.

Vanadium and Chromium Extraction from Iron Ores. E. Claassen. Amer. Chem. Journ. **8**, 437—443.

Soft ores, such as limonite, may perhaps be sufficiently finely powdered by crushing; but ores of considerable hardness, like magnetite, are treated with water and sulphuric acid to obtain an impalpable powder for fusion. A magnetite so prepared was treated by two methods.

(1.) *Treatment with Soda and Sulphur.*—The powder, mixed with six times its weight of equal parts of soda and sulphur, was exposed to a gradually increasing temperature in a well-covered porcelain crucible until most of the free sulphur was volatilised. The fused mass was lixiviated with hot water, filtered, and the filtrate acidulated with nitric acid. After standing some time the precipitate was filtered off, washed, dried and treated with carbon bisulphide to remove the free sulphur, leaving the vanadium sulphide as a chocolate-brown powder. This was incinerated with the filter, and the residue from the evaporated filtrates obtained above, in which there is always a small amount of vanadium present, added to it, with a small quantity of soda, and the whole ignited. The fused mass, green from the presence of manganate, was extracted with hot water, the filtered solution mixed with much ammonium nitrate and boiled. This addition of nitrate and boiling should be repeated until no further smell of ammonia is perceived. Not a trace of vanadic acid is reduced in this way. If nitric acid be used for neutralising instead of the nitrate, the liquid should never become acid for an instant, and should still be slightly alkaline at the end. The solution thus treated with ammonium nitrate, was filtered, precipitated with neutral lead acetate (or nitrate) the precipitate washed, digested for some time on the filter in a flask with a sufficient quantity of hydrochloric acid and alcohol. The precipitate thus formed was filtered off and washed with alcohol, the alcoholic liquids evaporated, the remnant mixed with water, treated with hydrogen sulphide, filtered, evaporated and ignited. The impure pentoxide thus obtained gave, after moistening repeatedly with ammonium nitrate solution, ignition and then extraction with ammonia or ammonium carbonate, a liquid which, when filtered, evaporated and ignited, left the exact amount of the vanadium pentoxide present excepting the merest traces, the vanadium being practically completely extracted by but one process. All the chromium in the ore remains undissolved in the residue after fusion with soda and sulphur. This residue was fused with six times its weight of equal parts of soda and nitre, and lixiviated and treated as below. This method is very good, particularly if the estimation of vanadium only is the object aimed at; if, however, the estimation of chromium be also required, it may be better to use the following mode of extraction, which gives nearly as good results, as regards the separation of vanadium.

(2.) *Treatment with Soda and Nitre.*—The ore, finely powdered by treatment with sulphuric acid, as described, was ignited with six times its weight of equal parts of soda and nitre, and extracted with hot water and filtered. Scarcely a trace of chromium, and but little more than a trace of vanadium, remain in the residue with care, and this trace may be recovered by an application of the process given under 1. The filtrate is evaporated to dryness and the residue fused, dissolved in hot water, filtered, boiled for some time, after addition of ammonium chloride, filtered again and evaporated so far as to avoid the separation of crystals after cooling and stirring for a while. Into this solution a lump of ammonium chloride was placed, large enough not to be dissolved completely; the separated ammonium metavanadate washed with saturated ammonium chloride solution and ignited. To purify the vanadium pentoxide, it was moistened with ammonium nitrate, ignited, dissolved in ammonia, evaporated until ammonia could scarcely be detected by the odour, then filtered, evaporated to dryness and ignited. Very exact analyses demand the collection of the small amount of metavanadate always remaining in the filtrate, and this is evaporated to dryness and ignited. The residue is digested with concentrated ammonia, filtered, and precipitated with alcohol. The precipitate, dissolved in a little water and precipitated with ammonium chloride, gives the residual ammonium metavanadate. From experiments made it appears necessary to employ a sufficient amount of soda and nitre in the fusion, at least three times the amount of ore of each, in order to obtain a good result. In course of this investigation a precipitate of lead chromate and lead vanadate was suspended in water, acidulated with nitric acid and treated with hydrogen sulphide, which decomposed it perfectly. A precipitate of the above lead compounds and of lead sulphate—the latter in considerable excess—did not give satisfactory results. In such a case, treatment with hydrochloric acid and alcohol will answer the purpose quickly and satisfactorily.—J. T.

Solubility of Manganese Sulphide in Melting Potassium Sulphide. E. Claassen. Amer. Chem. Jour. **8**, 436—437.

When experimenting with vanadiferous *magnetite*, the crushed ore was treated with an equal weight of water and double the amount of sulphuric acid of sp. gr. 1·840. The nearly dry mixture was subjected to a slowly-increasing temperature until the water, sulphuric anhydride and sulphur dioxide formed were driven off. A fine impalpable red powder remained, which was mixed with six times its weight of equal parts of sulphur and potassium carbonate and melted in a well-covered porcelain crucible until almost all free sulphur had gone. The fused mass was lixiviated with hot water, the filtrate, acidulated with nitric acid, mixed, after having been heated for some time, with an excess of potassium carbonate, heated again, evaporated to dryness and fused, gave a dark bluish green mass, due to the presence of potassium manganate. The intensity of the colour showed that the amount of manganese present was not inconsiderable.—J. T.

The Escape of Dissolved Bodies on the Evaporation of their Solvent. P. Marguerite-Delacharlonny. Compt. Rend. **10**, 1128.

The author proved by means of direct experiments that on evaporating solutions, even at common temperatures, traces of the dissolved matter are carried away with the vapours of the solvent. Aqueous solutions of sulphuric acid, sodium hydrate, sodium carbonate and ferrous sulphate were placed in shallow dishes and covered with inverted funnels, in the stems of which strips of litmus and potassium sulphocyanide paper respectively were fastened. At 60° to 70° C. the test papers showed the action of the dissolved matter after two or three hours, whereas at common temperatures the papers were not visibly affected until after two or three days. Strips moistened with potassium ferrocyanide and suspended over an acid ferrous sulphate solution were blued after a few days.—S. H.

New Method for Detecting Cinchona Alkaloids in Quinine Sulphate. E. Goebel. Brit. and Col. Druggist, March 12, 1887.

0·5grm. quinine sulphate is boiled with 10grms. water, 0·15grm. potassium chromate added, the mixture thoroughly stirred and then allowed to stand for four hours. The quinine separates completely as chromate; this is then filtered off and one drop of caustic potash solution added to the filtrate. The presence of 0·5 per cent. cinchonine, or of 1 per cent. quinidine or cinchonidine, produces a flocculent precipitate after standing half-an-hour; with larger quantities a turbidity ensues at once. The degree of turbidity serves as a guide to the quantity of foreign alkaloids present. The test may be applied to all quinine salts, the acid salts being first evaporated down with ammonia.—C. A. K.

New Colour Reactions of Starch and Gum. A. Ihl. Chem. Zeit. **11**, 19.

Phenols and sulphuric or hydrochloric acid give with carbohydrates brilliant colour reactions. If starch be moistened on a watch-glass with an alcoholic α-naphthol solution and a few drops of warm sulphuric acid added, the starch is coloured red-violet. Thymol, cresol, guaiacol and catechol produce a splendid vermilion-red; resorcinol and orcinol yellow-red, whereas phloroglucinol gives a yellow-brown colouration. The different kinds of gum behave on the whole like starch. The action of phloroglucinol on arabin is very characteristic. If arabin be boiled with an alcoholic solution of phloroglucinol and hydrochloric acid, a fine cherry-red dyestuff is obtained.—S. H.

Analysis of Fats. B. Röse. Rep. Anal. Chem. **6**, 685—695.

After pointing out the inaccuracies in some of the processes in common use, the author criticises at some length the gravimetric processes of Oudemans and Kremel, both of whom separate the solid from the liquid portions of a fat by treatment with ether, after saponification with lead, the lead soaps made from the liquid fats being soluble in ether, whereas those made from solid fats are insoluble. The results obtained by both processes are very liable to error, *firstly*, owing to oxidation, especially of the fatty acids of the linoleic series, during the operations. The products of oxidation being partly insoluble in ether, the undissolved matter would not merely consist of the lead soaps of the solid fats, but also of the lead compounds of the oxidised liquid fats. During the evaporation and drying of the filtrate, after extraction with ether, further oxidation takes place, thus *increasing* at this stage the apparent amount of the liquid fat. *Secondly*, during the digestion of the lead soaps with boiling ether, the excess of lead oxide tends to form basic compounds with the liquid fats, and these being insoluble in ether, the result is a still further increase in the apparent amount of solid fat, found by calculation from the weight of insoluble lead soaps. Further, on decomposing this lead soap with acid, the melting point of the resulting fatty acids will be too low, owing to the presence of the small quantity of liquid fatty acids introduced by the above defects in the process. The author overcomes these defects in the following manner:—In preparing the fatty acids from the fat, great care must be taken to avoid oxidation. The fat is saponified with an alcoholic solution of potash, decomposed with sulphuric acid, cooled, and the liquid with the solid fatty acids transferred to a graduated tube, in which it is shaken up with an equal volume of ether. When clear, the amount of fatty acid is determined in a portion of the ethereal solution on evaporation, the residue being dried in a current of dry carbonic acid, before weighing. A definite volume of the ethereal solution, corresponding to about 1grm. of fatty acid, is then transferred to a 100cc. flask, with an excess of lead oxide, diluted to about 80cc. with ether, and then allowed to stand *in a cool place* until the solution becomes strongly alkaline, which will require 2 to 4 days, with occasional shaking. The liquid is made up with ether to exactly 100cc.; 50cc. are passed through a small filter, into a tared flask, the filter being kept full as long as possible, and then evaporated to dryness, *out of contact with air*. After weighing, the lead is determined in the residue as lead sulphate. The trial experiments given in detail by the author, are exceedingly accurate. Working with 1grm. of pure oleic acid, he obtained as the mean of five closely-agreeing results, 1·3613grms. lead oleate, and 0·5358grm. of lead sulphate, instead of the theoretical amounts, 1·3617 and 0·5358grms. respectively. The figures obtained with stearic acid and mixtures of known composition were equally satisfactory; but it is recommended to check the results with the iodine process, using in the latter, fatty acids instead of the original glycerides.—E. E. B.

Trade Report.

(From the Board of Trade Journal.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

BELGIUM.

Modifications in Duties on Vinegar and Acetic Acid.

The following is a translation of a decree, dated the 24th March last, which appeared in the *Moniteur Belge* of the day following, provisionally modifying the import duties on vinegar and acetic acid:—

"Article 1.—Vinegar and acetic acid will pay import duties as follows:—Vinegars, acetic acids, and liquids containing pure acetic acid to the extent of 8 per cent. or less, 15frs. per hectolitre; more than 8 per cent. and less than 50 per cent., 75frs. per hectolitre; 50 per cent., or more, 120frs. per hectolitre. Acetic acid, crystallised, of 150frs. per 100 kilos.

"Article 2.—The present tariff of import duties on articles mentioned in Article 1 will be substituted for the above by the 1st July, 1887, at the latest, if, before that date, the existing duties on the said goods have not been definitely modified by law.

"Article 3.—The difference between the duties collected by the application of this decree and the duties which would be leviable under the existing tariff, until the 1st July, 1887, will be refunded if the duties as stated in Article 2 be not modified by law.

"Article 4.—The present decree will come into force on the day following its publication."

SWITZERLAND.

Classification of Articles in Customs Tariff.

(*Note.*—Quintal = 220·4lb. avoirdupois. Franc = $9\frac{5}{8}$d.)

The following decisions affecting the classification of articles in the Swiss Customs Tariff have been given by the Swiss Customs authorities during the month of February last:—

Bi-phosphate of lime, in bottles, without labels claiming for the article any curative properties, is included in Category 9, and pays a duty of 10 francs per quintal.

Bi-phosphate of lime, with labels attributing to it curative properties. Categories 11 and 12, duties as follows:—In wholesale packages, 10 francs per quintal, in retail packages, 100 francs per quintal.

Nitro naphthaline. Category 18, duty 2 francs per quintal.

Dextrine will in future pay a duty of 1 franc per quintal under Category 17.

UNITED STATES.

Customs Decisions.

"Tungsten-metal," which is a substance in the nature of an alloy obtained from wolframite ore, which contains principally the metal, tungsten, and several other metals in various small proportions, and which is imported and used for the purpose of being added in small quantities to steel or iron in order to render the latter metals suitable for the manufacture of tools, is not one of the substitutes for steel contemplated by the provision in section 177, but is dutiable at the rate of 20 per cent. *ad valorem* as an unwrought metal not otherwise provided for under the provisions in the same section for "metals unwrought."

Deductions for non-dutiable charges cannot be allowed in cases where they are included in the invoice or entry in the same item with dutiable charges.

"Doctor Liebreich's Lanoline," which, upon investigation, is found to be a rendered oil, and not an ointment or medicinal preparation, is held to be dutiable at the rate of 25 per cent. *ad valorem*, as a rendered oil, under section 92.

Certain "chlor-magnesium," or chloride of magnesium, which, upon analysis, was found to contain chlorine and magnesium in combination, is held to be dutiable at the rate of 25 per cent. *ad valorem*, under the provision in section 92 for "all chemical compounds and salts, by whatever name known, and not specially enumerated or provided for in this Act."

MEXICO.

Modifications in Customs Tariff.

According to the *Moniteur Belge* for the 25th March last, the following articles have been exempted from payment of import duties, by a decree of the President of the Republic, dated the 25th February last :—

Phenic acid, sulphuric acid, hydrochloric acid, chloride of lime, permanganate of potassium, sulphate of copper, and sulphate of iron.

GREECE.

Modifications in Customs Tariff.

A despatch, dated the 12th March last, has been received from Sir H. Rumbold, Her Majesty's Minister at Athens, enclosing a table showing certain modifications in the Greek Customs Tariff, which were to come into operation on the 13th March last, subject to subsequent ratification by the Chamber. The following is the statement of the modifications in question :—

(*Note.*—Drachme = $9\frac{4}{5}$d. Oke = 2·8lb. avoirdupois. Drachme (weight) = 0·111oz. avoirdupois.)

No. in Tariff.	Articles.	Old Rates of Duty.	Proposed New Rates of Duty.
		Dr. Lep.	Dr. Lep.
74	To read as follows :— "Roots, leaves, camphor"	—	Oke 0 50
83	To read as follows :—		
	(*a.*) Quinine in general	Drach. 0 10	Drach. 0 10
	(*b.*) Cinchona	,, 0 10	,, 0 10
81	To read as follows :— "All other medicines not specially denominated, with reduction of tare for receptacles"	—	Oke 0 20
103	To read as follows :—		
	(*a.*) Potash, soda, nitre in general, as well as sulphuric coal	—	Free.
	(*b.*) Chloride of lime, vitriol, bluestone (sulphate of copper)	—	Oke 0 05
	(c.) Acids in general, such as sulphuric, hydrochloric, nitric (*aqua fortis*), formic, etc., as well as any other chemical products not specially denominated	—	,, 0 20
104	To read as follows :— "Empyreumatic oils, including oils for machines"	,, 0 50	,, 0 50

TRADE BETWEEN SPAIN AND THE UNITED KINGDOM.

Imports into the United Kingdom from Spain.

PRINCIPAL ARTICLES.		Feb. 1886.	Feb. 1887.
Chemical Products unenumerated	Value	£4,577	£7,032
Copper Ore and Regulus	Tons	4,214	3,406
	Value	£120,254	£67,756
Pyrites of Iron or Copper	Tons	54,577	59,295
	Value	£102,898	£101,212
Quicksilver	lb.	906,000	600,000
	Value	£72,500	£58,500
Total Value		£940,906	£890,692

Exports of British and Irish Produce from the United Kingdom into Spain.

PRINCIPAL ARTICLES.		Feb. 1886.	Feb. 1887.
Alkali	Cwt.	31,424	18,647
	Value	£11,621	£6,559
Caoutchouc	Value	£1,178	£1,363
Chemical Products & Preparations, including Dye-stuffs	Value	£2,918	£4,609
Coal Products, Naphtha, etc.	Value	£1,419	£4,800
Soap	Cwt.	550	286
	Value	£520	£287
Total Value		£241,033	£297,122

Summary Statement showing the Trade between Spain and the United Kingdom during the period subsequent to the Conclusion of the Commercial Treaty, compared with the Corresponding Period of the previous Year.

Months.	Imports into the United Kingdom from Spain.		Exports of Produce and Manufacture of United Kingdom to Spain.		Exports of Foreign and Colonial Produce to Spain.	
	1885-86.	1886-87.	1885-86.	1886-87.	1885-86.	1886-87.
	£	£	£	£	£	£
September	636,652	719,560	231,762	328,466	42,775	32,441
October	963,845	940,778	210,142	301,133	62,592	59,358
November	793,550	884,052	228,011	242,845	92,649	54,638
December	924,165	867,183	241,868	253,238	69,940	59,020
January	635,256	818,935	240,097	235,826	60,676	34,821
February	940,906	890,692	241,033	297,122	52,034	37,317

MISCELLANEOUS TRADE NOTICES.

INTERNATIONAL COMPETITION OF SCIENCE AND INDUSTRY AT BRUSSELS IN 1888.

The *Moniteur Belge* for the 16th March last says :—

"The organisers of the International Competition of Science and Industry which will be opened in Brussels in 1888, have applied to the Government for assistance. Already a numerous commission, consisting of all the scientific, art, and industrial authorities, have been appointed to conduct the exhibition, and to induce Belgian producers to participate in this international work. The international import and export exhibition attached to the great exhibition will include a section devoted specially to colonial countries, but principally to the Congo."

A royal decree, appointing the jurors to the several sections of the exhibition, was published in the *Moniteur Belge* for the same date.

PETROLEUM RESERVOIR AT ROTTERDAM.

The *Bulletin du Musée Commercial* of the 8th January last says, that an immense iron reservoir is now being constructed at Rotterdam, which is to be used for storage of petroleum.

It will be sufficiently large to hold 7,900,000 litres of petroleum. Mineral oil will, on arrival, be transferred to the reservoir by means of pumps, thus obviating the necessity for the employment of casks and barrels, and considerably diminishing the expenses, and lessening the risk of accidents.

Commercial Museum at Bucharest.

The *Curierul Financiar* of the 13th February last informs its readers that M. Jean Bratiano has laid before the Roumanian Chambers a proposal to erect at Bucharest a permanent exhibition of the agricultural and industrial products of the country. The capital required for the construction and furnishing of this museum is about 1,200,000 francs. The object of this institution is to afford Roumanian merchants and manufacturers a knowledge of the resources and requirements of foreign markets, and to show the foreign purchaser the resources of Roumanian industry, by exhibiting samples of the principal industrial products of the country, so that he may be enabled to place his orders without visiting the various manufactories scattered throughout the kingdom. All information is to be given gratis, and a commission will be paid by agriculturists and manufacturers who obtain orders through the intermediary of this institution.

Commercial Museum at Buenos Ayres.

According to the *Journal Officiel* of the 11th March last, a Commercial Museum of articles of foreign produce has been opened by the Italian Chamber of Commerce at Buenos Ayres.

New Paper-making Invention in Japan.

According to the *Bulletin du Musee Commercial* of the 22nd January last, a native of Japan has recently invented a new process by which paper may be manufactured with seaweed. Paper made in this way is very strong, almost untearable, and is sufficiently transparent to admit of its being used as window glass; it takes all colours well, and in many respects resembles old window glass.

Registration of Trade Marks in Germany.

The German Imperial Supreme Court, sitting at Leipzic, has just pronounced judgment on a point of considerable importance to English and other foreign manufacturers and merchants who have no branch in Germany. It is decided that such houses can have their trade marks registered by the competent authority at Leipzic, even although they consist exclusively of numbers, letters, or words, which are not recognised as trade marks for purely German houses.—*Brit. and Col. Drug.*

The German Glass Industry.

Despite Belgian competition, the German glass industry is making steady progress. There is increasing activity in some branches, and a fair prospect of a good year's trade. Larger orders are being received from the United States and from England. The demand is chiefly for the cheaper sorts, the foreign trade in bottle glass being especially brisk. The total exports of glass from Germany last year amounted to 1,596,380cwt., against 1,547,360cwt. in 1885. The British export trade in glass, other than plate and mirrors, amounted in 1886 to 1,101,396cwt.—*Brit. and Col. Drug.*

American Sodium Bicarbonate.

The New York *Pharm. Rundschau* says that Dr. F. B. Power has recently examined five American and one German brand of sodium bicarbonate, more especially to note whether they contained any sodium thiosulphate (hyposulphite) and arsenic. Both these impurities have been asserted to be present in English and some of the German brands, but in the brands examined they were absent. A trace of sulphite was found in two samples; three of the brands contained but traces of normal carbonate; the other three samples contained less than 3 per cent. of normal carbonate. Of the American brands the Natrona and Dwight's ranked above the others.

Trade Statistics for March.

The Board of Trade Returns for March show the following figures :—

Imports.

	March, 1886.		March, 1887.
Total value	£31,490,937	....	£32,791,930

Exports.

	March, 1886.		March, 1887.
British and Irish Produce	£18,510,072	....	£19,002,083
Foreign and Colonial Produce (partly estimated)	1,631,796	....	5,076,379

Opposite are the details affecting drugs and chemicals :—

Imports.

		Mar. 1885.	Mar. 1886.	Mar. 1887.
Drugs, unenumerated	value £	71,846	69,328	58,858
Chemical manufactures—				
Products unenumerated	value £	123,299	119,877	117,152
Alkali	cwt.	3,651	4,517	4,571
,,	value £	3,113	3,096	3,424
Brimstone	cwt.	15,223	41,943	38,521
,,	value £	4,051	10,566	8,686
Nitre (nitrate of soda)	cwt.	188,188	131,017	226,220
,, ,,	value £	88,998	73,881	115,597
,, (nitrate of potash)	cwt.	18,355	26,510	39,839
,, ,,	value £	15,125	23,676	34,937
Quicksilver	lb.	632,550	538,425	313,500
,,	value £	55,610	42,724	30,575
Bark (Cinchona)	cwt.	8,001	8,500	16,670
,,	value £	51,813	50,924	80,385
Gum Arabic	cwt.	7,113	8,385	2,791
,,	value £	28,111	27,554	11,969
Lac, seed, shell, stick, and dye	cwt.	13,724	11,101	10,913
Lac, seed, shell, stick, and dye	value £	11,471	32,820	28,475
Dyes and tanning materials—				
Bark (for tanners' or dyers' use)	cwt.	28,999	23,501	24,805
Bark (for tanners' or dyers' use)	value £	12 830	7,926	10,335
Aniline dyes	value £	25,290	19,421	27,950
Alizarin	value £	23,788	24,149	20,706
Other coal-tar dyes	value £	189	118	214
Cochineal	cwt.	1,464	1,095	695
,,	value £	8,746	6,299	3,878
Cutch and gambier	tons	3,281	3,218	3,924
,,	value £	70,130	74,900	93,712
Indigo	cwt.	22,355	19,389	17,642
,,	value £	512,909	121,901	371,841
Madder, madder root, garancine, and munjeet	cwt.	19,585	1,977	1,400
Madder, madder root, garancine, and munjeet	value £	12,937	3,525	1,678
Valonia	tons	3,105	3,201	3,913
,,	value £	49,372	45,101	56,627
Oils—				
Cocoa-nut	cwt.	18,394	8,467	19,698
,,	value £	25,747	10,838	27,524
Olive	tuns	3,596	3,473	2,707
,,	value £	142,652	131,413	99,087
Palm	cwt.	61,117	97,326	80,131
,,	value £	88,383	99,944	81,334
Petroleum	gals.	5,150,427	6,294,481	4,768,355
,,	value £	163,096	215,023	150,873
Seed, of all kinds	tuns	1,065	970	1,494
,,	value £	29,034	21,672	34,147
Train, blubber, and sperm	tuns	593	766	998
Train, blubber, and sperm	value £	25,825	23,159	25,111
Turpentine	cwt.	9,371	11,153	8,714
,,	value £	13,219	16,620	11,359
Resin	cwt.	119,158	113,057	102,455
,,	value £	31,966	19,621	25,084
Tallow and Stearine	cwt.	72,986	113,817	72,199
,,	value £	118,027	115,112	90,918

Exports.

		Mar. 1885.	Mar. 1886.	Mar. 1887.
British and Irish produce :—				
Alkali	cwt.	675,280	537,761	531,101
,,	value £	196,982	156,680	154,709
Bleaching materials	cwt.	163,858	137,583	164,480
,, ,,	value £	55,130	41,074	62,512
Chemical manure	value £	150,654	186,064	192,311
Drugs and medicinal preparations (unenumerated)	,,	71,500	71,108	81,750
Other chemicals and medicinal preparations	value £	171,271	162,831	185,795
Oil (seed)	tons	7,141	7,416	8,601
,,	value £	161,208	157,448	171,379
Soap	cwt.	35,481	40,716	33,457
,,	value £	41,917	44,415	38,117
Painters' colours and materials (unenumerated)	value £	113,823	118,226	119,707
Foreign and Colonial merchandise :—				
Bark, Cinchona	cwt.	7,521	9,928	17,416
,,	value £	34,935	66,727	71,673
Chemicals (unenumerated)	,,	35,806	12,401	22,022

		Mar. 1885.	Mar. 1886.	Mar. 1887.
Cochineal	cwt.	553	851	704
"	value £	3.969	5,497	4,521
Cutch and gambier	tons	592	1,154	483
" "	value £	13,273	26,719	12,171
Gum Arabic	cwt.	3,601	4,404	2,595
"	value £	11.746	17,094	10,865
Indigo	cwt.	12,826	12,624	9,865
"	value £	285,170	281,700	222,238
Lac, various kinds..	cwt.	5.089	5.979	6,641
" " " ..	value £	16,638	19,432	18,134
Lard	cwt.	1,343	3,875	782
"	value £	2,529	7,235	1,517
Oils, cocoanut	cwt.	6,841	5,435	6,250
" "	value £	10,615	7,558	8,914
" olive	tons	451	347	166
" "	value £	19,949	15,083	8,020
" palm	cwt.	36,369	28,231	39,437
" "	value £	51,035	30,101	39,756
" petroleum	gals.	55,729	56,156	31,294
" "	value £	2,578	2,628	1,242
Quicksilver	lb.	293,715	768,496	361,113
"	value £	21,560	59,139	33,730
Nitre (nitrate of potash)	cwt.	961	2,212	2,460
Nitre (nitrate of potash)	value £	813	1,942	2,268
Spices, cinnamon ..	lb.	152,968	160,839	160,900
" " ..	value £	4,717	4,400	5,874
" pepper	lb.	1,316,230	1,251,178	2,591,900
" " ..	value £	43,652	41,553	81,259
Tallow and stearine	cwt.	7,236	21,160	8,727
" " " ..	value £	10,616	25,518	10,486

Messrs. Gehe & Co., of Dresden, in the preface to their half-yearly review of the drug and chemical markets, briefly refer to the proposals which have been made in several continental countries for the creation of a state monopoly in alcohol, a scheme which would, of course, greatly affect the pharmaceutical and chemical industries. The first country which will now be called upon to give a decision regarding the alcohol monopoly proposal is Switzerland, which produces a moderate amount of spirits only, and in which the scheme would therefore principally affect the importation of spirits from abroad. In France a strong agitation is also carried on in favour of a monopoly scheme, while in Germany it is certain that the Government intend to again bring forward a bill on the subject, as a means of increasing the revenue, though the details of the proposed measure have not as yet taken any practical form. Alcohol being an important article of export from Germany, although one which at present leaves no profit to the exporters, it is probable that a large part of the revenue derived from a monopoly would be absorbed by the export trade in the shape of bounties. In the interests of the pharmaceutical and chemical industries it is hoped that, under a state monopoly, the increase in duty on alcohol required in these branches of industry will be confined to the narrowest limits, and that no vexatious regulations for the control of manufacturers will be laid down, as otherwise it is feared that German firms will not be able to continue to compete with foreign rivals.—*Chemist and Druggist.*

The Report of the Belgian Commission to inquire into the condition of the industrial classes in that country, has been issued, and an abstract thereof will be found in the *Board of Trade Journal*—April, 1887—p. 316.

The text of the new French Butter and Oleomargine Law appears on page 350 of the *Board of Trade Journal* for April, 1887.

RECENT TRADE BLUE BOOKS.

(C—4968) Price 8½d. See *Board of Trade Journal* for April, p. 358.

Patent Office Inquiry. Report of the Committee appointed by the Board of Trade to inquire into the duties, organisation, and arrangements of the Patent Office under the Patents, Designs and Trade Marks Act, 1883, having special regard to the system of examination of the specifications which accompany applications for patents now in force under that Act, together with minutes of evidence, appendices, etc.

FOREIGN TRADE OF INDIA.

During the ten months (April 1 to January 31) just past, British India imported chemicals (including drugs, medicines, narcotics, and dyeing and tanning materials) to the value of 76,92,315 rupees as against 72,18,197 rupees for the corresponding period of 1885—1886. The exports under the same heading and for the same period amounted to 12,72,68,188 rupees as against 12,82,22,412 rupees during 1885—1886.

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

4168 J. H. Johnson—From F. Romain, France. Apparatus for raising and forcing liquids and obtaining motive power. Complete specification. March 19

4185 R. Thompson, London. Improvements relating to stop-cocks and stop-valves. March 19

4190 H. Gonne, London. Freezing and refrigerating apparatus. March 19

4207 J. Hall, Manchester. Steam jet condensers. March 21

4245 E. Bennis, E. Bennis, and A. W. Bennis, Liverpool. Improvements in boiler furnaces and in apparatus for conveying or feeding fuel thereto. March 22

4248 H. Holden and R. G. Brooke, Salford. Back-pressure valves. March 22

4326 W. A. Ross, Belfast. Apparatus for automatically obtaining and employing artificial currents of air. March 23

4338 J. B. Hannay and A. Murray. Air or gas compressors or pumps. March 23

4362 W. Gaskell, London. Apparatus for preventing smoke and economising fuel in steam-boiler furnaces. March 23

4425 H. E. Newton—From W. Baur, United States. Improvements in filter-presses. Complete specification. March 24

4439 G. Wilton, Silvertown. Improvements in the arrangements of furnaces and appliances where hydrocarbon oils together with water or steam, coal, or breeze, are used as fuel, March 25

4455 D. M. Salmond, Bradford. An improved composition for preventing and removing incrustation in steam boilers. March 25

4543 H. Moon, London. Improvements in amalgamating apparatus. March 26

4571 F. Friedenthal, Preston. Furnaces of steam-generators with forced draught for burning small fuel or fuel dust. March 28

4600 C. F. Dahl, London. An improved furnace for recovering in an inodorous manner the salts contained in the lyes used in the manufacture of wood fibre. Complete specification. March 28

4601 R. Marshall, London. Improvements in steam-boiler and other furnaces. March 28

4626 C. A. Koellner, London. Improvements in filter pumps. Complete specification. March 28

4653 J. J. Butcher, Newcastle-on-Tyne. Apparatus for increasing and controlling the pressure of coal or other gas. March 29

4651 G. S. Hendry and A. Faulds, Glasgow. Improvements in apparatus or hydraulic air-compressing engines for raising liquids. March 29

4685 E. W. Van Duzen, London. Improvements in furnaces and grate bars therefor. Complete specification. March 29

4699 W. Von Oechelhaeuser, London. Apparatus for regulating the flow of gas and other fluids. March 29

4749 A. M. Clark—From P. Orielle, jun., France. Means for preventing the emission of flame and smoke from the chimneys of furnaces working with a forced draught. March 30

4780 R. Matthews, London. Apparatus for refrigerating, or producing and utilising cold. March 30

4976 J. V. Wilson, Manchester. Improvements in or applicable to pans for heating oil or other liquids, and in apparatus for passing air or gases through liquids, and agitating liquids in pans and similar vessels. Complete specification. April 4

4989 D. Simpson, Edinburgh. See Class VII.

5161 J. W. Hartley, Stoke-on-Trent. Improvements in smoke consuming apparatus. April 7

5165 J. Davies, Manchester. Improvements in kiln and other furnaces. April 7

5235 F. W. Beck, East Grinstead. A damp detector and hygrometer. April 9

5255 W. D. Priestman and S. Priestman, London. Improvements in the manufacture of vapour and in apparatus therefor. April 9

5379 J. R. Alsing, London. Improvements in the construction of triturating cylinders. April 13

5411 W. D. Player and T. Dustman, London. New or improved apparatus for facilitating the removal of scale or incrustation from steam-boilers and other steam generators. April 11

5169 A. Dickinson, Birmingham. Improvements in condensers. April 15

*COMPLETE SPECIFICATIONS ACCEPTED.**

1886.

5618 R. Matthews. Apparatus for refrigerating, and for utilising cold. April 2

6792 F. Hilton. Open hearth furnaces. March 23

6801 R. W. Hitchins. Compound for preventing the radiation and transmission of heat. March 23

7015 J. B. Alliott and J. M. C. Paton. Filter presses and apparatus connected therewith. March 30

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* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

7088 G. F. Marshall. Improvements in filters. March 30

7119 W. T Sugg. Apparatus for heating water, etc. March 30

7180 G. Fulda. An improved valve-cock. March 26

7761 J. Allison and A. Thomson. Furnace fittings for use with forced draught. April 2

7768 A. Paget. Taps for gas and other fluids. April 16

8201 C Langer. Apparatus for mixing, stirring, and conveying various substances, and for drying and exposing the same to the chemical action of gases, vapours, etc. April 20

1887.

761 G. D. Hughes and D. Hughes. A furnace bar and smoke-consuming furnace. April 16

2710 J. A. Crocker. Filtering machines. March 23

2711 J. A. Crocker. Filtering machines. March 23

2881 B. J. B. Mills—From J. Retif. Filter for water and other liquids. March 26

3016 R. R. Evans. Centrifugal pumps and fans for blast and exhaust purposes. March 30

3388 A. Lentz. Charging retorts, and apparatus therefor. April 16

3999 E. Albin. Heating air and feeding the same to boiler furnaces, etc. April 20

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

1315 E. Entwistle, Blackburn. Apparatus to economise and improve the consumption of fuel and smoke in open or closed grates or furnaces, also regulating the draught or air current. March 23

1381 R. Auton, London. Improvements in manufacturing briquettes or blocks of artificial fuel or bricks or blocks of other material, and in machinery therefor. March 23

1139 G. Wilton. See Class I.

4187 W. H. Lindsay, London. Improvements in the utilisation of breeze dust and cinder waste, more especially the dust or waste collected from dwelling houses. March 25

1653 J. J. Butcher. See Class I.

4687 A. A. Harwood and M. D. Van Tassel, London. An improved apparatus for generating gas. Complete specification. March 29

4722 W. Wright and F. W. Wright, Manchester. Improvements in lighting. March 30

4751 E. Davies, London. Improvement in lighting. March 30

4810 G. H. Elphick, London. A new or improved appliance for preventing the guttering or wasting of candles. March 31

4859 A. Fehlen, London. Improvements in the methods of turning to account combustibility for heating purposes. April 1

4881 W. Majert and G. Richter, London. A process and apparatus for the production of hydrogen gas by a dry method, for military purposes. April 1

4884 G. F. Redfern—From A. Goutierre, Belgium. Improvements in and apparatus for the manufacture of gas for lighting, heating, or other purposes. April 1

4886 J. Wybauw, London. Improvements in apparatus for lighting and heating by means of gas. April 1

4888 F. Friedlander and J. Quaglis, London. Improvements in obtaining hydrocarbons from gases. Complete specification. April 1

4918 R. Haddon—From J. J. Imbs, France. A process for utilising the heat of the exhaust steam or gases of steam or other engines. April 2

5012 G. F. Redfern—From A. Robert, Belgium. Improvements in machinery or apparatus for the manufacture of artificial fuel. April 4

5026 W. G. Bussey, London. Improvements in apparatus for vaporising and burning liquid hydrocarbons. Complete specification. April 5

5035 H. Jefferies, Stourport. An improved apparatus or valve used in the manufacture of coal and other gases or for other similar purposes. April 5

5046 J. M. A. Fournier, London. An improved appliance for purifying heating and illuminating gas. April 5

5287 H. J. Newcome, Shenley. Rapidly obtaining the utmost degree of warmth from petroleum burnt in an open vessel placed in a close stove. April 12

5313 H. Cockey and F. C. Cockey, Westminster. Improvements in gas washers. Complete specification. April 12

5473 J. Laidler, Sunderland. Improvements for the manufacturing of every description of compressed fuel whatsoever. April 15

5474 J. Laidler. A machine for the manufacturing of every description of compressed fuel whatsoever. April 15

5481 R. Scott, Newcastle-on-Tyne. Improvements in the media and construction of globes for increasing the luminosity of light. April 15

5530 A. Harris, London. Improvements in gas producers. April 15

5571 W. W. Horn, London—From A. L. Allen, United States. Improvements in apparatus for the manufacture of gas. April 16

5638 G. E. Dorman, Stafford. Improved construction of thermopiles heated directly by the combustion of fuel, or by heated gases. April 18

5641 J. Broad, J. W. Broad, G. P. Broad, H. J. Broad, and G. C. Fowler, London. Improvements in night-lights. April 18

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

5727 T. Nicholson. Methods and appliances for obtaining, and cleansing, gas from coal. March 26

6858 A. J. Boult—From A. Montenegro. Method of heating apartments. March 23

7112 W. S. Sutherland. Improvements in gas producers. March 30

7228 E. J. Barnfield. Gas-retort furnaces. March 30

7258 R. Good. Hydraulic mains for gas works. March 30

7365 A. Paget. Manufacture of matters for incandescent gas-lighting. March 30

7705 J. Bartle. Adjusting and locking the handles of gas-retort covers or lids. April 9

7706 H. Cockey and F. C. Cockey. Gas purifier centre-valves. April 9

8157 O. Imray—From F. Siemens. Regenerative gas-retort furnaces. April 20

9047 J. Blum. The instantaneous generation of steam. April 2

10969 A. Brin and L. Q. Brinn. Means for heating steam boilers, etc., and for decomposing steam and burning its constituent gases for the production of light and heat. March 26

13214 P. Innes Hydraulic mains apparatus used in the manufacture of illuminating gas. March 26

1887.

2749 A. J. Boult—From W. H. Brooks. Manufacture of steam and oil gas for fuel and for illuminating purposes. March 23

2752 H. J. Seibel, jun. Apparatus for enriching gas. March 23

3999 E. Albin—See Class I.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

APPLICATION.

5519 J. Elliott, Westminster. Improvements in gas apparatus for effecting the continuous carbonisation of coal. April 15

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

4243 W. Majert, London. Improvements in and relating to the manufacture of colouring matters. March 21

4481 C. D. Abel—From O. Korschelt, Germany. An improved manufacture of logwood extract. March 25

4492 H. H. Lake—From K. Oehler, Germany. Improvements in the manufacture of colouring matters. March 25

4583 R. H. W. Biggs, London. Improvements in the manufacture of dyes, disinfectants, artificial stone, artificial ivory, artificial manure, sodium, and other substances. March 28

5049 S. J. Simpkin, London. Improvements in or relating to the manufacture of pure or refined indigo. April 5

5109 J. Hauff, Manchester. Producing basic sulphocyanides of aluminium, iron, and chromium for dyeing and printing purposes. April 6

5257 C. D. Abel—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Improvements in the production of dialkylised amidobenzophenones. April 9

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

4387 H. H. Lake—From A. Leonardt and Co. The manufacture of colouring matters. March 26

7137 C. D. Abel—From The Farbwerke vormals Meister, Lucius, and Brüning. Production of indoderivatives from the compounds of the aromatic hydrazines with the ketones and the aldehydes. March 30

12022 A. Kern. Improvements relating to substances chiefly designed for use in the preparation of colouring matters, and to the manufacture of colouring matters therefrom. April 20

1887.

2123 H. H. Lake—From L. Whitefield. Compound for producing designs upon textile fabrics. March 23

V.—TEXTILES, COTTON, WOOL, SILK, ETC.

APPLICATIONS.

4981 D. Smith and H. Smith, Bradford. Improvements in the method of and apparatus for washing wool and other fibres. April 1

5011 W. B. Nation and J. J. Worswick, London. Improvements in the treatment of vegetable fibres suitable for spinning, weaving, and other analogous purposes. April 5

5097 R. H. Collyer, London. Improved machinery and apparatus for the preparation of vegetable fibres for textile purposes. April 6

5205 H. H. Lake—From La Société Gillet et fils, France. Improvements relating to the treatment of fabrics composed of or containing silk for improving the appearance of the same. April 7

5315 N. Dubois-Mauduit, London. An improved process for rendering woven fabrics waterproof. April 12

5577 H. H. Lake—From E. Brown, United States. The manufacture of an improved textile fabric and apparatus therefor. April 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

7530 E. de Pass—From La Société de Lafarge, Lebre et Cie. See Class XIX.

7927 A. M. Clark—From L. P. Audouard. Treating woven and other fabrics, yarns, ropes, etc., to render same non-putrefactive and antiseptic. April 20

16765 J. H. Lorimer. Drying, bleaching, and disinfecting wool, cotton, paper pulp, or other textile or fibrous materials, and apparatus therefor. March 30

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

4289 W. G. Young, London. An improved mordant for dyeing cotton and other fibrous substances a fast black. March 22

4365 E. Booth, London—From W. A. Fourness, Belgium. Improvements in apparatus for dyeing loose or spun cotton or other fibres. Complete specification. March 23

4509 E. Sutcliffe, G. E. Sutcliffe, and the Patent Process Dyeing Co., Limited, Manchester. Improvements in the method of, and in apparatus for, washing, bleaching, dyeing, and treating textile materials. March 26

4517 R. Chadwick and J. W. C. Chadwick, London. Improvements in dyeing yarns and fabrics black, blue, and other colours. March 26

4764 G. Jugenburg, London. An improved mode of and apparatus for mordanting, dyeing, and bleaching raw cotton. Complete specification. March 30

4905 A. Ferrie, Manchester. Improvements in dyeing and printing blacks, blues, browns, and other dark colours upon animal and vegetable matters. April 2

4953 A. Brin and L. Q. Brin, Westminster. Improvements in bleaching fibrous substances used for making paper. April 2

5113 D. Stewart and R. Walker, Glasgow. Improvements in apparatus for stretching and airing, liquoring, soaping, or washing woven fabrics. April 6

5150 J. McNaught and W. McNaught, jun., London. Improvements in or applicable to machinery for scouring and washing wool and other fibrous materials. April 6

5166 J. Davies, Manchester. Improvements in aniline dyeing. April 7

5175 R. Gledhill, Bradford. Improvements in dyeing apparatus connected with machines for sizing worsted or other warps April 7

5212 A. Goldthorp, Wakefield. An improved form of rod or stick, and apparatus connected therewith, for more evenly dyeing fibrous substances in hanks. April 9

5359 J. Gibson and F. M. Gibson, Edinburgh. Improvements in bleaching fibrous materials. April 13

5596 J. Bromley and T. Harrison, Leeds. Improvements in machinery for bronzing, colouring, or otherwise ornamenting paper and other material in sheets or continuous rolls. Complete specification. April 18

COMPLETE SPECIFICATION ACCEPTED.

1886.

8065 C. Lohmann. Improvements in dyeing blue, especially adapted for wool. April 9

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

4088 G. Milligan, Oxford. Obtaining aluminate of soda by a new process, from clay and soda salts. March 18

4133 J. Y. Johnson—From C. Dubois, France. Improvements in condensing chambers for sublimed sulphur. Complete specification. March 18

4199 A. Brin and L. Q. Brin, London. Improvements in the production of chlorine and hydrogen. March 21

4201 J. Taylor, Glasgow. Improvements in the manufacture of nitric acid. March 21

4241 H. Baum, London. Improvements in the manufacture of pyro-sulphates. March 21

4363 A. Shelmerdine, Liverpool. Improvements in the treatment and utilisation of alkali waste, known as "lime mud," for obtaining a useful product therefrom. March 23

4371 A. Delhaye, London. Improvements in the manufacture of caustic or carbonated soda and caustic potash. March 23

4430 J. Brock, Widnes—Partly communicated by G. Lunge, Switzerland. Improvements in apparatus for the manufacture of monohydrated sulphuric acid. March 24

4686 H. Gall and V. A. de Montlaur, London. Improvements in the manufacture of chlorates of the alkalies or alkaline earths. March 29

4989 D. Simpson, Edinburgh. Improvements in apparatus for concentrating liquids, and for separating salts from their solutions by evaporation. April 4

5124 G. I. J. Wells—From S. Pick, Galicia. Improvements in the evaporating of liquors containing salts, and in the separation of those salts. April 6.

5250 A. Shelmerdine, Liverpool. Improvements in the treatment and utilisation of alkali residue, known as "lime mud," for obtaining a useful product therefrom. April 9

5393 E. Hermite, London. Manufacture of bleaching and disinfecting liquor. April 13

5419 T. Thompson, Edinburgh. An improved and entirely new method for the admixture of ferrous sulphate or sulphate of iron and potassium carbonate, so that chemical action between them is prevented until exposed to each other in the presence of moisture. April 14

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

1922 C. F. Claus. Manufacture of carbonate of soda and carbonate of potash, and treatment of residues obtained thereby. March 26

5512 D. G. Fitz-Gerald. The regeneration or production of chromic acid from exhausted battery and other solutions. April 20

7137 J. Y. Johnson—From C. Dubois. Apparatus for extracting and subliming sulphur. March 30

7192 A. Fritschi. Manufacture of carbonic oxide gas. April 2

7859 B. Dawson. Apparatus for evaporating waste lyes and recovering soda from black liquor. April 16

8602 J. Park. Manufacture of bichromate of ammonia. April 16

1887.

4133 J. G. Johnson—From C. Dubois. Condensing chambers for sublimed sulphur. April 20

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

4212 M. Hoffmann, London. An improved process for manufacturing artificial majolica, delft, porcelain, and enamel. March 21

4485 A. M. Clark—From C. J. Brunetti, France. An improved process of ornamenting articles of glass, porcelain, and other ceramic or vitrifiable materials. March 25

4689 L. Preussner, London. A process for the production of marble-like or enamel-like objects. March 29

4821 E. Moore, London. Improvements in the manufacture of opaque glass of a certain new colour. Complete specification. March 31

4822 E. Moore. The manufacture of opaque glass of a new colour. Complete specification. March 31

4975 D. Rylands, Barnsley. Improvements relating to the casting and cooling of glass sleepers or other glass castings. April 4

5420 T. W. Hogg and P. J. Jackson, Newcastle-on-Tyne. An improved method for printing upon glass, porcelain, or earthenware, and apparatus therefor. April 14

5429 F. Wallbrecht, London. Improvements in the manufacture of bricks, tiles, and all kinds of earthenware. Complete specification. April 14

5560 A. D. Brogan and A. M. Malloch, Glasgow. An improved method of producing rippled, chequered, or other patterns or designs upon rolled plate and sheet glass, and apparatus therefor. April 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

5291 D. Rylands and H. Lindsay-Bucknall. Glass-melting furnaces. April 20

7214 F. Gibbons. Manufacture of ceramic tesseræ, mosaic, tiles, seggars, etc., and apparatus therefor. March 30

8061 A. Feldmann. Production of fireproof articles of enamel. March 26

8526 J. R. Windmill. Making glass bottles, jars, etc., and apparatus therefor. April 16

9015 W. H. Jones, B. Jones, W. H. Jones, and B. H. Jones. Apparatus for use in the manufacture of enamel ware. Apl. 16

15579 H. J. Allison—From C. C. Gilman. Manufacture of porous earthenware. April 16

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

4151 J. M. Robertson, Glasgow. Fireproof floors and ceilings. March 19

4278 W. Corbould. See Class XII.

4370 C. Brann and E. W. Jones, London. An improved mode of treating the slag or scoria from blast furnaces for making blocks or slabs for paving or other purposes. March 23

4394 J. W. Stansfield, Manchester. Improvements in waterproof asphalting. March 21

4606 A. J. Boult, London—From J. X. Jorda, Spain. Improvements in paving. March 28

4615 R. Haddan—From E. Clerici, Italy. An improved brick or block to be used as building material. March 28

4634 T. C. Fawcett, Halifax. Improvements in machinery for working and pressing bricks, tiles, and other articles. March 29

5152 G. F. H. Clark and R. J. Clark, London. The manufacture of a cement or composition for fastening wood, linoleum, or other covering to iron or steel decks, wood flooring, etc.; applicable also for other purposes. April 6

5155 J. W. Hooton, London. Improvements in the manufacture of Portland cement, and apparatus therefor; applicable also for other purposes. April 6

5476 D. Burns, Carlisle. Improvements in the utilisation of waste products and manufacture of bricks, tiles, and other articles therefrom. April 15

5515 J. Steele, Liverpool. Improvements in celluloid attachment for glasses. Complete specification. April 15

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

8120 S. Lowdon. Manufacture of Portland cement. April 20

15965 C. J. Dodds. Construction of paving with moulded slag blocks. March 30

1887.

979 W. E. Gedge—From J. Thorraud, V. Nicolet, and A. Bonnet. A novel artificial cement. March 30

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

4086 R. Murray, Glasgow. A method of producing sound copper castings in sand or loam moulds. March 18

4170 F. Berry, Sheffield. Apparatus and appliances for automatically revolving heavy masses of material during the process of manufacture, as in the manipulation of forgings under steam hammers, forging presses, and the like. Mar. 19

4191 J. Lysaght, Limited, W. R. Lysaght, and J. Lakin, London. Improvements in rolling very thin gauges of iron and steel sheets. March 21

4218 W. Hope. Improvements in treating hollow cylinders or shafts of steel or other metal. March 21

4228 C. Netto, London. Improvements relating to the extraction of aluminium from substances containing the same. March 21

4233 J. W. Chenhall and J. Richardson, London. An improved method of constructing machines for breaking and crushing quartz or other hard materials. March 21

4234 J. W. Chenhall and J. Richardson. Improvements in machinery for concentrating ores. March 21

4247 T. Taberner and J. Hart, Liverpool. Improvements in safety lamps for mining and other purposes. March 22

4260 W. S. Sutherland, Liverpool. Improvements in heating, mainly for welding, and in furnaces therefor. March 22

4297 G. B. Nicoll, London. A new or improved method of heating metal forgings or castings for the purpose of expanding them, with a view to their subsequent contraction upon their seats. March 22

4318 P. J. Dowling and J. F. Dowling, London. Improvements in the method of weaving tinned steel or other wire for various uses. March 23

4389 G. J. Snelus, London. Improvements relating to the treatment of furnace slag, and to apparatus therefor. Mar. 23

4434 J. E. T. Wood, London. Treating and separating refuse metals. March 24

4472 S. P. Thompson. See Class XVIII.

4512 T. Marshall, London. Improvements in miners' safety lamps. March 26

4528 H. F. Taylor and W. P. Struve, London. Improvements in the method of finishing metal plates coated with tin or other metal or alloy, and in apparatus connected therewith. Mar. 26

4531 C. Tod, London. Improvements in pulverising gold quartz. March 26

4576 D. G. Reillon, S. T. Montague, and O. L. B. L. Bourgerol, Paris. Process for extracting aluminium from alumina. Complete specification. March 28

4584 R. H. W. Biggs, London. Extracting tin from iron or tin scraps. March 28

4609 J. C. Newbery and C. T. J. Vautin, London. Improvements in the wet or hydro-metallurgical method of extracting gold from crushed or other finely divided auriferous material. Complete specification. March 28

4661 W. P. Thompson. See Class XVIII.

4846 A. Gutensohn and E. Cox, London. Improvements in the process of coating iron or other metals with tin or other metal by the use of grease. March 31

4887 T. Bower, R. W. Bower, and J. Blackburn, London. An improved means for detaching or forcing down coal or other minerals. April 1

4993 W. H. Rickard and T. J. Rickard, Newport, Mon. Improvements in the method of, and apparatus or machinery for, coating plates with tin, lead, or other metal or alloys of the same. April 4

5002 E. Morris, London. Improvements in the method of, and apparatus to be employed in connection with, lime blasting operations in mines. April 4

5029 R. Hannan and M. Milburn, Glasgow. Improvements in obtaining zinc from its blende or sulphide. April 5

5399 G. W. Elliott, Sheffield. Improvements in wedges for winning coal, rock, and other minerals. April 11

5411 F. Herbert and C. G. Gordon, Newport, Mon. Improvements in "Bessemer" and other ingot moulds. April 14

5470 P. F. Kendall, Manchester. The determination of the direction of the dip of rocks in deep bore holes, and of the direction of deviation of boring from the perpendicular. April 15

5501 A. L. Keeport, London. Improvements in the process of obtaining the oxides, etc., of metals from their ores or from crude minerals. Complete specification. April 15

5622 W. H. Rickard and T. J. Rickard, London. Improvements in the method of, and apparatus or machinery for, coating plates with tin, lead and other metal, or alloys of the same. April 18

5627 A. Woodhouse, London. Improvement in apparatus for the amalgamation of gold. April 18

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

5832 J. Y. Johnson—From La Société Anonyme Le Ferro-Nickel. Manufacture of alloys of nickel, copper and aluminium. April 2

6747 A. M. Clark—From La Societe Anonyme de Produits Chimiques de St. Denis. Process and apparatus for treatment of iron ores for the manufacture of steel. March 23

6786 J. Thomas, H. Lewis, E. W. Lewis, and T. L. Thomas. Method and apparatus for galvanising sheet metal. March 23

6803 E. Edwards—From M. Ramos-Garcia. Separation of metallic tin from tinned plates, or from alloys or salts of tin. April 9

6810 J. Noad. Extraction of gold, silver, and platinum from ores and other substances. March 23

6974 E. Hunt—From G. Thomson. Obtaining copper from solutions of its salts. March 23

6977 C. J. Sandahl, G. Bargate, and C. B. Phillips. Manufacture of ferro-manganese, silico-spiegel, spiegelisen, and chrome iron. March 26

7008 W. Evans. Heating furnace for steel sleepers, etc., and apparatus connected therewith. March 26

7081 C. T. Cayley. Dies for use in the manufacture of rolled metal articles. March 30

7089 G. F. Redfern—From J. M. N. Millot. Compressing sand cores and moulds used in the manufacture of cast-metal pipes, and apparatus therefor. March 30

7191 A. Fritschi. Smelting iron and other metallic ores, and apparatus therefor. March 30

7777 W. Briggs. Preserving iron and steel structures from oxidation. April 9

8130 J. Noad. Extraction of gold, silver, and copper from ores, etc. March 23

8324 A. Gutensohn and J. M. James. Pickling or cleaning the surface of iron or other metal previous to coating it with tin or other metal. April 16

8359 T. Twynam. Refractory linings specially adapted for metallurgical furnaces, but applicable also for other purposes. April 20

8121 A. R. Ormiston and J. Ormiston. Processes and apparatus for testing miners' safety lamps. April 16

8881 P. M. Justice—From H. T. Rode. Manufacture of steel and ingot iron. April 16

9008 A. E. Stayner. Drilling machines for rock and coal. April 16

9015 W. H. Jones, B. Jones, W. H. Jones, and B. H. Jones. Apparatus for use in manufacture of enamel ware. April 16

10753 R. Schneider. Separating funnels or gits used for making perfectly solid and pure castings of iron, steel, etc. April 16

12053 D. McKechnie. Method and apparatus for smelting or refining copper. March 23

14982 C. W. Thompson. Rock drills. April 20

16935 E. de Pass—From La Société Industrielle et Commerciale des Métaux. Preserving the surface of copper or its alloys. April 16

1887.

2740 M. Constable and J. R. Bingle. Extraction of gold, silver, and other metals from ferriferous ores. March 23

2774 A. E. Outerbridge, jun. Moulds for metal castings. March 23

3738 P. M. Justice—From H. T. Rode. Manufacture of steel and ingot iron. April 16

XI.—FATS, OILS, and SOAP MANUFACTURE.

APPLICATIONS.

5132 W. P. Thompson—From La Société Industrielle de Glycerine et Acides Gras, Paris. Improved process for the continuous distillation of fatty bodies. April 14

5133 W. P. Thompson, Liverpool. Improvements in the manufacture or treating of cotton-seed oil and other products from cotton-seed, cotton-seed oil, or its residues. April 14

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

5277 H. Lambert and G. Greenwood. Apparatus for expressing oil from oil-yielding vegetable substances, and converting the residue into oil cake. April 16

6981 R. Jaques. Improvements in toilet soap tablets. March 26

10968 A. Brin and L. Q. Brin. Means for bleaching and disinfecting animal, vegetable, or mineral oils and fatty matters. March 26

12652 A. Brin and L. Q. Brin. Oxidation of oils for use in the manufacture of paints or varnishes, and for other purposes. March 26

1887.

2615 W. Buttner, J. G. Haller, and J. Magnus. Apparatus and means for extracting, washing and condensing fat, grease, glue, oil, or other substances from bones, wool, organic or inorganic substances; for drying the same, and recovering the solvent employed. March 30

3832 A. G. Wass. An improved lubricant. April 16

3833 A. G. Wass. An improved lubricant. April 16

XII.—PAINTS, VARNISHES, AND RESINS.

APPLICATIONS.

4267 A. Fromentin, London. Manufacturing a white colour called double carbonate, to be used as a painting colour. March 22

4278 W. Corbould, London. Improvements in the manufacture of whiting. March 22

4331 T. Kenyon, Manchester. Improvements in the preparation of pigments, and in the manufacture and treatment of bye-products therefrom. Complete specification. March 23

4607 R. M. Collingham, Manchester. Improvements in apparatus or presses used in the manufacture of black lead or other material for forming it into blocks. March 28

5545 S. Snell and A. W. Sanderson, Birmingham. A new or improved apparatus for the heating, melting, softening and burning of cements, paints, and the like for various purposes. April 16

5586 F. Crane—From J. Hale, United States. Improvements relating to the preparation of lacquers and varnishes, and to the method of applying the same for coating metallic or other articles. April 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

7497 J. Cameron. Antifouling composition for ships. March 23

1887.

3791 T. Garton. Transparent protective enamel or varnish. April 16

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

4384 H. Jamelle, London. An improved process for tanning hides and skins. March 23

5521 G. Delfos, London. See Class XX.

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

6138 R. Baker and W. Baker. Manufacturing leather from seal splits. April 16

7747 E. P. Nesbit. An improvement in tanning. April 9

XIV.—AGRICULTURE, MANURES, ETC.

APPLICATIONS.

4854 N. Proctor, Alfreton. An apparatus for creating vapours from a chemical compound for the destruction of insects. April 1

5532 E. Edwards—From J. Jeger. See Class XVII—C.

XV.—SUGAR, GUMS, STARCHES, ETC.

APPLICATIONS.

4397 H. W. Walker and T. L. Patterson, Glasgow. Improvements in apparatus for moulding and refining sugar. March 24

4407 A. Trebitsch, London. Apparatus and process for rendering amber waste available for manufacture. March 24

5066 A. Seyberlich and A. Trampedach, London. Improvements in and relating to the manufacture of grape sugar. April 5

5459 A. Schuhmann, London. An improved manufacture of a non-fermentable cementitious body soluble in water, from starch. April 14

5460 A. Schuhmann. An improved manufacture of dextrine or soluble starch free from smell and taste. April 14

5579 W. H. Hope, London. Increasing the durability and hardness of gutta-percha. April 16

COMPLETE SPECIFICATION ACCEPTED.

1886.

7970 M. Blake and J. Barclay. Improvements in and connected with sugar mills. April 16

XVI.—BREWING, WINES AND SPIRITS.

APPLICATIONS.

4332 J. France, Halifax. A new treatment of excisable liquors. March 23

4138 O. Imray, London—From F. W. Wiesebrock, United States. A process and apparatus for drying and cooling malt, grain, and other substances. Complete specification. Mar. 21

4530 J. W. Bailey and J. A. R. Greaves, London. The Manufacture of a new or improved saccharum for the use of brewers, distillers and vinegar makers. March 26

4863 F. Faulkner and W. Adlam, London. Improvements in and apparatus for effecting the process of sterilising "yeast-press drawings," "returns," and other waste liquids in brewing, vinegar-making, and other like processes. April 1

5337 I. A. F. Bang and M. C. A. Ruffin, London. A process and apparatus for purifying crude spirit and regenerating the purifying agent. April 12

5378 F. J. von der Ropp, London. Improvements in or relating to the treatment of yeast. April 13

COMPLETE SPECIFICATION ACCEPTED.

1886.

8082 W. S. Squire. Manufacture of yeast April 20

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, ETC.

APPLICATIONS.

A.—CHEMISTRY OF FOODS.

17046 A. J. P. Larieux and H. Gregoire, London. An improved food for horses and other animals. December 29, 1886. Previously included in No. 17046 of 1886.

4203 T. Kerfoot, Manchester. Preparing a dry saccharated extract of tea from which a cup of tea can be quickly made by the addition of boiling water. March 21

4271 A. Walker, London. Improvements in the manufacture of yeast. March 22

4836 P. E. Establie, London. Improvements relating to barrels or receptacles for the preservation and transport of meat, fish, and other substances. March 31

5267 W. H. Gilruth, London. Improved means and apparatus for treating tea leaves and other vegetable matter to evaporate moisture therefrom. April 9

5362 J. B. Fabre and L. Bergel, London. An improved dry colouring powder for cheese, butter, and other products. April 12

5535 A. P. Wire, London. A new compound applicable especially for the preservation of animal and vegetable substances. April 15

C.—DISINFECTANTS.

4283 A. Dupré and C. N. Hake, Westminster. Improvements in the preparation of disinfectants, deodorants, and antiseptics. March 22

4355 E. R. Blumstone, London. Improvements in disinfectants. March 23

5393 H. Hermite. See Class VII

5532 E. Edwards, London—From J. Jeger, Poland. A new or improved material to be used as a disinfectant, manure, preservative against decay, and for other purposes. April 15

COMPLETE SPECIFICATIONS ACCEPTED.

A.—CHEMISTRY OF FOODS.

1886.

7644 H. H. Lake—From N. Muller. The preservation of alimentary substances. April 9

7862 G. Grout. An improved preparation of cocoa and chocolate. April 16

17017 M. Samelson. Manufacture of liquid extract of coffee. March 30

B.—SANITARY CHEMISTRY.

1886.

4544 T. Reid. Apparatus and method for clarifying sewage, and filtering large volumes of water. March 26

4572 F. Petrie. Disinfection of sewage, waste liquors, and the like. March 30

4609 T. G. Hardie. Furnace for the combustion of town refuse, etc., and utilisation of the resultant products. March 30

6306 J. S. Edwards and J. Edwards. Apparatus for drying waste animal matter, etc. March 23

6813 J. G. Lorrain. Improvements in filtration. March 23

7333 J. Fenton. Purifying, precipitating, and filtering sewage, drainage, etc. March 30

1887.

2766 J. Y. Johnson—From La Société G. Boone et J. Nory Decantation apparatus for clarifying and purifying water and other liquids. April 16

2860 H. Davey. Method and means for automatically raising sewage. April 20

C.—DISINFECTANTS.

1886.

6819 W. Thompson. The employment of certain substances for antiseptic purposes. March 23

8509 A. Boake and F. G. A. Roberts. Improvements in disinfectants. April 9

XVIII.—ELECTRO-CHEMISTRY.

APPLICATIONS.

4114 L. R. Davies and M. Shearer, London. Improvement for protection of elements (while in solution) of batteries or cells. March 18

4126 M. Bernard and E. Bernard, London. An improved process for the electrolysis of certain double chlorides. March 18

4219 C. Desmazures, London. Certain improvements in accumulators of electricity or other primary or secondary galvanic batteries. Complete specification. March 21

4225 G. Hookham, London. Improvements in electricity meters, partly applicable to dynamo-electric generators and motors. March 21

4303 W. Main, Brooklyn, U.S.A. Improvements in and relating to secondary batteries. Complete specification. March 22

4311 H. H. Lake—From A. Vanwyck Meserole, U.S.A. Improvements in and relating to secondary batteries. Complete specification. March 22

4322 J. Hopkinson and E. Hopkinson, London. Dynamo-electric machines. March 22

4460 T. Parker, Manchester. Improvements in electro-dynamic and dynamo-electric machines. March 25

4472 S. P Thompson, London. Improvements in electro-deposition of cobalt. March 25

4527 L. Epstein, Liverpool. Improvements in electrodes applicable for use in primary or secondary batteries. Complete specification. March 26

4571 W. E. Heys—From J. Beattie, jun., United States. Improvements in the construction and manufacture of zincs for galvanic batteries. March 28

4577 H. C. Beland, London. Improvements in electric secondary or storage batteries. March 28

4618 C. L. Tweedale, Manchester. Improvements in primary batteries. March 29

4664 W. P. Thompson—From E. H. Cowles and A. H. Cowles, United States. Improvements in or relating to electric furnaces applicable for making aluminium, and for other purposes. Complete Specification. March 29

4667 W. P. Kookogey, London. Improvements in galvanic battery solutions. Complete specification. March 29

4744 H. J. Harris, London. Means for supporting or suspending elements in electric batteries. March 30

4781 The Electrical Power Storage Co. Limited and H. W. Butler, London. Improvements in electric batteries. March 30

4823 C. H. Cathcart, London. An improved galvanic battery. March 31

4824 O. C. D. Ross, London. Improvements in the method of and in apparatus for generating electro-magnetic currents. March 31

4832 H. Leipman, London. Manufacture and construction of carbon "plates" or electrodes for use in primary batteries and for electro-metallurgical, electrolytical, and otber electrical purposes. March 31

4931 M. Bailey and J. Warner, London. An improved construction of battery and method of regulating the same. Complete specification. April 2

5009 J. T. Armstrong, London. A new and improved method of charging, cleansing, changing, and varying the chemicals and liquids used in secondary batteries. April 4

5096 J. Kapp, London. Improvements in dynamo-electric Machinery. April 5

5125 G. E. Dorman, Stafford. Improvements in thermo-electric elements. April 6

5140 W. H. Quarterman, London. Improvements in galvanic batteries. April 6

5193 G. A. Grindle, London. Improvements relating to a system of generation and distribution of electricity. April 7

5303 H. W. Ravenshaw, W. T. Goolden, and A. P. Trotter, London. Improvements in dynamo-electric machines. April 12

5162 W. H. Scott and E. A. Paris, London. Improvements in dynamo-electric machines. April 11

5505 H. W. Ravenshaw, W. T. Goolden, and A. P. Trotter, London. Improvements in dynamo-electric machines. April 15

5562 W. Maxwell, London. A system of generating, re-producing, and distributing electricity. April 16

5583 H. Liepmann, London. Improvements in galvanic batteries. April 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

2880 H. H. Lake—From G. E. Cabanellas. Apparatus for the generation and utilisation of electrical energy. March 30

4662 F. King. Automatic electrical distribution and charge of secondary batteries. March 30

4751 H. S. Maxim. Application of magnetism or electro-magnetism for the separation of metals, and for other purposes; and apparatus therefor. April 2

5092 A. Rust. Thermo-electric generators. April 9

6422 J. G. Statter and S. L. Brunton. Armatures for magnets or dynamo-electric generators. March 23

7004 R. E. B. Crompton. Apparatus for generating electricity. April 2

7189 J. E. Pearce. Primary voltaic batteries. March 30

7353 P. R. de Faucheux d'Humy. Galvanic batteries. April 2

7596 J. Pitkin. Elements for secondary batteries. April 9

7704 E. J. Houghton. Fuse for dynamo-electric machinos. April 9

10186 C. W. Hill. Electric generators and motors. March 26

1887.

1337 N. W. Perry. Galvanic cells. April 9

2721 C. G. Curtis, F. B. Crocker, and S. S. Wheeler. Electric batteries. April 9

2835 G. Y. Lagarde. Improvements in electric batteries, and means for putting same into and out of action. March 26

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

4619 T. M'Dougall and F. Lindley, Glasgow. Improvements in the manufacture of paper, and in apparatus therefor. March 29

5269 G. Pitt—From R. P. Pictet and G. L. Brelaz, Switzerland. Improvements in the manufacture of paper from wood, and in apparatus therefor. Complete specification. April 9

5296 L. Bastet, London. The manufacture of waterproof and combined water- and fireproof paper. Complete specification. April 9

5406 W. Bertram, Glasgow. Improvements in drying paper. April 14

5425 W. Bertram, Glasgow. Improved mechanism for drying paper. April 14

5528 T. Goodall and T. Webster, London. Improved means for straining pulp. April 15

5649 C. Barataud, London. An improved machine or apparatus for reducing material for the manufacture of paper. Complete specification. April 18

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

7530 E. de Pass—From La Société de Lafarge, Lèbre et Cie. A process and apparatus for rendering all kinds of paper impermeable and transparent; the said apparatus being applicable for rendering cotton and other fabrics impermeable. March 26

17159 N. Browne—From J. Scherbel and T. Remus. Apparatus for drying strawboard, cardboard, and the like. April 16

1887.

3927 C. Russell and P. H. Craigin. Paper-pulp screens. April 16

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

5524 G. Delfos, London. An oily chemical preparation for the manufacture of Russian leather. April 15

5590 E. Merck, London. Improvements relating to the manufacture of naphthalol, and to the utilisation of the same for medicinal purposes. April 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

7903 W. L. Wise—From E. Mourlot, fils. Obtaining certain products or substances from essence of birch bark, and utilising the same in the manufacture or production of certain compounds or substances. April 16

XXI.—EXPLOSIVES, MATCHES, ETC.

APPLICATIONS.

4110 R. W. Punshon and H. J. Maclure, London. Improvements in the manufacture of explosive compounds. March 25

4111 H. J. Maclure, London. Smokeless gunpowder. March 25

4636 E. Hollanders, Portsea. An improved electric safety-pistol for firing canons and explosives. March 29

4713 C. D. Abel—From H. Schöneweg, Germany. Improvements in explosive compounds and safety cartridges for blasting purposes. March 29

5366 G. A. Farini, London. Improvements in ammunition for rifles, sporting and other guns, pistols or revolvers; also applicable to heavy ordnance. Complete specification. April 13

5161 W. J. Brewer, London. An improved land torpedo. April 11

5538 W. J. Brewer. Improvements in torpedoes. April 15

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

7911 J. Rigby. Improvements in ammunition. April 16

9166 C. Roth. Manufacture of explosives. April 9

1887.

2679 C. Roth. Manufacture of explosives. April 2

3173 S. H. Neuly and L. Hutchins. Marine torpedoes. April 9

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NOTICES.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those members of Council whose names are placed in italics in the annexed list, will retire from their respective offices at the forthcoming Annual General Meeting.

Professor James Dewar, F.R.S., has been nominated to the office of President, and Mr. David Howard has been nominated Vice-President under Rule 11.

Professor Clowes, Mr. J. Neilson Cuthbertson, Mr. Ivan Levinstein, and Professor W. A. Tilden, F.R.S., have been nominated Vice-Presidents under Rule 8; and Mr. B. S. Proctor has been nominated Ordinary Member of Council under Rule 17, in the place of Mr. Levinstein, nominated Vice-President.

The Treasurer and Foreign Secretary have been nominated for re-election.

Members are hereby invited to nominate fit and proper persons to fill four vacancies among the Ordinary Members of Council under Rule 18. Special nomination forms for this purpose can be obtained from the General Secretary upon application.

Extract from Rule 18:—"No such nomination shall be valid, unless it be signed by at least ten members of the Society, who are not in arrear with their subscriptions, nor unless it be received by the General Secretary, at the Society's Office, at least one month before the date of the commencement of the Annual General Meeting, to the election to take place at which it refers. Nor shall any such nomination be valid if the person nominated be ineligible for election under Rules 12 or 15. No member shall sign more than one nomination form."

Notice is hereby given, that the next Annual General Meeting will be held in Manchester on Wednesday, Thursday, and Friday, the 13th, 14th, and 15th of July next. Detailed arrangements and the programme of proceedings will appear as soon as complete.

Comment having been made on the delay in reprinting the numbers for January, 1882 and 1883, the Secretary begs to inform those whom it may concern, that the delay is due to the fact that up to the present not more than twenty orders for those numbers have been received. It is hoped that this notification may stimulate those who desire to complete their sets, to make early application with a view to expedite the consideration of the question of reprinting by the Council. Notice is also hereby given that the numbers for January and February, 1886, being exhausted, no orders for those copies, nor for complete sets of Vol. V., can be executed.

Authors of communications read before the Society or any of its Local Sections are requested to take notice that, under Bye-Law 43, they cannot receive the prescribed 50 copies of their communications unless they comply with the condition laid down in that Bye-Law—viz., that they give notice of their desire to receive such copies upon their manuscript before sending it to the Editor. Mention should also be made as to whether the Discussion is to be included in the reprint.

CHANGES OF ADDRESS.

Herbert W. Bainbridge: Journals, etc., to Malvern Hall, Solihull, near Birmingham.

G. H. Beckett, l/o Forest Gate; 21, Howard Street, Horton Lane, Bradford, Yorks.

J. C. Belcher, l/o Brighton; c/o Sanitas Co., Limited, Letchford's Buildings, Three Colts Lane, Bethnal Green, E.

Jas. Beveridge, l/o Cardiff; Main Street, Frodsham, Cheshire.

C. W. Bickerton, l/o Bosden; Torkington Fold, Norbury, near Stockport.

Dr. L. Claisen, l/o Coln; Marsstrasse 1 *a* 2, Munchen, Bavaria.

W. P. Cochrane, l/o Redcar; Holmhurst, The Park, Middlesbro'-on-Tees.

Wm. Donald, l/o Pembrey; 29, Eglinton Street, Saltcoats, N.B.

H. Fergusson, l/o Manchester; Prince Regent's Wharf, Victoria Docks, E.

And. Ferrie, l/o Corporation Street; Harpurhey Chemical Works, Manchester.

H. Forth, l/o New Basford; Beech Avenue, Sherwood Rise, Nottingham.

C. J. Fox, l/o Aldersgate Street; 17, Charterhouse Buildings, London, E.C.

Wm. Glover, l/o Silvertown; 180, Hulme Hall Lane, Miles Platting, Manchester.

R. Grimwood, l/o Upper Holloway; 41, Lady Margaret Road, London, N.W.

J. Hammond, l/o Lewes; Resident Engineer, Gas Works, Eastbourne.

W. Hoghen, l/o Edinburgh; c/o Monville Phibrolithoïd Co., Limited, Monville, Seine Inférieure, France.

Dr. H. Kupferberg, l/o Blackley; 49, Cleveland Road, Higher Crumpsall, Manchester.

F. H. Leeds, l/o Forest Gate; 29, Bouverie Road, Stoke Newington, N.

Otto Luthy, l/o Church Street; 2336, Fairmount Avenue, Philadelphia, Pa., U.S.A.

T. R. Marshall, l/o Edinburgh; bei Herrn Kolle, 9/3 Dachauer Strasse, Munchen, Bavaria.

Jno. Murphy, l/o Prince's Park; Kingston House, Aigburth Road, Liverpool.

F. Nettlefold, l/o 52; 21, Sterndall Road, West Kensington, W.

Chas. Renard, l/o L'Estaque; 25, Allées de Meilhan, Marseilles, France.

T. Rowley, l/o Manchester; Croston Cottage, Alderley Edge, Cheshire.

Wallace Thorneycroft, l/o Glasgow; Tettenhall Towers, Wolverhampton.

H. Wager, l/o Lymington; Larich Bhan, Loch Awe Side, Dalmally, Argyllshire, N.B.

A. J. Watts, l/o Pernambuco; 40, Goldhurst Terrace, South Hampstead, N.W.

G. S. V. Wills, l/o Southwark; Arundel Lodge, Tulse Hill, S.W.

L. Wykes, l/o Oldbury; Minas de Rio Tinto, Huelva, Spain.

CHANGES OF ADDRESS REQUIRED.

C. S. Doggett, l/o 53, Karl Strasse, München.

Jas. Towns, l/o Morgan Street, Canning Town, E.

LIST OF MEMBERS ELECTED, MAY 23, 1887.

F. W. Babington, School of Practical Science, Toronto, Canada, demonstrator of applied chemistry.

F. J. Beaumont, 42, Trinity Square, Borough, S.E., lecturer on science.

J. Edwin Boon, High Street, Brading, Isle of Wight, chemist.

J. M. Collett, 7, Brunswick Square, Gloucester, chemical manufacturer.

Jno. Craig, Clippens Villa, by Johnstone, N.B., manager of oilworks.

Thos. Goodall, Hendon Grange, Sunderland, paper manufacturer.

Hugh Hastings, 13, Neal Street, Bradford, Yorks., student of chemistry.

Alf. H. Knight, 18, Chapel Street, Liverpool, metallurgical chemist and assayer.

G. A. Koenig, University of Pennsylvania, Philadelphia, U.S.A., professor of mineralogy and metallurgy.

Eardley B. Manby, Lightbounds, Halliwell, Bolton-le-Moors, manager of bleach and dyeworks.

Edmund Milnes, Seedfield, Bury, Lancashire, manufacturer of extracts for dyeing and printing.

Philip H. Rathbone, The Cottage, Green Bank, Liverpool, Chairman of Weldon's Chlorine Co.

Thos. B. Saunders, 8, Melbourne Place, Horton Lane, Bradford, Yorks., manufacturing chemist.

Willis Scrutton, University College, Gower Street, W.C., demonstrator.

H. Thornton, 5, George Street, Euston Road, London, N.W., chemist.

Jno. Turney, Trent Bridge Leather Works, Nottingham, tanner.

Jos. T. Wood, Trent Bridge Leather Works, Nottingham, tanner.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

Chairman: David Howard.

Committee:

Sir F. A. Abel.
H. E. Armstrong.
W. Lant Carpenter.
W. Crowder.
C. Graham.
S. Hall.
A. K. Huntington.
R. Messel.
B. E. R. Newlands.
B. Redwood.
T. Royle.
John Spiller.
G. C. Trewby.
J. Williams.

Hon. Local Sec. and Treasurer: Thos. Tyrer, Garden Wharf, Church Road, Battersea, S.W.

The meetings of the London Section will be held on the first Monday in each month.

SESSION 1886—87.

Prospective Arrangements.

June 6.—Dr. H. E. Armstrong, "The Alkaloids—the Present State of Knowledge concerning them, and the Method employed in their Investigation."

" Mr. Boverton Redwood, "Notes of a Recent Visit to some of the Petroleum-producing Territories of the United States and Canada."

Mr. J. Ruttle, F.I.C., F.C.S., "Further Notes on the Analysis of Certain Fertilisers."

July 13, 14 and 15.—Annual Meeting in Manchester.

Notices of Meetings and Papers will be found in the Scientific Journals.

Notices of papers and communications to be made to the Local Secretary.

Meeting held May 2, 1887.

RECENT BACTERIOLOGICAL RESEARCH IN CONNECTION WITH WATER SUPPLY.

BY PERCY F. FRANKLAND, PH.D., B.SC. (LOND.), F.I.C.

Eighteen months ago I had the honour of introducing to the notice of this Society some of those novel methods of bacteriological research which have given such an impetus to this study during the past few years, and by means of which such important results have been obtained.

The functions of micro-organisms are so closely connected with such numerous industrial processes, and are of such wide practical significance, that I cannot but think that the Journal of this Society is a medium pre-eminently fitted for bringing to the knowledge of practical men the progress which is being made in a subject with which so many are consciously, or unconsciously, directly or indirectly concerned.

In my previous communication I endeavoured to point out how these new methods of investigation could be rendered available for the solution of a number of problems which have long presented themselves to those interested in the subject of water-supply, but which had previously been unapproachable owing to the technical difficulties with which they were surrounded. I pointed out more especially how the efficiency of filtration and other methods of water-purification could now be determined from an entirely new point of view, and one which for many purposes was of much greater importance than the chemical standard which had hitherto been alone available. At the present time I think no one will dispute that the biological standard of purity, as regards drinking-water, is of more importance than the chemical standard, for it has long been admitted that the *greater* dangers of contaminated drinking-water reside in the presence of living organisms and not of unorganised organic matter. I say the "*greater*" dangers of contaminated water, for there can be no doubt that minor disturbances may be caused by the presence of excessive quantities of organic matter in water, irrespectively of the presence of pathogenic organisms; but cases of such gross pollution in which toxic effects result from the presence of large quantities of organic matter are comparatively rare, are almost exclusively confined to private supplies from wells, tanks and cisterns, and possess but little interest in connection with the supply of water on the large scale.

The new bacteriological methods, as I have already pointed out, admit of being applied to the examination of water supplies in such a manner as to ascertain what is the efficiency of the purifying processes—natural or artificial—upon which the safety of the supply is supposed to depend. In my previous communication I dwelt at some length on the results which are obtained when water is submitted to filtration on the small scale in the laboratory, and I pointed out how substances which had hitherto been regarded as of practically no value for filtration, could, when employed in a sufficiently fine state of division, be made to act as highly efficient filters, at any rate for a short period of time.

I propose, in the first instance, this evening to bring before you the results which I have obtained during the past year in my monthly examinations for the Local Government Board of the London Water Supply, by the methods in question.

These results are of interest, not only as illustrating the variations in the amount of organic life present in the different waters throughout the year, but also in showing the effect of the processes practised in the purification of water on the large scale; for besides determining the number of developable microbes in each of the various waters, the number is likewise determined in the unfiltered river-waters at the points where the latter are abstracted for supply.

In Table I. I have recorded the total number of micro-organisms found in one cubic centimetre of each of the waters.

In connection with this table there is one point to which I particulrly desire to draw attention, and that is, that in the case of the river-waters the samples richest in micro-organisms are those collected in the winter months, and not in the summer. It might have been anticipated that the reverse of this would be the case, and that the higher temperature being favourable to the growth and multiplication of the organisms, the latter should be more prevalent in the summer than in winter. It must, however, be remembered that in summer the rivers are principally fed by spring-water, and receive comparatively little surface-drainage, whilst in winter the rivers are generally more or less in flood, and are swollen by large volumes of surface-water, which is naturally rich in micro-organisms. The fact that the filtered waters also contain, as a general rule, the smallest number of organisms in the summer and not in the winter, clearly shows that the figures obtained do really give a picture of the work done in the purification of the water, and are not materially affected by any process of multiplication which may be favoured by a high temperature.

It will, moreover, be seen that in every case a very much smaller number of micro-organisms was found in the filtered than in the unfiltered waters, and in most cases this difference is exceedingly striking indeed.

In Table II. this difference between the filtered and unfiltered waters is expressed as a percentage

TABLE I.

TOTAL NUMBER OF COLONIES OBTAINED BY CULTIVATION OF ONE CUBIC CENTIMETRE OF WATER.

DESCRIPTION OF WATER.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	October.	Nov.	Dec.	Average.
THAMES—													
Thames unfiltered....	45,400	15,800	11,415	12,250	4,800	8,300	3,000	6,100	8,400	8,600	56,000	63,000	20,255
Chelsea	159	305	299	94	59	60	59	303	87	34	65	222	146
West Middlesex......	180	80	175	47	19	145	45	25	27	22	47	2,000	231
Southwark............	2,270	284	1,562	77	29	94	380	60	49	61	321	1,100	524
Grand Junction	4,891	208	379	115	51	17	14	12	17	77	80	1,700	630
Lambeth..............	2,587	265	287	209	136	129	155	1,415	59	45	108	305	475
LEA—													
Lea unfiltered	39,300	20,600	9,025	7,300	2,950	4,700	5,400	4,300	3,700	6,400	12,700	121,000	19,781
New River............	363	74	95	60	22	53	46	55	17	10	32	400	102
East London..........	224	252	533	269	143	415	134	213	165	97	248	280	253
DEEP WELLS—													
Kent (well direct)	—	5	44	7	8	4	12	9	5	82	12	11	18
Kent (district)	43	119	38	47	101	39	48	13	25	341	196	66	92

number, exhibiting in each case how many out of every 100 microbes present in the original water have been removed in the processes of treatment adopted by the companies.

It is particularly interesting to find from this table that the results obtained by the various companies are by no means identical, but that some companies are almost uniformly more successful than others. In another place (the Institution of Civil Engineers) I have pointed out that these differences correspond in a remarkable manner with certain differences in the mode of treatment, such as the time of storage, rate of filtration, thickness of filtering materials, etc., adopted by the various companies. This is a point deserving the special attention of water engineers, and it is especially desirable that the connection between the mode of treatment and the results obtained should be elaborated by a systematic series of experiments made on the individual filter-beds, instead of upon the whole supply.

Quite recently I have had an opportunity of applying these tests to the water supply of a large town in the North of England, and the results are of interest, by way of comparison with those obtained in the case of the Metropolitan supply, as the circumstances are in many respects similar.

The water supply in question is derived from a river which receives the drainage of several towns of considerable size above the point where the water is abstracted.

The following four samples of water were collected as representative of the conditions of supply, and these four samples were respectively submitted to chemical and bacteriological examination.

Sample 1.—Collected from the river about 27 miles above the intake, and down to this point the river has received no drainage from any place of considerable size.

Sample 2.—Taken about 16 miles above the intake in question, and 10 miles below a town of 7000 inhabitants, from which, and from a smaller town, it receives sewage.

Sample 3.—Taken from the river at the intake, between which, and the point at which Sample 2 was taken, there is no noticeable source of pollution.

Sample 4.—The water as supplied to the town in question, and after undergoing the processes of storage and filtration.

TABLE II.

PERCENTAGE REDUCTION IN THE NUMBER OF DEVELOPABLE MICRO-ORGANISMS PRESENT IN THE RIVER WATERS BEFORE DELIVERY BY THE COMPANIES.

Description of Water.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	October.	Nov.	Dec.	Average.
THAMES—													
Chelsea	99·7	98·1	97·4	99·2	98·8	99·3	98·0	95·0	99·0	99·6	99·9	99·7	98·6
West Middlesex......	99·6	99·5	98·5	99·6	99·6	98·3	98·5	99·6	99·7	99·7	99·9	96·8	99·1
Southwark	95·0	98·2	86·3	99·4	99·4	98·9	87·3	99·0	99·1	99·3	99·4	98·3	96·7
Grand Junction	89·2	98·7	96·7	99·1	98·9	99·8	99·5	99·8	99·8	99·1	99·9	97·3	98·2
Lambeth..............	94·3	98·3	97·5	98·3	97·2	98·5	94·8	76·8	99·3	99·5	99·8	99·5	96·2
LEA—													
East London........ .	99·1	98·8	94·1	96·3	95·2	90·5	97·5	94·3	95·5	98·5	98·0	99·8	96·5

The results obtained in the chemical and bacteriological examination of these waters are recorded in the following table :—

	Samples.*	1.	2.	3.	4.
Results of Analysis expressed in parts per 100,000.	Total Solid Residue ..	21·08	31·20	28·40	26·20
	Organic Carbon........	0·108	0·118	0·123	0·119
	Organic Nitrogen . .	0·020	0·028	0·025	0·022
	Ammonia...	0	0	0	0
	Nitrogen as Nitrates and Nitrites	0·075	0·123	0·077	0·089
	Total Combined Nitrogen	0·095	0·151	0·102	0·111
	Chlorine	1·1	1·6	1·6	1·6
	Temporary Hardness..	13·4	12·9	11·5	10·9
	Permanent ,,	4·9	7·1	7·1	7·1
	Total ,,	18·3	20·0	18·6	18·0
	Remarks	Slightly turbid.	Slightly turbid.	Slightly turbid.	Very slightly turbid.
	Number of colonies obtained on cultivation of 1cc. of water	1,800	33,400	31,200	122

From the above it will be seen that, whilst the river at the points 1, 2, and 3 is of much the same chemical composition in each case, the condition as regards the amount of microbial life present in the water at the point No. 1 is very different from that at the points Nos. 2 and 3. Now it must be observed that the increase in the number of micro-organisms which No. 2 exhibits, as compared with No. 1, is coincident with the admission into the river between these two points of the sewage of the two towns referred to above, whilst the practical equality in the numbers found at points 2 and 3 corresponds with

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* The samples in question were collected in the forenoon, with all due precautions, and were received at my house and there submitted to plate-cultivation on the evening of the same day, so that there was no time for any disturbance of the results through multiplication in the interval between the times of collection and cultivation.

the 16 miles' length of river in which, as we have seen, there is no noticeable source of pollution.

Most striking of all, however, is the enormous reduction in the number of microbes found in the case of the Sample No. 4, which is the water actually supplied, and which, as regards chemical composition, is almost an exact duplicate of No. 3, the differences exhibited by the two samples being almost within the limits of experimental error.

The reduction in the number of microbes before distribution to the town in question thus amounts to no less than 99·6 per cent., which compares favourably with the results similarly obtained in London, for the average reduction in the case of the Thames water during the whole year 1886 amounted to 98·0 per cent.

In connection with the results to which I have just referred, I wish it to be most clearly understood that no conclusions whatever, as to the relative excellence of the various waters, are to be drawn from their greater or less freedom from micro-organisms, any more than it is possible, on the strength of chemical composition, to say that one water is more wholesome than another. On the other hand, these determinations undoubtedly do indicate what would be the probable fate of any harmful organisms gaining access to the sources of supply, and what is the relative chance of their reaching the consumers; *for that method of treatment which abolishes the largest proportion of organisms of all kinds is also the most likely to abolish any pathogenic forms should they be present.*

Experiments on the Filtration of Water on the Small Scale.

Since the communication of my previous paper, further experiments have been made on the subject of domestic filtration, but whilst my experiments were made with a view of testing the efficiency of various materials when employed in the most advantageous manner, these later experiments, on the other hand, have been made with filters which are actually in the market at the present time.

Were I to follow my own inclinations in the matter, I should pass over these experiments without any comment, as it is certainly my experience that any public reference, whether favourable or unfavourable, to proprietary articles of any kind is invariably followed by annoyance and unpleasantness. I feel, however, that I should be but imperfectly executing the task which I have undertaken of bringing before you the recent progress in this subject, without briefly recapitulating the results which have been obtained in these investigations.

The experiments in question have been obtained by Dr. Plagge, of the Hygienic Institute of Berlin, who published his results last autumn before the Public Health Section of the German Association of Naturalists and Physicians.

Dr. Plagge has examined a great variety of filters—viz.: (1.) *Carbon filters.* (2.) *Stone and sand filters.* (3.) *The spongy iron filter.* (4.) *Paper filters* of several kinds. (5.) *The porous earthenware filters* of Chamberland (Paris), Olschewsky (Berlin), and Hesse (Schwartzenburg). (6.) *The Asbestos filters* of Breyer (Vienna), Hesse, Arnold & Schirmer (Berlin).

In experimenting with these various forms of filter, Dr. Plagge found—

(1.) That the *carbon filters* not only admitted of the free transmission of micro-organisms, but that in some cases the number of microbes in the filtrate greatly exceeded that in the unfiltered water; thus in one case the

Unfiltered water yielded 68 colonies per cubic centimetre.

whilst—

The filtered „ „ 12,000 „ „ „

It may be remembered that a similar case was cited by me in my previous communication, in which an experimental filter of animal charcoal, which I had had in operation for one month, gave the following results:—

Unfiltered water yielded ......2800 colonies per cc.
Filtered „ „ ..... 7000 „ „

In these cases the filtering medium obviously acts as a hotbed for the development of micro organisms.

(2.) The *stone and sand filters* were all found to be worthless.

(3.) The *spongy iron filter* yielded the following results:—

Unfiltered water yielded 38,000 colonies per cc.
Filtered „ „ 18,000—24,000 „ „

(4.) The *paper filters* yielded very unsatisfactory results; thus in one case in which filtration was carried under a pressure of 1¾ atmosphere—

Unfiltered water yielded ....40,000 colonies per cc.
Filtered „ „ .... 8,000 „ „

And in another case at a low pressure (½ atmosphere), the 40,000 colonies in the unfiltered were reduced to 4000 in the filtered water.

(5.) The *earthenware filters*, on Pasteur's principle, gave in nearly every instance a filtrate practically free from micro-organisms. Thus in one case the unfiltered water yielded 284, and the filtered only 4 colonies per cubic centimetre.

This result is similar to that previously obtained by me in the filtration of London water through a Chamberland filter.*

(6.) The *asbestos filters* gave results essentially similar to those obtained with the earthenware filters.

These results of Dr. Plagge's speak for themselves, and require no further comment; they obviously enable us to classify these domestic filters in three definite groups:—

(1.) Filters which are highly efficient.
(2.) Filters which are inefficient.
(3.) Filters which are not only inefficient, but absolutely injurious to the purity of the water.

Experiments with Specific Organisms.

In all experiments with natural waters we have, as I have already pointed out, to deal principally with organisms which in themselves are not known to be endowed with dangerous properties, and consequently as the results possess only an indirect significance, it has been thought desirable to conduct experiments in which definite organisms, some of which are known to possess pathogenic properties, are employed.

The object of these experiments has been to ascertain what is the fate of these various pathogenic organisms when they are artificially introduced into different kinds of natural water, and in order to simplify the investigation—I might almost say, in order to bring the investigation within the limits of experimental possibility—the natural waters into which the pathogenic forms are introduced are previously freed from all other microbes by sterilisation. The method of investigation, which has been followed in the more systematic of these experiments, has been to introduce a very minute quantity of a pure cultivation of the particular organism in question into a large quantity of water previously sterilised, and contained in a sterile vessel protected from aërial contamination. The inoculated water is then rendered homogeneous by agitation, and a measured portion removed with a sterilised pipette, and submitted to plate-cultivation in the ordinary way. Thus the initial number of organisms of the particular kind in a given volume of water is ascer-

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* "The Removal of Micro-organisms from Water," Proceedings Royal Society, 1885.

tained. The infected water is then allowed to stand for a definite length of time—so many hours, days, weeks, months, etc.—and then again submitted to plate cultivation at suitable intervals, the sample being of course thoroughly agitated immediately before removing a portion with the sterilised pipette for cultivation.

I have myself carried out a large number of experiments in this manner on some of the best characterised organisms—viz.:—

1.—Koch's "comma" spirillum of Asiatic cholera.

2.—Finkler-Prior's "comma" spirillum, which is an organism very closely resembling Koch's comma, and formerly erroneously supposed to be identical with it. It was originally found in a case of European cholera.

3.—The bacillus pyocyaneus, an organism which gives rise to the greenish-blue colouring matter frequently present in abscesses.

4.—The micrococcus of erysipelas, the undoubted cause of this well-known disease.

5.—The bacillus anthracis, the unquestionable cause of splenic fever in cattle and of woolsorters' disease or malignant pustule in man.

The behaviour of these several organisms was studied when they were introduced respectively into distilled water, deep-well water, filtered Thames water, and sewage.

VITALITY OF KOCH'S COMMA SPIRILLUM IN SEWAGE, AND IN FILTERED THAMES WATER.

NUMBER OF COLONIES OBTAINED FROM 1cc.

		Day of Preparation	2nd Day.	5th Day.	6th Day.	9th Day.	11th Day.	17th Day.	29th Day.	11 Months.
LONDON SEWAGE..	(20° C.)	4,750	60,000	Innum.	Innum.	—	Innum.	—	—	1,136*
	(Incubator at 37° C.)	4,750	Innum.	Innum.	Innum.	—	96,000	—	—	—
DITTO DITTO ..	(20° C.)	300	19 000	Innum.	—	Innum.	—	Innum.	Innum.	572*
	(Incub.)	300	Innum.	Innum.	—	Innum.	—	128,000	56,000	—
FILTERED THAMES	(20° C.)	—	63	313	480	173	—	—	—	0
	(Incub.)	—	188	0	0	0	—	—	—	—

* These figures indicate the number of undoubted comma colonies; there was in each of these two cases also an immense number of other colonies due to a micrococcus.

Thus the "comma" spirilla were found in every case to flourish and multiply abundantly in sewage, whilst in deep-well and in filtered Thames water, although they were still demonstrable on the ninth day, they were present only in small number. It is moreover worthy of notice that both in the case of the deep-well and filtered Thames waters the numbers were greatly reduced immediately after inoculation, whilst subsequently they distinctly increased, only again to diminish after the fifth or sixth day. This process of acclimatisation, which I have also observed in the case of the bacillus pyocyaneus, has been likewise noticed by Wolfhugel.

Indeed, in sewage, the comma spirilla are so permanent that, after 11 months, I have still found them abundantly present in the case of two experiments which I have carried on up to the present time. As only the earlier observations made in these experiments have been previously recorded,* I have collected the results in the above table.

In other cases in which a weak cultivation of the comma spirillum was employed, a much more rapid destruction of the organism was observed, the latter being no longer demonstrable after the first day.

The results obtained with Finkler's spirillum differed very strikingly from those observed in the case of Koch's comma. This is particularly interesting, in consequence of the many points of similarity, both in microscopical appearance and in their behaviour, in cultivations which these organisms present. The invariable result obtained with Finkler's spirillum was that the organism could no longer be demonstrated in any of the waters, not even in London sewage, after the first day. The vitality of Finkler's spirillum in water is, therefore, very much less than that of Koch's comma.

The bacillus pyocyaneus, on the other hand, exhibits a vitality in water which far exceeds that of the comma spirillum: for this organism, when similarly introduced, was found to multiply, not only in sewage, in filtered Thames, in deep-well, but even in distilled water, and only in very exceptional cases was any destruction of the bacillus observed. As already pointed out, however, there were several instances in which a rapid diminution in the number of introduced organisms was subsequently followed by an even still more marked multiplication than in the case of the comma spirillum.

Note.—It should be observed that when it is stated that an organism has multiplied in distilled water, it must be understood that this multiplication has doubtless taken place at the expense of those *traces* of organic matter which must of necessity be present in experiments of this kind.

More recently I have made somewhat similar experiments with the bacillus anthracis and with the micrococcus of erysipelas; two organisms which are most indisputably the causes of the two well characterised diseases with which they are associated.

An introductory word or two is necessary in connection with the experiments made with the bacillus anthracis. The bacillus anthracis is the micro-organism of all others of which perhaps the life-history has been most completely and satisfactorily worked out. Now the life-history of this organism is divisible into two parts—(1) the *bacillar* stage, and (2) the *spore*, or oviform stage. It has long been known that the vitality of micro-organisms is very different according as they exist in one of these stages or the other; in point of fact, that the spore is enormously more refractory than the bacillus. Thus the spores of anthrax can be exposed without injury to all manner of conditions of temperature, of desicca-

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* "On the Multiplication of Micro-organisms." Proceedings Royal Society. 1886.

tion, of antiseptic action and the like which would be rapidly fatal to the bacilli of anthrax. Under ordinary circumstances, when anthrax grows in any cultivating medium, it is present in both the bacillar and in the spore form, and it is only when the organism is taken immediately from the blood or tissues of an animal dead of anthrax that the bacillus is with certainty obtained free from spores. It is, therefore, the practice, in making experiments in which it is desired to employ an absolutely sporeless growth of anthrax, to take portions of the blood or tissues of an animal freshly dead of this disease.

Bearing these facts in mind, therefore, it is obvious that in conducting any experiments on the vitality of this microbe in water it is altogether essential that we should employ the organism in its spore-form if any conclusions are to be drawn as to the power of water to act as a carrier of this disease.

The experiments which I have made in this direction have, therefore, been conducted with cultivations of anthrax in which spores were abundantly present. From such a cultivation (agar-agar) a small quantity, about the size of a drop, was taken on a sterilised platinum needle and introduced into 50cc. of sterilised distilled water contained in a small sterilised stoppered bottle. The bottle and its contents were then thoroughly agitated, and from it two cubic centimetres were taken out in a sterilised pipette and introduced into 1500cc. of sterilised London sewage, Grand Junction water, and distilled water respectively. The inoculated waters were thoroughly agitated and then three small sterilised flasks were partially filled with each, so that there were nine smaller samples, three of which contained infected sewage, three infected Grand Junction water, and three infected distilled water. Each of these flasks was of course immediately plugged with sterile cotton wool.

Now assuming that 1cc. = 20 drops, it will be seen that in preparing the first attenuation in the stoppered bottle the original cultivation was diluted $50 \times 20 = 1000$ times, and in inoculating this attenuation into the waters themselves a further dilution of $\frac{1500}{2} = 750$ took place, so that the total dilution effected amounted to no less than $1000 \times 750 = 750{,}000$. In other words, the infected waters contained only one part of the original cultivation in 750,000 parts of water. From these smaller flasks, at the intervals of time given below, gelatine plates were then prepared in the ordinary way, with all the customary precautions.

The results of these experiments are recorded in the table on next column.

Thus in the distilled water, in all three experiments, the number of developable anthrax organisms remained practically the same during the period of 61 days over which the observations were extended. There can be no doubt, therefore, that the spores of anthrax are wholly unaffected by this long residence even in distilled water. They obviously undergo no development—no numerical multiplication in this medium; but their vitality is unchanged, and they have only to be introduced into the ordinary cultivating media in order to display their usual activity and exhibit their characteristic appearances of growth.

In the Grand Junction water, of which the chemical composition is given below,* the phenomena were somewhat different, as in the course of the first five days after inoculation a perceptible diminution in the number of developable anthrax organisms took place, after which the number remained practically stationary as in the case of the distilled water. The explanation of this is not difficult to find. In the case

NUMBER OF COLONIES OBTAINED FROM 1cc. OF INFECTED WATER.

	First Hour after infection.	2nd Day.	5th Day.	14th Day	21st Day	4[illegible]th Day.	61st Day.
ANTHRAX.							
Distilled Water.							
No. 1.	69	72	53	70	—	67 Contaminated with mould	110
No. 2.	65	65	53	80	—	89	36
No. 3.	106	67	87	63	—	88	100
Grand Junction Water.							
No. 1.	310	270	67	81	—	75	100
No. 2.	530	175	41	95	—	67 Largely contaminated with small smooth rimmed colony	88
No. 3.	192	187	54	68	—	89	121
London Sewage.							
No. 1.	753	59	82	Much multiplied	2041	—	5543
No. 2.	108	240	111	198 Probably more	517	—	290
No. 3.	289	115	129	Contaminated	—	—	—
ERYSIPELAS MICROCOCCUS.							
Distilled Water.							
No. 1.	0	0	0	0	—	—	—
No. 2.	0	0	0	0	—	—	—
No. 3.	0	0	0	0	—	—	—
Grand Junction Water.							
No. 1.	13	34	0	0	—	—	—
No. 2.	37	55	1	0	—	—	—
No. 3.	80	37	2	0	—	—	—
London Sewage.							
No. 1.	103	7	0	0	—	—	—
No. 2.	179	5	0	0	†	—	—
No. 3.	68	12	0	0	—	—	—

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* Grand Junction Water.—*Results of Analysis expressed in Parts per* 100 000:—Total solid residue, 26·00; organic carbon, 0·299; organic nitrogen, 0·059; ammonia, 0; nitrogen as nitrates and nitrites, 0·256; total combined nitrogen, 0·315; chlorine, 1·6; hardness, 18·0.

† On this day plates were prepared from the *first* attenuation of the erysipelas micrococcus, but were found quite sterile.

of the distilled water, doubtless all the organisms which cultivation, within even the first hour, revealed were spores, the anthrax bacilli perishing, as we know, so rapidly in this medium; whilst in the case of the Grand Junction water the anthrax bacilli required several days before their vitality was wholly extinguished, and it is not until the fifth day that the numbers recorded are due wholly to the residual spores which, as in the case of the distilled water, remain practically unaffected for the remainder of the time over which the observations were continued.

The experiments with the sewage again present further differences: the diminution in the course of the first few days is less marked than in the Grand Junction water, but subsequently a very decided multiplication takes place, clearly showing that in this medium the anthrax organism is not only able to preserve its vitality in the spore form, but that it is also capable of finding in it the means whereby to exercise the functions of nutrition and reproduction.

It is thus obvious that ordinary drinking water, even should it be practically as pure as distilled water, is capable of acting as the carrier of the virus of anthrax, and that sewage may not only act as the carrier, but forms a suitable medium for the growth and multiplication of this pathogenic microbe.

I should remark that these results are in precise accord with those obtained by Meade Bolton in the Hygienic Institute of Göttingen, who, in similarly conducted experiments, found that whilst the bacilli of anthrax became extinct between the third and sixth days, their spores remained unaffected for practically an indefinite time (many weeks) even in distilled water.

I will now turn to the last pathogenic organism with which I have experimented—viz., the *micrococcus of erysipelas*. The distilled water, Grand Junction water, and sewage employed in these experiments were the same as those used in the anthrax experiments, and the method of inoculation was essentially the same as that already described, excepting that the degree of dilution was not quite as great. The erysipelas organism was taken from a broth cultivation, the final dilution amounting to 75,000 times. As in the case of the anthrax experiments, the waters were preserved at about 20° C., or rather under. The results obtained are recorded above.

The results of these experiments, which were carried on simultaneously with those with anthrax, present a very striking contrast to the latter. Thus, even within one hour of infection, the micrococci of erysipelas could not be demonstrated in the distilled water, whilst in the sewage they were still demonstrable on the second day, and in the Grand Junction water, in two out of the three flasks on the fifth day, but not afterwards. In fact, so slight is the vitality of this organism in these dilute media that on the 21st day it was no longer demonstrable even in the first attenuation, in which the original broth culture was diluted about 100 times with distilled water.

It is of interest to compare with this behaviour of the erysipelas micrococcus the behaviour under similar circumstances of the other pathogenic micrococci which have been submitted to investigation in this respect. Meade Bolton has made similar experiments with the *staphylococcus pyogenes aureus*, and with the *micrococcus tetragenus*. The former of these is the commonest generator of suppuration, having been found in about 71 per cent. of all the abscesses which have been submitted to careful bacteriological examination. The M. tetragenus, on the other hand, is an organism found in the caverns of phtisical patients; it is not known to be pathogenic to man, but is highly pathogenic to mice. Now experiments with the staphylococcus pyogenes have shown that this organism was no longer demonstrable in distilled and in ordinary drinking water after the 20th to 30th day, whilst the micrococcus tetragenus when placed in similar water could not be detected on the 2nd to 4th day.

I have lastly to refer briefly to those experiments which have been made with the organism which is with very considerable probability regarded as the cause of typhoid fever. This organism, like anthrax, is known in two distinct forms, the bacillus and the spore. Owing to the different powers of resistance possessed by these forms, we find the typhoid organism exhibiting a very similar behaviour in water to that which we have already noticed in the case of anthrax. Thus we find the typhoid bacilli are less persistent in water than the spores, although even the bacilli were not destroyed by remaining 10 to 14 days in distilled water, and the spores, of course, are quite unaffected by an immersion of even much longer duration.

There is yet another point upon which a few words must be said, and that is as regards the influence which is exerted upon these pathogenic organisms by the non-pathogenic forms commonly present in water. Very little has yet been done in this direction, and in point of fact the enquiry is attended with considerable technical difficulties. There is, however, a very prevalent impression that the permanence of these pathogenic forms is much reduced by the simultaneous presence of non-pathogenic or saprophytic forms, which flourish in water. The evidence of this crowding out by the saprophytic forms is, however, far from convincing, and there are many facts which can be adduced and which tend to show that this destruction of pathogenic forms by saprophytic ones has been much exaggerated. Thus, in several of my experiments, the pathogenic organisms have been persistent in the presence of saprophytic forms which have accidentally gained access during the numerous exposures of the flasks in taking out portions for cultivation. Thus, the comma spirilla, which had retained their vitality for 11 months, were present, in company with countless numbers of a micrococcus which had accidentally gained access. Similarly in the anthrax experiments in two or three cases saprophytic forms were present at the same time.

There can be no doubt that in many cases it has been erroneously supposed that the pathogenic forms have been suppressed by the saprophytic, in consequence of the great difficulty attending the recognition of comparatively few of the former in the presence of large numbers of the non-pathogenic. Again, in many cases, no doubt, the experiments have been interrupted too soon, and an erroneous conclusion has been arrived at in consequence, which would have been avoided if the competition between the various forms had been permitted to continue longer. Thus it was formerly supposed that the comma spirilla possessed but little power of competing with the ordinary putrefaction bacteria, and that if a cultivation of comma spirilla became contaminated with putrefaction bacteria the latter soon altogether suppressed the comma spirilla. Quite recently, however, it has been shown by Gruber* that, although the putrefaction bacteria gain an enormous numerical ascendancy over the comma spirilla for some time, yet the vitality of the latter is by no means extinguished, and that if the struggle between the two is sufficiently protracted, until the process of putrefaction is less active, the presence of the comma spirilla can be again readily demonstrated by cultivation.

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* *Gruber*, Wiener medicinische Wochenschrift, 1887, No. 7 & 8.

It is necessary, therefore, to exercise considerable caution in judging upon this point in the present state of our knowledge, and it would be highly premature to place too much reliance upon this alleged destruction of pathogenic forms by non-pathogenic ones.

The various investigations which we have considered this evening have many very obvious bearings on the practical aspects of water supply and general sanitation.

In the first place we learn, as I have before pointed out, that the ordinary process of treatment by storage, sand filtration, etc., produces a far more marked effect on the biological than on the chemical properties of the water. Moreover, that the differences in the mode of treatment as practised for the various branches of the Metropolitan river supply result in the attainment of different degrees of efficiency in the removal of micro-organisms, which render it highly desirable that the individual details of these processes should be systematically investigated, with a view to bringing the several factors of treatment to the highest state of practical perfection.

As regards filtration on the small scale, we learn that most of the filters at present in use are, from a biological point of view, highly inefficient, or even worse than inefficient, and that it is extremely important that the private householder should be made fully aware of what is the real value of these professed guardians of our domestic health.

Again, the experiments made on the vitality of pathogenic micro-organisms in water, show that whilst ordinary drinking-water does not form a suitable medium for their extensive growth and multiplication, and that in some cases these forms may undergo more rapid destruction than was formerly supposed, yet, that in the condition of spores, they are extremely permanent in any kind of water, however pure, and that even those of which no spores are known may often be preserved for days or even weeks. We have thus no difficulty in now understanding both how zymotic poisons can be carried by water, as well as how in some cases water known to have been infected has failed to communicate disease.

We have seen that the behaviour of the various pathogenic microbes already experimented with is by no means uniform, and the fallacy of generalising from the results obtained in the case of a single form must be sufficiently apparent. It is essential that the results obtained with any particular organisms should only be made use of in drawing conclusions concerning the particular disease with which it is associated. It is, moreover, of the utmost importance that the great difference in vitality exhibited by bacilli and spores respectively should be most clearly kept in mind, and that in the case of those organisms which are known to exist in both forms, no legitimate conclusions of any practical value can possibly be drawn from the behaviour of the baccilli alone.

Finally we learn that ordinary sewage forms a suitable medium not only for the indefinite preservation of some pathogenic micro-organisms, but also, in some cases, for their rapid growth and multiplication.

DISCUSSION.

The Chairman said the members present must all feel the great importance of the researches which had been so lucidly laid before them. In this, as in every new branch of science, it was of course possible to make a wrong use of the knowledge acquired: to be over frightened on the one hand, or over confident on the other; but no one who had followed these researches carefully could fail to be impressed by the immense strides which knowledge had made in this direction. It might be said that a vast number of organisms might be present in water, and yet do no more harm to man than did the small organisms to the whale that lived on them. But though certain microbes might be harmless, the study of them was part of the great question of sanitation. An offensive smell might not do any serious immediate harm indeed, if offensive smells were fatal, a good many villages in England and towns in Italy would soon be devoid of inhabitants; but ordinary experience showed that a bad smell was generally a warning of some more serious danger which required to be grappled with. If we could remove 99 per cent. of the organisms present in water, it was clear that the chance of the pathogenic one surviving was much diminished. No doubt in the near future we should learn more of the real dangers and safeguards: at present we could but recognise the great value of the results obtained, and the immense importance of continuing those researches.

Mr. Gustav Bischof said it was of course understood that Dr. P. Frankland's paper was based on the assumed efficiency of Dr. Koch's gelatine test. He fully admitted that the rapidity and ease with which results were obtained by the test, the uniformity of those results in parallel experiments, and the nicety of the whole apparatus, formed a great fascination to the experimentalist. All the same, he was expressing not only his own opinion, but that of very weighty bacteriologists, when he entirely disputed that, so far, the efficiency of the test had been proved. In the first place, it was obvious that only those microphytes were cultivated by Dr. Koch's test which could be cultivated under any conditions whatever in gelatine-peptone; Dr. Klein had told them a number of pathogenic and other microphytes absolutely refused to be cultivated in that medium. Next, a great many pathogenic microphytes required for culture a temperature much higher than was possible in following the ordinary test; some requiring as much as 38°C. Time would not permit him to go further into details on that point. Next, Dr. Klein and others had told them that a great many microphytes required weeks—some even months—for their full development. Nevertheless, with the gelatine test observation ceased as a rule about the third day, when the liquifying colonies had developed to such an extent as to render thereafter distinction of colonies impossible. Therefore, we were left in ignorance of what might have taken place in a sample after that period. He thought he had said sufficient to show that there was great doubt as to the reliability of Dr. Koch's test. Then as to the number of colonies, Dr. Klein had referred to a case in which another method indicated as many as 150,000 colonies, while Dr. Koch's test indicated only 5000. And this was what Dr. Percy Frankland called "determination with very considerable quantitative accuracy"—indicating 3 per cent. He could not agree with Dr. Frankland that the teaching of the test rested on a satisfactory basis, if, as admitted by him, no inference could be drawn from the number of colonies as to the wholesomeness of water. Wholesomeness was the object of testing potable water, but under the circumstances, of two samples of water, the one which contained the greater number might even be the more wholesome. Dr. Frankland had repeated on this occasion an assertion which he had made before—viz., that although he did not draw any inference as to the greater or lesser wholesomeness of water before and after a treatment from the difference in the number of colonies, yet that the fact of the reduction of microphytes by a certain percentage admitted of the conclusion that any pathogenic microphytes present would be similarly reduced: and that therefore the danger of infection from them, should they accidentally have gained access to the water, would be correspondingly lessened. He had argued, moreover, some time ago, that neither in respect of size, nor form, nor habits, could pathogenic organisms be sharply distinguished from non-pathogenic organisms. Dr. Koch had, however, distinguished between different organisms, for he had written: "These bacteria, which I have called *Comma Bacilli* on account of their peculiar shape, are smaller than the tubercle bacilli." Was there no difference of size or form there? For all we knew, pathogenic microphytes might exist infinitely more minute than any micro-organisms as yet isolated. Then as to habits. If pathogenic microphytes differed essentially in the temperature, the medium, and the length of time they required for development, surely it could not be said that there was no difference in their habits. Dr. Frankland had himself said in another place that it was highly misleading to apply the results obtained with one set of organisms to the case of another set. Passing now to the pathogenic experiments, he doubted whether any inference could be drawn from the result of infecting a sterilised water with one particular pathogenic microphyte as to what would have taken place if an ordinary natural water were infected with the same microphytes. He could not share Dr. Frankland's doubts as to the effect of crowding out. He would again quote Dr. Klein, who had said he would prepare a sample of water, infected by a dozen pathogenic microphytes, state the names of those microphytes, so that it might be known what to look for, and in nine cases out of ten no one would be able to recognise any given form. With regard to the results of filtration experiments shown on the large diagram before them, he would like to know how it was supposed that the sand acted in retaining microbes—was it a purely mechanical action? If so, then these tabulated results contradicted well-established biological facts, or, if one preferred to put it that way, were contradicted by well-established biological facts. These sand filters were permeated month after month and year after year by water containing a greater or lesser number of colonies. Now, what happened if one took a sample of water containing even only a few microphytes, and stored that water in a sterilised flask protected against any possibility of contamination? Dr. Frankland and himself were agreed that the result was an enormous multiplication of the microphytes. If the microphytes were simply retained in the sand, how was it that no multiplication took place there? He had no hesitation, therefore, in saying that there must be an error somewhere. Again, the percentage reduction tables were entirely misleading. Supposing he had a sample of filtered water containing 100 microphytes, a 90 per cent. reduction would be shown if the unfiltered water contained 1,000 colonies, and 99 per cent. if it contained 10,000. The worse the unfiltered water, the better the showing of the percentage reduction; but after all, one sample of water containing 100 colonies, as far as the numbers of colonies go, was no worse than another containing the same number. He would like to call attention to certain experiments, made, he admitted, before Dr. Koch's method was known, and before many considerable improvements had taken place in the construction of sand filters. Dr. Burdon-Sanderson had experimented on the Metropolitan water supply, with the result that he found that the average "zymotic property" of water was not in any appreciable degree affected by sand filtration. Perhaps something had happened since to alter the conditions; but it was remarkable that a man like Dr. Burdon-Sanderson should have published such statement in an official report in 1870, and that now everything should be quite the reverse. There was a question he would like Dr. Frankland to answer. He had spoken of the large number of microphytes in certain months as the result of the filters being overtaxed. He hoped that this would bring out Dr. Frankland's opinion as to whether the sand exercised a purely mechanical action or not; because if the action were purely mechanical, then the overtaxing would be in direct contradiction to all experience. Every chemist knew that the longer filtration was continued through a filter the more complete was the separation of suspended matter, though of course the yield was reduced; and it was equally well known that with certain precipitates the filtrate had to be returned again and again on to the filter before all suspended matter was retained. With respect to the domestic filter experiments he would say very little. It was remarkable that the results given that evening by Dr. Frankland did not at all agree with those which the same author communicated to the Society last year, when, for instance, in the case of spongy iron, he (Dr. Frankland) had found that after one month's action a water containing 1280 organisms per cc. gave a filtrate containing only 2 organisms per cc., or, as this was within the limit of error of the test, Dr. Frankland found last year that filtration by spongy iron after one month's action gave a sterile water. Nothing had been said as to the conditions under which the experiments were made by Dr. Plagge, and everything depended on that. It was easy to obtain in any such experiment a large number of microphytes; for instance, if one took an ordinary filter with a big reservoir at the bottom, of course multiplication would take place in the water standing in the reservoir. He would say only a few words about the only filters which Dr. Frankland represented as efficient, viz: Pasteur's filter tubes, and the asbestos filters. It was not possible to manufacture these filters absolutely uniformly; hence some would transmit microphytes freely, others be so close in grain as even not to let water pass through. It was, however, quite true that these filters frequently yielded sterile water, but again it was equally true—and he had this from Dr. Koch's own lips—that microphytes very soon grew through the filter tubes, and he might add also through the asbestos filters, when a larger number of colonies might be indicated in the filtered than in the unfiltered sample. One was thus placed in the awkward position of not having a single really trustworthy filter left, if Dr. Frankland's latest conclusions were accepted.

Mr. C. T. Kingzett said this was a most interesting and instructive paper; at the same time, he thought that some of Dr. Frankland's assumptions were not free from danger. In the first place he had drawn too hard and fast a line between pathogenic and non-pathogenic organisms. Many years ago Panum had found (and his results were afterwards confirmed by Burdon-Sanderson) that micro-organisms which were not ordinarily considered pathogenic would, under favourable conditions, produce substances which were poisonous to animals. For instance, sepsin had been thus formed, and sepsin was a body which had considerable toxic effect upon animals. Therefore it was not fair to say that such organisms were not pathogenic to a certain extent. It was too often assumed that microbes had but one mode of life, for instance that the cells of yeast could only live in solutions of sugar, and produce alcohol—in brief, that they could only perform one particular fermentation. But that idea was quite erroneous. The action of the microbes depended upon the mediums into which they were introduced; and if the mediums were changed, the products would necessarily change also. This was not a matter of mere speculation, but had been experimentally demonstrated by him (Mr. Kingzett). It was even conceivable that the *bacillus subtilis* should produce effects corresponding to the *bacillus anthracis* (from which it could hardly be distinguished under the miscroscope) if acting under the same conditions. He did not like to hear any investigator assuming that which passed beyond the limit of ascertained fact. Dr. Frankland had averred, that the organism associated with erysipelas had been proved to be the cause of that disease, and that Koch's *comma bacillus* was the real cause of cholera. He was tolerably well acquainted with the literature of this subject, and he disputed that statement; the assumed connection was in each case a pure matter of influence upon grounds that were open to much criticism. It was true that these micro-organisms had been found associated with the particular disease; there was no absolute proof that they constituted the real causes of the diseases, and as to Koch's *comma bacillus*, it was to be found under many circumstances where there was no question of disease existent. With respect to the inoculation of different waters with the *Anthrax* spores, Dr. Frankland had admitted that in the case No. 3, the experiment had failed through the accidental introduction of other spores on the removal of the stopper. If that was so, how could he be sure, in those other cases where the number had multiplied to a great extent after the first few days, that at some intermediate stage other organisms had not been admitted—especially as dilute sewage was one of the best mediums, not alone for *anthrax* spores, but also for many of the germs which were generally found floating in the atmosphere, and all of which had the power, in common with the *bacillus anthracis*, of liquefying this particular gelatine test. And this led him to a fourth point, which was—had Dr. Frankland proved that the forms which had liquified the test were the spores of the *bacillus anthracis* or not? Apparently he had been satisfied with a microscopical examination, but even if that could be relied upon, it would leave unsettled the doubt that they had been introduced from the atmosphere of the laboratory in the way that he had suggested.

Mr. Johnson suggested that the table representing the effect of filtration upon the water of the different companies would have been improved by the addition of figures representing the rainfall during each month. It had recently come to his knowledge that the month of April, which was proverbially the rainiest month, had for ten years past been one of the driest, and that July had been one of the wettest. Therefore the theory that surface water contamination was the source of impurities seemed to be contradicted. It was more likely that the organic impurities naturally formed by the decay of vegetation would account for the results found by Dr. Frankland. With regard to the experiments on the cultivation of pathogenic germs in drinking water, he questioned whether the quality of the water was not materially altered by the means employed to render it sterile. He did not know what those means were, but if they consisted in raising the temperature, it suggested the possibility that the albumenoid matters which formed the pabulum in which those bodies grew might be readily coagulated by the heat. He thought that the manner in which Dr. Frankland's statements had been received by the members, and the striking concordances elicited, dispelled altogether the idea that his results were not reliable.

In reply, Dr. Percy Frankland said he regretted that Mr. Bischof had spoken in the names of others rather than of himself. He regretted, too, that Dr. Klein was not present, because the greater part of Mr. Bischof's remarks professed to have his authority; and thus in disputing Mr. Bischof's statements he would be brought indirectly into antagonism with Dr. Klein. With regard to the idea that these tests were of no value for forming an opinion as to the number of organisms in water, it occurred to him that their value could be best illustrated by a comparison. Let it be supposed that one had a test for white-faced people, and suppose that this test was applied to the inhabitants of London, and it indicated only the white population: now, although one would undoubtedly miss in such a census of the Metropolis all the coloured inhabitants, yet the absolute result would not materially differ from the correct census taken by the Registrar-General. Similarly, in the case of these waters, what was the probability of any large proportion of those particular and comparatively rare organisms being present which could not be revealed by gelatine culture? Was it likely, for instance, that a sensible percentage of the microbes in Thames water should be tubercle bacilli, which it was quite true could not be cultivated on gelatine? He had no hesitation in saying that the number of organisms of this kind in water must be quite insignificant compared with those which were revealed by gelatine cultivation. It was most necessary to bear in mind that practically all the greater discoveries which had been made in bacteriology during the past few years had been achieved by means of these methods of Dr. Koch's, and that it was almost impossible to overestimate their value. He did not say that the test was perfect, but it was undoubtedly by far the best at present known. With regard to the particular example which Mr. Bischof had brought forward, the case of 150,000 colonies shown by one method against 5000 colonies revealed by the gelatine test, he had often heard that statement before, but always from Mr. Bischof only, and never from Dr. Klein. Dr. Klein had never published that statement in any paper of his own, and had he been present he would like to have asked him by what method that result had been arrived at. There were only two methods in use for arriving at the number of organisms present in any sample of water or other liquid—viz., the method by plate cultivation and the method of Fol and Dunant. By the latter method a certain quantity of water was divided into, say, 50 equal parts, and each part was then put into a tube of sterile broth. The number of organisms present was then deduced from the number of these broth-tubes, which, on incubation, developed organisms, and it was necessary, therefore, to so arrange the experiment that only a portion of the whole number of tubes became infected. Thus if 1cc. of the water in question was distributed through 50 broth-tubes, and of these 10 subsequently developed organisms, it would be assumed that the water contained 10 organisms in 1cc. He (Dr. Frankland) had fully discussed this method in another place (*Journal of the Society of Arts*), and he had shown that it was not only intolerably cumbrous and inconvenient, but was liable to lead to hopelessly erroneous results. With each of these fifty tubes one ran the risk of aërial contamination through fifty exposures to the air. The chances of error were therefore very considerable. In Dr. Klein's laboratory the chances of contamination were found to be so great that he (Dr. Klein) could not perform the operation in the ordinary way by opening the tubes at all, but had to introduce a sterilised pipette down the side of the wool. A series of experiments had recently been made in the Hygienic Institute of Göttingen on the results obtained by this method and by the gelatine method, and in those cases where the Fol and Dunant method yielded trustworthy results they agreed fairly well with the gelatine method. Referring again to this particular experiment mentioned by Mr. Bischof, he would observe that it was only quite recently that one had become aware of the fact that the microphytes in ordinary water often underwent enormous multiplication in a comparatively short time. It was quite unknown at the time that Dr. Burdon-Sanderson's experiments were made, and he had little doubt that it was unknown when this experiment with the 150,000 colonies was made. Numerical experiments of that period must be regarded with great suspicion; and he felt certain that the authors of these experiments would not wish them to be now utilised as they had been by Mr. Bischof. However, even assuming that the gelatine test did not reveal more than a comparatively small fraction of the total number of organisms, its value in estimating the efficiency of filtration was by no means impaired, because the same test being applied to the water before and after filtration, the differential result obtained clearly indicated what was the effect of the filtering process on those organisms which gelatine cultivation reveals. There could, moreover, be no doubt that the process of filtration would deal in just the same manner with any micro-organisms, whether the latter were developable in gelatine or not. Thus the suggestion made by Mr. Bischof that there was some intrinsic difference in size between pathogenic and non-pathogenic organisms was wholly contrary to fact, and the quotation from the writings of Dr. Koch was quite irrelevant and misapplied. Thus Dr. Koch, in describing his *comma bacillus*, wished to give some general idea of its size, and so, instead of saying that it was so many micromillimetres long, etc., he said "it is rather smaller than the *tuberculosis bacillus*;" and from this Mr. Bischof wished it to be understood that Dr. Koch had said that there was a great difference in the size of pathogenic and non-pathogenic organisms! In reply to what Mr. Kingzett had said about the micrococcus of erysipelas, he could only say that Mr. Kingzett was in error in supposing that the evidence as to this micrococcus being the real cause of erysipelas was incomplete. The action of this organism had been perhaps more fully established than that of any other. It had been the practice of some surgeons to artificially produce erysipelas in patients who were suffering from certain forms of cancer, and instead of using virus directly from another patient suffering from erysipelas the disease had by Fehleisen been produced by inoculating carefully prepared pure cultivation of the micrococcus in question. With regard to Mr. Kingzett's criticism of the *anthrax* experiments, and his doubt whether the multiplication indicated in the table was due to the *anthrax* organisms or to some other organisms accidentally introduced, he could say that all the numbers put down in the table were the numbers of undoubted *anthrax* colonies. It was exceedingly easy to distinguish them. The other organisms which had gained access were in the one case a mould, and in the other case a micrococcus, which also formed a totally different colony. With regard to Mr. Johnson's suggestion as to the rainfall being introduced into the tables, that would be a great advantage if these samples were really representative samples of the month, but that unfortunately was not the case. He had only taken one sample per month, and in a month which on the whole might be a dry one the particular sample might have been collected at a rainy time, and *vice versa*. One would have to multiply the number of experiments enormously to give a really average result for each month. As a general rule, however, the river was in flood in January and in the winter months, and comparatively free from flood in July and throughout the greater part of the summer. He must admit that the experiments on the vitality of organisms would be more satisfactory if they could be conducted in unsterilised water; but that would enormously increase the difficulty of the experiments, if indeed it did not render them impossible. Such experiments had been tried by some people, but the results obtained were highly misleading. For the present he thought they could only make use of the results with the sterilised water, and these already established some very important points connected with the vitality of pathogenic micro-organisms in water.

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NOTE ON THE ACTION OF ZINC CHLORIDE ON CASTOR OIL.

BY C. R. ALDER WRIGHT, D.SC., F.R.S.

CASTOR OIL has, as is well known, a somewhat peculiar constitution as compared with other oils and fats. Whilst, like these, it is a threefold ether of ordinary glycerol, the acid radical present is of a character different from that of palmitic, stearic, oleic, linoleic acids, etc., in that it contains more oxygen; so that the various acids of oils and fats may be distinguished as belonging to the several families—

$C_nH_{2n}O_2$	—*e.g.*,	Stearic acid $C_{18}H_{36}O_2$: Palmitic acid $C_{16}H_{32}O_2$.
$C_nH_{2n-2}O_2$	,,	Oleic acid $C_{18}H_{34}O_2$.
$C_nH_{2n-4}O_2$	,,	Linoleic acid $C_{18}H_{32}O_2$ (according to earlier experiments, $C_{16}H_{28}O_2$).
$C_nH_{2n-2}O_3$	,,	Ricinoleic acid $C_{18}H_{34}O_3$.

Accordingly, the glyceride of ricinoleic acid (the main constituent of castor oil) differs in numerous physical and chemical characters from the glycerides of the other commonly-occurring fatty oils and acids, more particularly in its specific gravity and solubility in alcohol and other menstrua. Inasmuch, however, as ricinoleic acid belongs (like oleic and linoleic acids) to the series of non-saturated substances, therein differing from stearic acid and its homologues, it possesses, in common with the former, the property of becoming polymerised by contact with certain agents—of which nitrous acid or materials generating it is one of the best known—and thereby altered in physical condition to an extent depending somewhat on the nature of the polymerising agent, and the extent and duration of its action, etc.

Whilst experimenting in conjunction with Dr. Alexander Muirhead upon actions of this class, it was observed that zinc chloride in concentrated solution, or as fused hydrated crystallised salt, possesses a most marked thickening and solidifying action upon certain oils, and more especially upon castor oil, so that under suitable conditions this latter is converted into a horny or gristly indurated mass, which, when freed from zinc chloride by thorough washing with water, is capable of various useful applications, more especially as an ingredient in mixtures intended as covering and insulating materials for electric leads, etc. According to the proportion of zinc chloride used and its concentration and the temperature employed, the degree of solidification and induration effected can be controlled at will, the consistency of the product varying from a somewhat thicker and more viscid or semi-solid oil up to a tough, leathery, cartilaginous mass, resembling rasped horn. The most effective treatment consists in evaporating down zinc chloride solution until the boiling-point rises to near 175° C., at which temperature the degree of hydration is not far from that corresponding with the formula $ZnCl_2,H_2O$. This concentrated fluid is then cooled to about 125°, and well intermixed by agitation with one-third its weight of castor oil at about the same temperature. The oil rapidly becomes converted into a thick clot, which separates from the fluid zinc chloride in lumps resembling bullocks' liver in appearance, but becoming a mass of nearly white cartilaginous shreds when digested with water and vigorously agitated therewith. The zinc chloride used is practically all recovered, the majority in the form of hot fluid separating spontaneously from the clot and ready for immediate use over again, and the remainder in the form of aqueous solution washed out from the clot and simply requiring evaporation down to the proper strength.

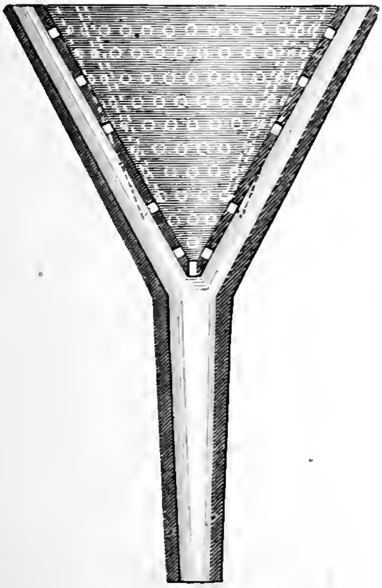
The cartilaginous shreds thus obtained differ much in their general physical character from the original unconverted castor oil, being practically insoluble in the various menstrua in which the latter dissolves. The glyceridic character, however, is not wholly destroyed; thus notable quantities of impure glycerol can be obtained by long-continued boiling with alcoholic potash of the shreds, previously completely freed from all traces of unconverted oil by repeated digestion with carbon disulphide.

◆

IMPROVED FILTERING FUNNELS.

BY B. NICKELS, F.C.S.

The usual devices for accelerating filtration are well known to chemists, but they all have the disadvantage of leaving certain parts of the filter paper without any support at the back, causing thereby a grave risk of breakage of the paper. Fig. 1 represents a double funnel, the inner attached to the outer by means of suitable "ribs" or "projections" placed at intervals. The inner funnel is perforated with holes in a downward direction. Fig. 3 is similar to Fig. 1, with the exception that the space between the two funnels at the top is closed, with a stop-cock for admission of air, and for cleaning purposes. Ordinary filtration with these funnels is greatly quickened, as the filtrate has a free exit through all the perforations. It is frequently desirable to wash the back of a filter paper; but this is risky, and always unsatisfactory. With the improved filter, however, it is only necessary to attach a piece of tube, with a stop-cock, to the bottom of the funnel, and when the filtrate has drained away, to close the cock and fill the jacket with the water or other wash liquor, which immediately makes its way, through the holes, to the *back* of the filter paper, quickly and thoroughly washing the same. Fig. 3 is for use in connection with aspirator water or other pump: the usual hollow platinum cone is unnecessary: the perforations in the inner funnel, being very small but numerous, admit of a high vacuum being employed without risk of breaking the paper, and filtration is conducted with very great rapidity. Dialysing, as usually conducted, is troublesome, owing to the difficulty of making a tight joint with the parchment paper to the proof containing the liquid to be dialysed. All that is necessary with this funnel is to attach a tube and stop-cock to the end, and place a piece of parchment paper folded as a filter paper in the inner funnel, but projecting about one inch above the top. The liquid to be dialysed is placed therein, and the jacket filled with distilled water, which may be drawn off as it becomes charged with the products of diffusion, and replaced by a fresh supply. The quantity of water is thus minimised, which is an important feature in this operation. The funnel is well adapted for filtration of volatile liquids, and may supersede the somewhat complicated apparatus usually employed. The funnel is placed through a cork, and tightly inserted into a vessel to receive the filtrate. The filter paper having been inserted in the usual manner, the liquid to be filtered is poured therein in the ordinary way, and the *whole top of the funnel* covered with a disc of ground glass, underneath which may be placed a disc of indiarubber, if the joint is not tight enough. As the filtrate enters the vessel, the displaced air finds its way to the top of the funnel jacket, and entering the inner funnel through the holes, causes filtration to proceed without cessation or loss of volatile liquid filtrate.



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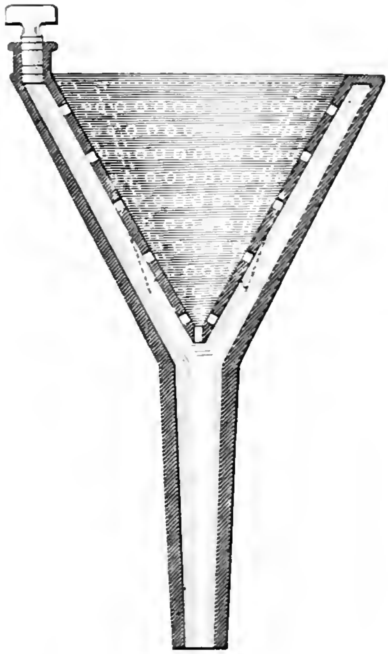

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◆

ON MOISTURE AND FREE ACID IN SUPERPHOSPHATES AND SIMILAR FERTILISERS.

BY JOHN RUFFLE, M.R.A.C., F.I.C., ETC.

Moisture in superphosphates is usually determined by exposing a weighed portion to 212° F., cooling, reweighing, and the loss found considered as moisture, and so stated in all analysis. A suspicion, however, exists in the minds of some chemists that if left too long at 212° F., some of the water of combination may be driven off, and so the result be stated too high; and commonly a limit of about one and a half to two hours is accepted as the time to leave the portion at 212° F. Some operators put the portion into the water-oven and leave it overnight; this has apparently one merit—*i.e.*, that the total loss of 212° F. is then constant, and any error be a constant one, but whether such be an error or no, no one knows.

In preparing a sample for analysis it is most usual to rub it into a paste with a pestle and mortar. Some chemists take a part of this paste and expose it to 212° F., whilst some take the manure in the natural state, but in neither case with any definite knowledge as to whether the pasting does or does not affect the result, and, if affecting it, then the degree is unknown. This article is therefore put forward as a contribution on the subject, and as an assistance towards a satisfactory method of dealing with a vexatious question as yet unattacked.

Some samples of ordinary superphosphates were selected from large heaps and maintained at various temperatures until practically constant, the loss noted, and the soluble and total P_2O_5 estimated before and after drying.

CAROLINA SUPERPHOSPHATE.

	100–120° F.	160–180° F.	212° F.	300° F.
Loss..................	12·92	15·42	16·10	17·93
Soluble P_2O_5, theory	15·74	16·20	16·34	16·70
,, ,, found	15·02	15·11	14·45	10·26
,, ,, loss	0·72	1·09	1·89	6·44
Total ,, theory	16·25	16·72	16·86	17·24
,, ,, found	16·19	16·52	16·63	17·10
,, ,, loss	0·06	0·20	0·23	0·14

SOMBRERO SUPERPHOSPHATE.

	100–120° F.	160–180° F.	212° F.	300° F.
Loss..................	11·96	11·20	15·50	17·62
Soluble P_2O_5, theory	20·17	20·69	21·01	21·55
,, ,, found	19·90	20·07	19·50	11·20
,, ,, loss	0·27	0·62	1·51	7·35
Total ,, theory	20·13	20·96	21·29	21·80
,, ,, found	20·43	20·85	20·69	20·92*
,, ,, loss	—	0·11	0·60	0·88

The above results show that the soluble P_2O_5 is affected as the temperature rises, and that even the total P_2O_5 is affected in a minor degree. Some superphosphate was therefore dried without rise of temperature over oil of vitriol under a bell glass till constant.

	Carolina Super. over H_2SO_4.	Sombrero Super. over H_2SO_4.
Loss	14·84	13·56
Soluble P_2O_5, theory	16·09	20·54
,, ,, found	16·04	20·47
Total ,, theory	16·61	20·81
,, ,, found	16·61	20·90

These results show that drying a superphosphate without rise of temperature does not affect the soluble nor total P_2O_5. Such drying over H_2SO_4 was, however, too tedious, occupying about fifteen to eighteen days.

The operation at 212° F. was again tried to see if some stated period could not be found at which the result could be accepted. (See tables on top of next page.)

In their natural state these superphosphates contained—

	Carolina.		Sombrero.
Soluble P_2O_5..........	13·71	....	17·76
Insoluble ,, ...	0·44	....	0·23
	14·15		17·99

The figures show that a drying of from five to seven hours was necessary to arrive at anything like constant results, and that from a quarter of an hour upwards the soluble P_2O_5 was affected, and no period was discernible at which the result could be finally accepted.

Some portions of superphosphate from large stocks in heap were then dried at 212° F. in the natural state, and also after beating up in pestle and mortar, giving results as below:—

	Carolina Superphosphate.		Sombrero Superphosphate	
	Natural State.	Beaten up.	Natural State.	Beaten up.
½ hour ..	18·51	7·27	17·44	7·76
1 ,, ..	18·68	8·24	17·45	11·0
2 ,, ..	18·73	10·17	17·68	13·63
3 ,, ..	—	11·11	17·89	14·73
4 ,, ..	—	13·33	17·87	15·88
5 ,, ..	—	—	—	16·57

It is evident here that the "natural state" or "beaten up" vitally affects the loss at 212° F.

The loss at 212° F. being so unsatisfactory, it was desirable to show if it were all moisture or if including water of combination, and if so how much.

To help to clear this up some superphosphates were prepared of known composition, the raw materials analysed beforehand, the losses in mixing noted, and the products carefully weighed and preserved. These superphosphates were made from ordinary raw materials, and, from long experience with this class of compounds, and the agreement of the results obtained with these preparations in comparison with those obtained from superphosphates made on the usual wholesale scale, the writer has confidence in putting forward the results as reliable, and in accordance with the properties and behaviour of ordinary superphosphates.

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* 1·018grms. of this was fused with "fusion mixture," and the total P_2O_5 determined, obtaining 21·68 per cent. instead of 20·92 per cent., showing, therefore, that the total P_2O_5 had been affected, but was recoverable as ortho-phosphoric acid.

CAROLINA SUPERPHOSPHATE, EXPOSED TO 212° F. FOR VARIOUS PERIODS.

	¼ hour.	½ hour.	1 hour.	2 hours.	3 hours	4 hours.	5 hours.	7 hours.
Loss	—	9·97	12·85	13·89	15·52	16·03	17·68	17·15
Soluble P_2O_5 theory	—	15·22	15·73	15·92	16·22	16·32	—	16·54
„ „ found	—	15·06	15·52	15·72	15·62	15·66	—	15·31
„ „ loss	—	0·16	0·21	0·20	0·60	0·66	—	1·23

SOMBRERO SUPERPHOSPHATE, EXPOSED TO 212° F. FOR VARIOUS PERIODS.

	¼ hour.	½ hour.	1 hour.	2 hours.	3 hours.	4 hours.	5 hours.	7 hours.
Loss	13·27	14·80	14·95	15·12	15·09	15·25	—	15·96
Soluble P_2O_5 theory	20·47	20·81	20·88	20·92	20·91	20·95	—	21·13
„ „ found	20·12	19·91	19·97	19·97	19·80	19·91	—	19·55
„ „ loss	0·35	0·90	0·91	0·95	1·11	1·01	—	1·58

The loss in mixing was in each case accepted as due to carbonic acid and water. Of course, in some cases a little hydrofluosilicic acid was driven off, but any loss on this head was not enough to disturb the result, and any attempt to ascertain the loss due to this would have been unreliable.

Four superphosphates were prepared with Carolina, Sombrero, Spanish, and Curaçao phosphates respectively, and gave superphosphates in good, fair condition:—

COMPOSITION OF THE PREPARED SUPERPHOSPHATES.

	Carolina.			Sombrero.			Spanish.			Curaçao.		
Water	24·20			21·23			24·65			23·68		
Soluble P_2O_5	13·68			16·68			15·22			18·29		
Insoluble P_2O_5	0·15			0·73			0·73			0·06		
Lime	21·01	Needing.		23·64	Needing.		21·18	Needing.		25·05		
Sulphuric acid (SO_3)	26·40	SO_3	H_2O	27·59	SO_3	H_2O	26·61	SO_3	H_2O	30·16		
(¹) Soluble oxide of iron	0·25	0·12	0·25	0·10	0·14	0·10	0·15	0·22	0·15	—		
(²) „ alumina	0·13	0·69	0·40	0·10	0·23	0·31	0·06	0·14	0·18	—	Needing.	
(³) „ soda	0·26	0·33	0·75	0·22	0·28	0·63	0·10	0·16	0·29	—	SO_3	H_2O
(⁴) „ magnesia	0·05	0·10	0·15	0·30	0·60	0·94	0·30	0·69	0·94	0·51	1·02	1·60
Organic matter	0·10	1·54	1·55	0·61	1·35	1·98	0·01	1·21	1·56	0·31		
Undetermined matters	7·64			4·76			2·96			2·61		
Insoluble silicious matters	5·83			1·01			8·03			0·53		
	100·00			100·00			100·00			100·00		

(¹) Assumed to be $Fe_2O_33SO_39H_2O$
(²) „ „ $Al_2O_33SO_318H_2O$
(³) Assumed to be $Na_2OSO_310H_2O$
(⁴) „ „ $MgOSO_37H_2O$

With the above superphosphates experiments were carried out as to effects of exposure to 212° F.—What is soluble in water? etc.

The above superphosphates of known composition were exposed to 212° F. for various periods in natural state and beaten up (November, 1886). (See table on top of next page.)

These results, after exposure to 212° F., show that if exposed in natural state a loss is suffered well within the usual time of exposure, which must include some of the water of combination, and give results much too high; whilst if exposed in the beaten-up state, the results drag a long way behind, need twenty-four hours to overtake the natural state, and are not certain to do this even then, as is instanced in the "Carolina," which is only 18·60 against 20·22 after 24 hours.

The soluble P_2O_5 is in note-books and in practice held to exist, combined with two molecules of water and one molecule of lime, but is this really so? If such be the fact, then on dissolving out the soluble P_2O_5 with water, there would be found as much CaO present as would combine with the soluble P_2O_5, and a little more from the calcium sulphate dissolved. The superphosphates were mixed with their own weight of water, and allowed to filter, and the filtrate examined, with the results tabulated in second table on next page.

From these results it is manifest that, whilst some of the soluble P_2O_5 may be present as monocalcium, the larger portion must be present as free acid—*i.e.*, $P_2O_53H_2O$, especially when we bear in mind that some of the lime present is doubtless combined with

Hours at 212° F.	Carolina.		Sombrero.		Spanish.	
	Natural State.	Beaten up.	Natural State.	Beaten up.	Natural State.	Beaten up.
½	15·89	6·00	16·65	7·59	15·07	7·57
1	19·29	8·21	18·03	13·34	16·49	9·97
2	19·73	10·94	18·43	15·55	16·82	12·68
3	19·93	11·27	18·71	15·92	17·18	11·05
4	19·41	11·57	18·76	16·01	—	15·14
5	19·53	11·93	18·89	16·83	17·20	15·52
6	19·67	12·98	18·96	17·81	17·00	15·94
7	19·94	13·48	18·84	18·16	17·40	16·22
9	20·16	16·29	18·96	18·17	17·13	17·46
12	20·32	18·22	18·96	18·19	17·43	17·64
24	20·22	18·60	18·95	18·89	17·74	17·80

the SO_3 found. Also the SO_3 found is in smaller proportion to the P_2O_5 than would be if the soluble iron, soda, alumina and magnesia were sulphates; so that the SO_3, not being present in enough quantity to combine with all these, cannot be considered present as free SO_3, and in particular in presence of so much more lime than it needs, and the known solubility of calcium sulphate. This is additional ground for accepting that the free acid is phosphoric.

Having shown that the existing soluble P_2O_5 is not entirely present as monocalcium phosphate, and that exposure to 212° F. drives off too much, it remained to arrive at some convenient results which should agree with an apportionment of the existent water amongst the constituents present. To this end drying was tried over H_2SO_4 under a bell jar, and the same in vacuum of an air-pump; over sodium hydrate, sodium chloride, sodium carbonate, potassium carbonate, magnesium chloride, etc., etc., in the vacuum of an air-pump; also with dry calcium chloride ditto. All these various experiments gave results too irregular for acceptance, save those with calcium chloride, which, approaching to a definite formulæ, with variations as may be expected in a body of such variable composition as a superphosphate, and yet following in figures some of the known properties of these bodies, offers a plan for estimating the true moisture —that is, the adhering, uncombined water.

	Carolina.	Sombrero.	Spanish.	Curaçao.
Soluble P_2O_5 found ..	10·96	13·12	14·15	16·91
" CaO* " ..	1·58	3·18	0·67	3·00
" SO_3 " ..	0·17	0·38	0·56	0·44
* Amount thoretically needed to form monocalcium phosphate with the soluble P_2O_5 found	4·32	5·17	5·53	6·78

To make a rigidly accurate assignment of the water, combined with each constituent present, is practically impossible, but the main components being water, soluble P_2O_5, lime and sulphuric acid, we may deal with these, and disregard the smaller matters, and if the final results approximate to the results found, consider the method put forward as sustained, particularly as these important constituents, with the insoluble silicious matters, make up 91·12, 93·15, 95·69, and 97·70 per cent. of the totals respectively.

(*a.*) From the soluble P_2O_5 and soluble CaO found in the filtrate, calculate how much soluble CaO is proportional to the total per cent. of soluble P_2O_5 in the manure, and this calculate into monocalcium phosphate.

(*b.*) The soluble P_2O_5, not so combined, calculate into free phosphoric acid.

(*c.*) From the insoluble P_2O_5 calculate the insoluble tricalcium phosphate.

(*d.*) The whole of the SO_3 calculate into calcium sulphate, combined with one molecule of water.

The results obtained by the exposure to dry calcium chloride in vacuum of an air-pump were :—

	Feb. 1.	March 3.	March 23.	April 25.
Carolina Superphosphate	14·38—14·12	13·57—13·55	13·17	12·86—12·90
Sombrero Sup'rphosphate	15·65—15·81	15·28—15·31	14·79	14·45—14·30
Spanish Superphosphate....	14·50—14·48	13·89—13·91	13·46	12·96—12·85
Curaçao Superphospate	—	12·37—12·21	11·89	11·38—11·22

It is known practically that superphosphates, if kept in a heap, bag or jar, gradually improve in condition—that is, become drier to handle; and it is interesting to notice in the above figures that as every few weeks go on the amount of uncombined water slightly decreases, thus becoming a measure of the drying which is proceeding by the calcium sulphate gradually absorbing more water than it had at first.

The amounts of "moisture by calcium chloride" put down above are the amounts obtained up to the date when the filtrates were examined; they will, therefore, refer to the conditions the superphosphates were under at such time. Owing to the acid products present it may be that the calcium sulphate does not at once absorb the whole of its water, but does so gradually; if so, some of its water, as calculated, would come out on drying, and so be reckoned twice. To such may be due the high result obtained in some cases.

However, from the close approximation of the results obtained to those calculated, and bearing in mind the complex composition of superphosphate with its known variation in condition, the method proposed may be accepted.

A convenient way is to weigh out 2 to 5grms. in its natural state on a double watch-glass, place under air-pump, exhaust, and leave for 18 to 24 hours, then weigh. This period is sufficient for practical purposes, and is the one here adopted. A shorter period suitable for any one day's work is not always enough; the portion can therefore be left overnight.

To show the effect of time the results below are given as obtained :—

LOSS BY THE VARIOUS SUPERPHOSPHATES IN VACUUM OF AN AIR-PUMP OVER DRY CALCIUM CHLORIDE.

	Carolina.	Sombrero.	Spanish.	Curaçao.
	%	%	%	%
2 hours......	12·79	14·70	12·53	11·84
5 "	12·84	14·75	12·85	11·88
24 "	13·17	14·79	13·46	11·89
48 "	13·36	14·87	13·81	12·04

The gradual drying of the manure, as shown by the results by dry calcium chloride and in agreement

Carolina Superphosphate:—

			H_2O.
Monocalcium phosphate from the soluble CaO—			
CaO	1·97		
P_2O_5	4·99		
$2H_2O$	1·26		1·26
	8·22	8·22	
Free $P_2O_5 3H_2O$—			
P_2O_5	8·69		
$3H_2O$	3·30		3·30
	11·99	11·99	
Insoluble phosphate—			
P_2O_5	0·45		
3CaO	0·53		
	0·98	0·98	
Calcium sulphate—			
SO_4	26·40		
CaO	18·48		
H_2O	5·91		5·91
	50·82	50·82	
			10·50
Undetermined matters		7·61	21·20
"Moisture" by calcium chloride		13·17	
Silicious matters		5·83	13 70
Iron, alumina, soda and magnesia		0·79	
		99·41	

Sombrero Superphosphate:—

			H_2O.
Monocalcium phosphate from the soluble CaO—			
CaO	4·04		
P_2O_5	10·28		
$2H_2O$	2·59		2·59
	16·91	16·91	
Free $P_2O_5 3H_2O$—			
P_2O_5	6·10		
$3H_2O$	2·43		2·43
	8·83	8 83	
Insoluble phosphate—			
P_2O_5	0·73		
3CaO	0·86		
	1·59	1·59	
Calcium sulphate—			
SO_3	27·59		
CaO	19·31		
H_2O	6·20		6·20
	53·10	53·10	
			11·22
Undetermined matters		4·76	21·23
"Moisture" by calcium chloride		14·79	
Silicious matters		1·01	13·01
Oxide of iron, alumina, soda and magnesia		0·72	
		101·71	

Total H_2O	21·20	21·32
H_2O combined as above	10·50	11·22
,, uncombined	13·70	13·10

Spanish Superphosphate:—

			H_2O
Monocalcium phosphate from the soluble CaO—			
CaO	0·72		
P_2O_5	1·82		
$2H_2O$	0·43		0·43
	2·97	2·97	
Free $P_2O_5 3H_2O$—			
P_2O_5	13·10		
$3H_2O$	5·09		5·09
	18·19	18·19	
Insoluble phosphate—			
P_2O_5	0·73		
3 CaO	0·86		
	1·59	1·59	
Calcium sulphate—			
SO_3	26·61		
CaO	18·62		
H_2O	5·98		5·98
	51·21	51·21	
			11·50
Undetermined matters		2·96	24·65
"Moisture" by calcium chloride		13·46	
Silicious matters		8·03	13·15
Oxide iron, soda, alumina, magnesia		0·61	
		99·32	

Curacao Superphosphate:—

			H_2O
Monocalcium phosphate from the soluble CaO—			
CaO	3·25		
P_2O_5	8·24		
$2H_2O$	2·08		2·08
	·57	13·57	
Free $P_2O_5 3H_2O$—			
P_2O_5	10·05		
$3H_2O$	3·82		3·82
	13·87	13·87	
Insoluble phosphate—			
P_2O_5	0·06		
3CaO	0·13		
	0 19	0·19	
Calcium sulphate—			
SO_3	30·16		
CaO	21·18		
H_2O	6·78		6·78
	58·12	58·12	
			12·68
Undetermined matters		2·61	23·68
"Moisture" by calcium chloride		11·81	
Silicious matters		0·53	11·00
		100·73	

Total H_2O	21·65	23·68
H_2O combined in above	11·50	12·68
,, uncombined	13·15	11·00

with practical observation, is not at all indicated by exposure to 212° F. Thus :—

	Carolina.	Sombrero.	Spanish.
Loss by exposure to 212° F. ...	19·11	18·76	17·18
Ditto two months afterwards ..	19·79	18·69	17·40

One precaution is advisable—*i.e.*, to have an air-pump which will keep its vacuum for 24 hours. This can be readily obtained, but many pumps sold will not do it.

Ammoniated Superphosphates.

The treatment of Peruvian and other guanos with sulphuric acid, and the treatment of phosphates intermixed with sulphate of ammonia or other more or less ammoniacal matter, is in each case essentially only a superphosphate ammoniated by the ammonia added, and these form a very large proportion of the chemical manures produced. Having proposed a method for the estimation of the moisture in superphosphates, it is desirable to see how far such method could be used in the ammoniated superphosphates. If in both of these classes, then the method could be generally adopted for artificial, or rather for chemical manures produced by treatment with sulphuric acid in the dinary way.

Three mixtures were prepared by using curaçao phosphate, sulphate of ammonia, H_2SO_4, and water, all of which were carefully examined beforehand, weighed off, losses in mixings duly noted, and the final product kept for trial and experiment. The mixtures were intended to represent ammoniated superphosphate, containing respectively 3%, 6%, and 9% of ammonia (NH_3).

The analyses of these were as follows, all the H_2O of all the constituents being classed as water, and the SO_3 from all sources put together :—

COMPOSITION OF THE AMMONIATED SUPERPHOSPHATES.

	3% NH	6% NH_3	9% NH_3
Water	21·63	20·71	20·33
Soluble P_2O_5	15·02	13·05	11·66
Insoluble P_2O_5	2·40	1·77	1·01
Lime (CaO)	21·43	18·44	16·72
Sulphuric acid (SO_3)	31·40	35·62	38·45
Ammonia (NH_3)	2·98	6·15	8·87
Magnesia, alkalis, etc	4·60	3·82	2·63
Insoluble silicious matters	0·54	0·44	0·33
	100·00	100·00	100·00

These were each mixed so as to make good, fair-conditioned manures.

Each was then, as in the case of the plain superphosphates, mixed with its own weight of water, filtered, and the filtrate examined. The first table on next column gives the results.

It is at once evident, from the very wide divergence between the CaO found and the CaO of theory, that substantially monocalcium phosphate is not, and can not, be present in the manure.

Also it is highly interesting to notice the relative amounts of SO_3 and NH_3 found. The NH_3 was put in wholly in combination with SO_3, and one would at first sight naturally expect to find it still combined with SO_3, so that whatever changes occurred in the manure the SO_3 would, at anyrate, be present in sufficient amount to combine with NH_3; but such is not the case, as is seen by a comparison of the SO_3 and NH_3 found :—

	Filtrates of the		
	3 per Cent.	6 per Cent.	9 per Cent.
Soluble P_2O_5	13·12	13·08	12·10
" CaO....................	0·31	0·10	0·14
" SO_3	1·18	7·44	10·70
" NH_3	2·29	4·19	5·10
The above P_2O_5 to form monocalcium phosphate would need of CaO	5·17	5·15	4·77

	3 per Cent.	6 per Cent.	9 per Cent.
SO_3 found	1·18	7·11	10·70
Would need of NH_3—theory	0·50	3·16	4·50
NH_3 found	2·29	4·19	5·40

Here the NH_3 was more than the SO_3 could combine with, and the only other acid present was the P_2O_5, therefore the P_2O_5 must have been liberated so as to act as a free acid, and have attacked the ammonium sulphate so as to drive out some of the sulphuric acid and take its place.

Also the P_2O_5 is much more than is needed to combine with the small amount of CaO present and the remaining or even all the NH_3; and there are no other constituents to combine with the P_2O_5, therefore here also the free acid is phosphoric.

To arrive at the proportionate amounts of the various bodies present we can proceed thus :—

(*a.*) From the CaO found in the filtrate calculate the amount of CaO combined with the percentage P_2O_5 so as to form monocalcium, in proportion between the P_2O_5 in the filtrate and the percentage P_2O_5.

(*b.*) Calculate the insoluble P_2O_5 into insoluble tricalcium phosphate.

(*c.*) The CaO of the monocalcium and of the insoluble phosphate add together, the sum subtract from the total CaO, combine the remaining CaO to calcium sulphate plus one molecule of water.

(*d.*) The SO_3 of the calcium sulphate deduct from the total SO_3, and the remaining calculate into ammonium sulphate.

(*e.*) The ammonia of the ammonium sulphate deduct from the total ammonia, the balance calculate into ammonium phosphate.

(*f.*) Add together the P_2O_5 of the ammonium phosphate and of the monocalcium, the rest calculate into free phosphoric acid.

Tabulate these (see table on top of next page) and set out the H_2O combined.

These manures were also dried over dry calcium chloride in the vacuum of an air-pump, and the result obtained at about the same date as the making of the filtrate is put down above as "moisture by calcium chloride."

The water combined off, deducted from the total water, leaves amount of 8·99, 7·39, 7·33 per cent., which, reduced by the "moisture" found, leaves respectively 1·09, 2·81, 3·02 per cent. of water unaccountable for. Now it is seen that such figures approximate to the amounts of water in the ammonium sulphate of 3, 6, and 9 per cent. respectively.

3 per Cent.				6 per Cent.				9 per Cent.			
—			H_2O Combined.	—			H_2O Combined.	—			H_2O Combined.
Monocalcium Phosphate—				Monocalcium Phosphate—				Monocalcium Phosphate—			
P_2O_5	0·96	1·58	0·24	P_2O_5	0·21	0·35	0·05	P_2O	0·32	0·53	0·08
CaO	0·38			CaO	0·09			CaO	0·13		
$2H_2O$	0·24			$2H_2O$	0·05			$2H_2O$	0·08		
Insoluble Phosphate—				Insoluble Phosphate—				Insoluble Phosphate—			
P_2O_5	2·40	5·23		P_2O_5	1·77	3·86		P_2O	1·01	2·19	
3CaO	2·83			3CaO	2·09			3CaO	1·18		
Calcium Sulphate—				Calcium Sulphate—				Calcium Sulphate—			
CaO	18·22	50·09	5·85	CaO	16·26	44·71	5·23	CaO	15·41	42·35	4·93
SO_3	26·02			SO_3	23·22			SO_3	22·01		
H_2O	5·85			H_2O	5·23			H_2O	4·93		
Ammonium Sulphate—				Ammonium Sulphate—				Ammonium Sulphate			
SO_3	5·38	8·87	1·21	SO_3	12·40	20·46	2·79	SO_3	16·44	27·11	3·69
NH_3	2·28			NH_3	5·27			NH_3	6·98		
H_2O	1·21			H_2O	2·79			H_2O	3·69		
Ammonium Phosphate—				Ammonium Phosphate—				Ammonium Phosphate—			
P_2O_5	0·97	2·04	0·37	P_2O_5	1·22	1·76	0·46	P_2O_5	2·63	5·52	1·00
$3NH_3$	0·70			$3NH_3$	0·08			$3NH_3$	1·89		
$3H_2O$	0·37			$3H_2O$	0·46			$3H_2O$	1·00		
Free Phosphoric Acid—				Free Phosphoric Acid—				Free Phosphoric Acid—			
P_2O_5	13·09	18·06	4·97	P_2O_5	12·62	17·40	4·79	P_2O	8·70	12·00	3·30
$3H_2O$	4·97			$3H_2O$	4·79			$3H_2O$	3·30		
Insoluble silicious matters		0·51	12·64	Insoluble silicious matters		0·44	13·32	Insoluble silicious matters		0·33	13·00
Water as "moisture"*		7·90	21·63	Water as "moisture"*		4·58	20·71	Water as "moisture"*		4·31	20·33
Water unaccounted for		1·09	8·99	Water unaccounted for		2·81	7·39	Water unaccounted for		3·02	7·33
Magnesia, alkalis, etc.		4·60	7·90	Magnesia, alkalis, etc.		3·63	4·58	Magnesia, alkalis, etc.		2·64	4·31
		100·00	1·09			100·00	2·81			100·00	3·02

By calcium chloride.

On adding a strong solution of ammonium sulphate to gypsum it sets to a hard crisp mass, different in texture to gypsum hydrated with plain water, and this hard crisp condition is also a characteristic condition of ammoniated superphosphates. From facts and the approximation of the foregoing figures, it is probable that a double sulphate is formed appropriating to itself one molecule of water for combination, in which case the whole of the water present is satisfactorily accounted for.

The gradual dryings of the samples noticed in the plain superphosphates is also observed in these fertilisers :—

	3 per Cent.	6 per Cent.	9 per Cent.
March 9, after 24 hours	8·81—8·93	4·98—4·95	5·15—5·41
March 24, after 24 hours	8·51	4·58	5·03
April 25, after 24 hours	7·90—7·91	4·11—4·01	4·37—4·31

The effect which the length of the exposure to the chloride has upon the result is shown in the following table :—

	3 per Cent.	6 per Cent.	9 per Cent.
After 2 hours	8·20	4·38	4·94
After 6 hours	8·30	4·51	5·03
After 24 hours	8·51	4·58	5·03
After 48 hours	8·56	4·63	5·03
After 72 hours	8·56	4·65	5·11

Whilst the "moisture" by the method proposed was as given, the loss by exposure was as shown beneath :

	3 per Cent.	6 per Cent.	9 per Cent
Loss after 212° F., 3 hours	11·65	12·15	9·18

It is instructive and novel to compare the loss at 212° F. with the known water in the samples, and to see where the loss has arisen, and to notice how in this, the usual way of proceeding, the water of combination is attacked.

The results over dry calcium chloride in air-pump vacuum are confirmed by those over dry calcium chloride under a simple bell jar, but the latter are much longer in becoming constant, needing in fact from 300—400 hours.

Bearing in mind that the alkalis and the magnesia are not determined, and that these throughout the whole series of these experiments will have an influence upon the moisture, though of too irregular a nature for their extent to be accurately measured, whilst the important and extensive constituents are the water, soluble P_2O_5, the SO_3, and the CaO, which have been dealt with and assigned to their places with as fair an approximation as can be expected in a compound which is continually and progressively altering in some small degree, the method proposed for estimating the "moisture"—*i.e.*, the uncombined adhering water by exposure to dry calcium chloride in the vacuum of an air pump—is one to be accepted.

Only one molecule of water has been assigned to the calcium sulphate in the above calculations, because of all the various experiments tried by drying in presence of calcium chloride, sodium hydrate, etc., none left sufficient water in the manure to supply the calcium sulphate with more than one molecule; the inference, therefore, is that one molecule is all that is combined with the calcium sulphate.

The writer desires to express his indebtedness to Mr. Thomas W. B. Mumford for the kindly practical assistance with which he has helped on this research.

Liverpool Section.

Meeting held Wednesday Evening, May 4, at the University College.

DR. J. CAMPBELL BROWN IN THE CHAIR.

Mr. J. W. Macdonald exhibited a few samples of scale and powder taken from the external shells of boilers, which he thought would be of interest to members. He said that the boilers he had had to do with had no external scale until recently, but during the last five weeks they had noticed the grey scale, which was about $\frac{1}{16}$in. thick, and on the scale a grey powder, $\frac{1}{8}$in. thick. On analysis, the scale was found to consist chiefly of ferric sulphate. It was very difficult to remove, and required a great deal of hammering. Under the scale the boiler plate was as bright as new silver. He could not be certain that the scale had been formed at the expense of the boiler plates; probably the first of it was from the metal, but the rest of it had the appearance of being deposited in layers from the outside. No doubt they had been getting some bad slack, containing an undue amount of sulphur and pyrites. His theory of it was that the sulphuric acid, having been oxidised by the presence of nitrates in the coal, condensed on the boiler-plates, which would not be much hotter than the water on the other side of them. The fine flue dust, which contains a considerable quantity of oxide of iron, would then stick to the condensed vitriol, and thus layer by layer of the sulphate might be formed. The powder, strange to say, had not the same composition. Its chief ingredient certainly was sulphate of iron, but this was mixed up with the other constituents of coal ash. Notwithstanding the brightness of the metal below the scale, it could not be said that there was any apparent wasting of the plates. He would be glad if any of the members could throw any light on this matter, and send their experience to the Journal. He himself thought it showed the objection to using coal with much sulphur. Apart from the injury of the plates by the sulphuric acid, the loss of heat, owing to the presence of $\frac{3}{16}$in. of a non conducting substance, must have been considerable. Their boilers were fed by mechanical stokers, but he could not say whether the better combustion thus obtained helped the formation of sulphuric acid more readily than hand firing. He had made many inquiries, both from sellers and consumers of large quantities of coal, but could not hear of any similar experience, excepting in their works in London, where stokers, but different slack, were used. In this case, however, there was no scale, only a *dark* powder, resembling in composition the grey powder, but containing more carbon (only 2½ per cent., however). This powder was easily removed by a hard wire brush. All boilers were more or less covered with a dark powder, and which was generally assumed to be soot. He thought it was more likely to be chiefly sulphate of iron, and that consumers should pay more attention to the quantity of sulphur in the coals they used. The following were the analyses of the three samples referred to; the grey powder contained copper, but it was not estimated:—

	Liverpool Scale: Grey.	Liverpool Deposit: Grey.	London Deposit: Dark.
Carbon	0·47	0·57	2·48
Silica	0·62	9·50	9·25
Water	8·53	1·78	3·65
Ferric Oxide	31·05*	19·75	26·75
Sulphuric Anhydride	57·97*	44·36	42·21
Potash	0·63*	11·05	7·12
Lime	Trace.	2·41	1·20
Magnesia	Trace.	0·72	0·41
Copper	None.	Not determined.	None.
Soda and loss	0·73	9·86	7·00
	100·00	100·00	100·00
* Equal to:			
$Fe_2 3SO_4$	77·63		
K_2SO_4	1·17		
Free SO_3	10·85		

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MANUFACTURE OF ARROWROOT STARCH IN ST. VINCENT.

BY J. W. MACDONALD.

As we have lately been treated to a very interesting paper on starch manufacture from Indian corn, it was suggested to me that we might with advantage continue our discussions on this subject by learning something of its manufacture from another raw material, arrowroot, or, as it is known in botany, Maranta Arundinacea. This plant is essentially a starch-producing plant, the starch existing in it in almost absolute purity, and no other use having been found for it, as far as I am aware, excepting for feeding cattle. I have long felt, and this was also dwelt upon by our Chairman in his discussion on Dr. Archbold's paper, that it was a great waste of valuable nitrogenous matter to manufacture starch from such materials as maize, wheat, rice and potatoes, which in themselves form a large proportion of the food of man. We have around us large masses of half fed human beings, nevertheless we daily destroy hundreds of tons of valuable food in the manufacture of starch, etc. I feel sure that as the world advances and becomes more populated, a more conserving spirit must prevade our manufactories, and only such raw materials be used as will cause the least waste of matter; countries, too, that are best suited by natural forces for the production of certain commodities, will have to carry out the intentions of nature. We will not then have such anomalies as Europe trying, by the aid of Governments, to supply the world with sugar; for nature's sugar plant is the sugar cane, and its home, the tropics.

Arrowroot is also a native of the tropics. The island of St. Vincent in the West Indies has taken the foremost part in its growth and production; a fair quantity is also made in Natal, and smaller quantities in India, Fiji, Queensland and other countries. Formerly, the Bermuda Islands produced a good deal, but, as there is very little arable land and a scarcity of water, and the inhabitants having turned their attention to growing early vegetables for the New York markets, arrowroot is gradually being given up.

In St. Vincent the plant grows two to three feet high. It is a weak fibrous stalk with six to eight arrow-shaped leaves resembling the leaves of the lily. When the root is ripe, these leaves fall and wither. The plant flowers but does not bear seed, and is therefore propagated by the root. This can be done in two ways, either by pulling the green stalks, trimming off the long hairy roots, and setting them six inches apart in fields previously prepared for their reception, or, as is most generally done, by returning to the soil the upper end of the root, which is hard and fibrous and contains very little starch. As the fields are dug up, the labourers pick out the roots and break off these top pieces four to six inches long, and bury them in holes six inches apart and a few inches deep. In this way reaping and planting go on simultaneously. Care must be taken, however, to avoid returning to the soil small thin weak roots. The roots commence to grow in about a fortnight, but, to avoid choking, the fields have to be weeded two or three times. In about ten to twelve months the roots are ripe, and are then twelve to eighteen inches below the surface. If they are reaped before being properly ripe, the next crop suffers and frequently takes fifteen months to mature, and the fields require to be frequently weeded. With careful attention and manuring fields will produce crops for over 20 years. The arrowroot is a very hardy plant, and will continue to grow up and die down for years after its cultivation has ceased in a field. The roots are long and tap shaped, and are jointed at intervals of three quarters to one inch. In the soil they are protected by a fibrous covering which grows from each joint, the folds overlapping each other to the end of the root. Full-grown roots are from ten to eighteen inches long, the most starch being found in the lower or youngest end.

The first part of the manufacturing process is to soak the roots in water to soften the covering and the adhering earth. They are then stripped of the covering and washed, and thrown into a second or rinsing tank. When thoroughly clean they are taken to the pulping machine. The skin is said to contain a resinous matter which gives a yellow tinge and unpleasant flavour to the starch, if the latter is not well washed. In former times the roots were very carefully skinned with German silver knives, before being pulped. This is said to have produced whiter starch, but as it was so laborious and expensive, it was discontinued. The skinned roots were pulped by subjecting them to great pressure by passing them through an upper, and then a lower and much closer, pair of polished brass rollers, to break the starch cells. The method of pulping now generally adopted is to feed the clean unskinned roots against a fine saw grater very similar to a potato grater. It is a solid cylinder of hard wood about 23 inches diameter and seven inches wide. Slits are made by a saw from end to end of the wood at half-inch intervals. Saw blades having six to ten teeth to the inch are then fitted into the slits, and the whole immersed in water to swell the wood and fix the saws. The grater is now fitted into its place very close to a wooden feeding bed. As it revolves several hundred times per minute it tears the roots into shreds. A great deal, however, depends on the fineness of the teeth and the velocity of the drum.

On account of the very fibrous nature of the pulp there is considerable difficulty in the sieving or separating of the starch from it. The fibres readily gather into lumps and enclose the starch, so that hand sieving, although very tedious, has to be resorted to. The pulp is first run into a box or sieve, the bottom of which is a sheet of copper or tin punched with holes about one-fifth inch diameter. While water flows on, the contents are kept thoroughly agitated by hand, until all the starch has been washed out. While one strainer full is being washed, another is being filled so that there should be no delay. However careful one is, there is a loss of starch in the fibre owing to the presence of small bits of the roots which have escaped pulping.

In one factory, instead of the above strainer a tin-lined copper cylinder has been tried. The cylinder was stationary, its under side being pierced with holes, and, inside, paddles or beaters revolved at great speed amongst the pulp and water, until the latter flowed away free from starch. The washed fibre was then removed and a fresh charge of pulp put in. This, however, has been discontinued. In another factory, a half cylinder, also stationary, is in course of erection. Its under side is also pierced with small holes, but there is a slide under this to open or close at will. Inside, there are rakes attached to two shafts, which move in opposite directions and cause the rakes to oscillate very rapidly between each other, thereby keeping the fibre always open. The starch water is let out, more water run in, and the operation repeated until the starch has ceased; then the fibre is taken out. The great objection to any mechanical washer is the tendency of the fibre to accumulate on the agitators and break them. I do not know at present of a single mechanical washer being in use. To get over this difficulty it has been proposed to chop up or slice the roots into small short pieces, and either rasp them or pass them through metal rollers or mill-stones, so that the thin disintegrated pulp may flow over mechanical sieves. I do not know if this plan has yet been tried. Although causing a loss of starch, the present method of rasping avoids an undue pulverising of the soft yellow fibre, and so gives a very white starch without much further trouble.

From the fibre strainers the starch water flows consecutively through a series of brass wire sieves of 40, 80, and 100-meshes; each of these retain small fleshy bits of unpulped root. From the last sieve the water runs into the settling cisterns, which are preferably lined with white glazed tiles to avoid accumulation of slime.

A portion of the fibre collected on the finer sieves is used for feeding the animals on the estate, the remainder and all the coarse fibre are used as manure. For this purpose it is left in heaps until it decomposes, after which it is distributed on the fields along with pen manure. Sometimes also ashes and guano are used. The waste water from washing the starch contains a considerable amount of vegetable matter, and gives good results where it is run on the fields, but the extensive application of this is not practicable. After the starch has settled in the cisterns the water is run off and more added, the whole is stirred up and again allowed to settle. This generally suffices to dissolve out soluble matters. At night all the cisterns are drained, and the starch is dug out and taken to a mixing box, where it is mixed with a small amount of water, then run through another fine sieve into the separating pans. These are small round galvanised cisterns with smooth perpendicular sides. When filled, the starch milk is stirred round with a small oar until it is in violent circulation. The oar is withdrawn and the cisterns left until morning. The stirring has the effect of separating the starch from any remaining impurities. These, being of less specific gravity, settle last and therefore on top of the starch. Next morning the water is drained off, and the light impure starch scraped off the surface. If the earlier parts of the process are carelessly done, this separation may have to be repeated before the starch is quite pure. The impure surface starch contains a large proportion of starch entangled in very fine particles of fibre and broken cell walls. Although this can be dried and exported as an inferior starch, it is generally given to the labourers as a perquisite. It is used in various forms as flour. Poultry and pigs are also fed with it. Weak caustic soda extracts a colouring matter from it, but also precipitates a yellow substance, making it very difficult to separate the starch from it in a pure state.

The pure starch in the separators is now taken out in blocks, and placed on trays for about twelve hours to drain and harden. It is then broken into smaller pieces, and taken to the drying house, where it is air dried. This building is open on all sides for free circulation of air. It is surrounded, however, with galvanised wire to keep out the small birds which hover about. Inside, there are a series of wire shelves over large shallow wooden trays. The top shelf is made of very open wire, the next is closer, and so on, the lowest being the closest. The wet lumps of starch are placed side by side on the top shelf, where they remain until by the action of the air they crack up and fall through on to the next shelf. In time, the whole falls through the lowest shelf, and is in a fine granular state, ready for packing. It contains from 14 to 17 per cent. of water. In cold wet weather the starch dries very slowly, taking sometimes as long as two weeks. During this time, if the starch has been imperfectly purified, the lumps get sour, and become yellowish. Indeed, the whole process must be as rapid as possible. In the settling cisterns especially, if the starch is left in contact with the impure water too long, its whiteness is affected. The crop lasts from October to May. The name "arrowroot" is, I think, derived from the Indian word, Ara-ruta, or "mealy root;" but some say that this root has been confounded with the maranta galanga, which was called the arrowroot on account of its bruised roots being used as an antidote to the poison of the Jatropha Manihot, which was used for poisoning their arrows. I may say that tapioca starch is obtained from this poisonous root. The poison, however, is contained in the juice only, and is destroyed by heat.

Regarding the yield of arrowroot, an acre will produce 13,000 to 15,000lb. of roots, according to the season: in wet seasons the roots are heavy and moist, and give less starch. A fair average yield is 22cwt. air-dried starch, with 14 per cent. water, per acre, or about 19 per cent. on good roots. I have no doubt that this will be considerably increased by the use of much-needed improved pulping and sieving machinery. The roots that I have analysed got slightly dried in transit, so that they show a rather high amount of starch. The analysis, however, will give an idea of the constituents of the roots. In some respects it differs from an analysis by Benzon, stated in Ure's Dictionary, and which I append:—

	J. W. M.	Benzon.
Starch	27·07	26·00
Fibre	2·82	6·00
Fat	0·26	0·07
Albumin	1·56	1·58
Sugar, Gum, &c. ..	4·10	0·60 (Gum)
Ash	1·23	0·25 ($CaCl_2$)
Water	62·96	65·50
	100·00	100·00

The ash consisted of phosphate of lime and alkaline sulphates, and chlorides.

I have made an attempt to introduce the residual coarse fibre as a raw material for paper manufacture, but consumers say that it is too weak and lacking in tenacity. For paper making the starch still remaining could be recovered by steeping in boiling water, and used for sizing the finished paper.

Owing to the fall in the value of sugar, the production of arrowroot in the West Indies has been extended rather beyond the demand. The wholesale price has consequently fallen to an almost unremunerative point. This low price, however, will permit it to be used for whatever purposes the commoner kinds of starch are now employed. In some respects it is superior to common starch, and one of my chief objects in writing this paper is to draw the attention of large users of starch to this comparatively new source of very fine starch. Arrowroot swells much more readily and with less heat than maize, rice, or wheat starch, and forms a stiffer jelly. It is, therefore, highly adaptable for sizing and laundry purposes. I think this property is attributable to the larger size of the granules of arrowroot starch which are among the largest of the starch granules, whereas the granules of wheat, maize, and rice starch are very small and will contain a greater proportion of starch cellulose and less granulose, the latter being the substance which swells when dissolved in hot water. Another use for which arrowroot starch is very suitable on account of its great purity and freedom from chemicals, is for the preparation of powder for the skin. Many of the powders sold are composed of very questionable ingredients: arrowroot well crushed and dried on a plate before the fire is both simple and safe.

It is as an article of food, however, that it has hitherto been mostly used, but the exorbitant retail price put on it (from 8d. to 2s. per lb.) has kept it out of general use. Of course being starch it cannot have the flesh-forming power of flour and other nitrogenous meals, but it is the purest, most digestible and palatable of the starches, and is devoid of the unpleasant taste or flavour observed in potato starch and in the so-called cornflour, and other starches extracted from the cereals by the caustic soda and fermentation processes.

Regarding adulteration, this is only done when the arrowroot is for sale at a high retail price for food. This is chiefly effected by such cheap starches as those from potato sago and tapioca. I have also found chalk and plaster of Paris in arrowroot, but this is very rare. The microscope affords the only reliable means of detecting admixtures of starch, and as this is only within the reach of very few, admixtures often go on with impunity. I need not here enter into a description of the characteristics of various starch granules, for they are described in many well-known books. I find, however, that many of the prints given and the descriptions are very erroneous, so that one should resort more to personal observations, using samples of the various starches for comparisons, the origins of which have been carefully ascertained and noted. When examining a sample of unknown starch, a small portion from the standards should be mounted and compared in order to make sure of the origin of the unknown sample. If a thin well-washed section of the root be examined by the microscope, the arrangement of the cells is seen to be very perfect and beautiful, resembling somewhat a section of the honeycomb. The cells are hexagonal and very transparent, and are filled with very uniform starch granules. The pith of the root contains very small and somewhat irregular cells, which are filled with exceedingly small starch granules; this is probably the source of the smaller granules seen in a sample of arrowroot starch. The fibres are arranged in concentric rings round the pith. They are somewhat strong in the fleshy part of the root, but weak at the joints, which break very easily.

Regarding the annual production of arrowroot, I have not been able to obtain many statistics. Bermuda raises only 500 to 700 kegs, so that very little of what is sold as Bermuda really comes from there. Natal produces 2000 to 3000 cases, and St. Vincent about 22,000 brls., 20,000 of which come to England, and most of the remainder is sent to America. The production of other countries is, I believe, very small.

ANALYSIS OF ARROWROOT STARCH.

	Per cent.	Per cent.
Starch	83·70	99·5 when dry
Fibre	0·04	0·05 ,,
Fat	0·07	0·08 ,,
Sugar, Gum, etc. ..	0·18	0·21 ,,
Ash and Sand	0·14	0·16 ,,
Water	15·87	—
	100·00	100·00 ,,

DISCUSSION.

Dr. J. Campbell Brown (Chairman) said that the Society was indebted to Mr. Macdonald for his able and interesting paper. He thought it formed a very good appendix to Dr. Archbold's paper. No doubt it was new to most of them that the name arrowroot was derived from the Indian name signifying "mealy root," and he thought this a much better derivation than "arrow" root, the root that yields arrow poison.

Before calling on Dr. Hurter to read his paper, the Chairman read a letter received by the Local Secretary from Messrs. Cross and Bevan, stating their inability to attend, and intimating that if Dr. Hurter's experiments did not, as they understood, agree in results with theirs, it was probably because the conditions of electrolysis were different in the two cases.

Dr. Hurter said that in justice to himself he must say that he himself invited Mr. Cross to be present at that meeting. He then read his paper on Hermite's Process.

ON HERMITE'S ELECTROLYTIC PROCESS FOR THE MANUFACTURE OF BLEACHING LIQUOR.

BY FERDINAND HURTER, PH.D.

Some years ago, when an electrolytic process for the manufacture of soda and chlorine from common salt was advertised as the "Tyne alkali process," I made a series of experiments on the electrolysis of common salt, which led me to the general conclusion that for the production of articles of low price electrolysis as a manufacturing operation was impracticable. Even for such an article as chlorate of soda, the electrolytic preparation of which presents no difficulty, I found the process too expensive, the efficiency of the current being extremely low. I was, therefore, greatly surprised to find, on reading Messrs. Cross and Bevan's paper on the Hermite process, that their results differed so far from mine as to lead them to entirely opposite conclusions, and to calculate a handsome profit on the electrolytic preparation of a substitute for so cheap an article as bleaching powder. I must, therefore, have been wrong in my conclusions, and I determined to make a few experiments myself, particularly as Messrs. Cross and Bevan obtained much more chlorine from a given current than could be calculated by Faraday's law, a result which was diametrically opposed to all my experience, for I had never been able to obtain as much as the theoretical quantity.

The Hermite process, as described in the English specification of patent No. 3957, 1886, consists in electrolysing solutions of the chlorides of the alkalis and alkaline earths between electrodes of platinum or carbon, as anodes and mercury, or amalgamated zinc plates as cathodes. The apparatus described consists of a tank, the bottom of which is covered by a layer of mercury at a distance above which the anode of platinum is placed horizontally. The anode is perforated to permit the free escape of gases. It is asserted that during the electrolysis of the chlorides the metal of the chloride amalgamates with the mercury, and that this is an essential feature of the process.

From Messrs. Cross and Bevan's paper we learn that the best results are obtained by the use of magnesium chloride of such concentration that one litre contains 25grms. of the anhydrous chloride. With such a solution Messrs. Cross and Bevan obtained in four successive periods the following amounts of chlorine :—

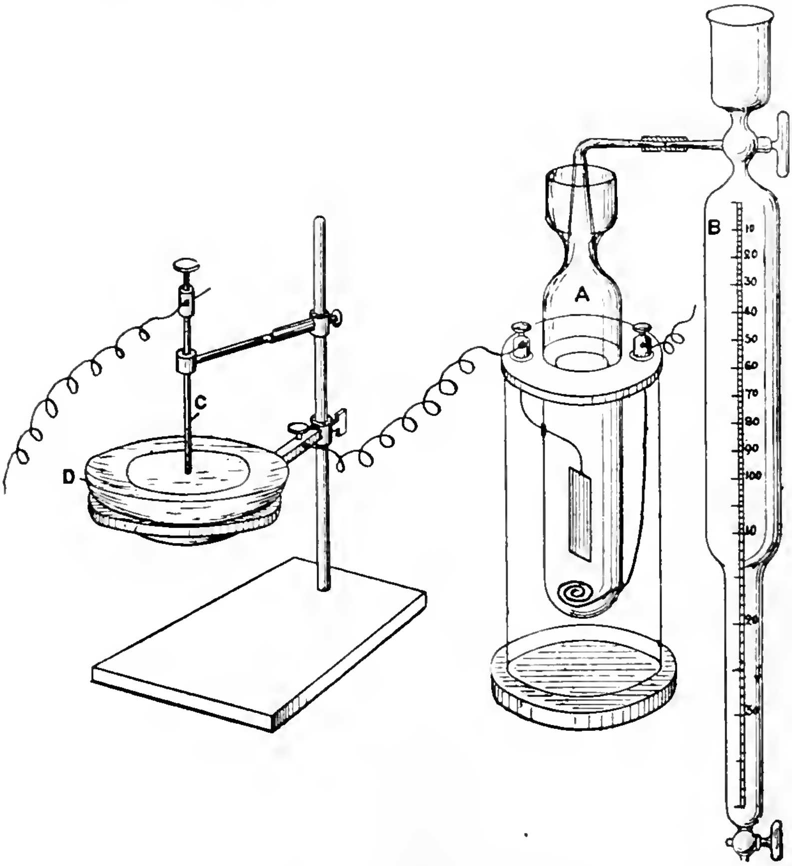
	Per Ampère Hour.	Or for 100 Cl theoretically possible.
1.	1·80grms.	134·3%
2.	1·12 ,,	83·5
3.	1·56 ,,	116·3
4.	1·40 ,,	104·4
Mean.	1·47grms.	109·4

The low result in the second period is said to be explained by the addition of lime, which in some way diminishes the yield.

Upon these marvellous results, Messrs. Cross and Bevan quite seriously base a calculation of costs to which I shall refer later on.

The first point which I had to investigate was, whether this high yield was a reality or an illusion

Clearly, if one ampère gives more chlorine than the electro-chemical equivalent, it must also yield more magnesium, or since that metal is not deposited in the metallic state, we must obtain more hydrogen gas. I, therefore, so arranged my experiments that I could measure and analyse the gas obtained during the electrolysis as well as the electrolysed liquid. The apparatus was very simple, the electrolytic cell A consisted of a glass cylinder in which were fused in at the bottom a platinum spiral, afterwards covered with mercury, and higher up a piece of platinum foil serving as anode. The cylinder was closed by a gas delivery tube ground into the neck. This delivery tube was connected to a Bunte's burette B, in which the gas could be measured and analysed. The current of a Bunsen battery, after passing the cell, was conducted through a copper voltameter, consisting of a copper plate C as anode, and a platinum dish D as cathode, containing pure copper sulphate solution three-fifths saturated as electrolyte; the current afterwards passed through a galvanometer. I will only trouble you with the details of one single experiment, as most of them were carried out in a similar manner.



Experiment No. 1.—A solution of magnesium chloride containing 8·70grms. of $MgCl_2$ per litre was electrolysed in two successive stages, for both of which the amount of copper deposited and the gases evolved were determined separately; but owing to the small amount of solution in the cell, this was only analysed after the second stage.

The gas obtained during the first stage amounted to 37·3cc., corrected for temperature and pressure, and consisted of—

Cl	1·50	per cent.
O	9·17	,,
H	89·03	,,

The copper deposited during this period amounted to 0·1035grm., which, taking 0·0003307 as the electrochemical equivalent of copper, corresponds to 313 coulombs (ampère-seconds) of electricity.

The amount of hydrogen in the gas corresponds to 37·3 × 0·8903cc. = 33·20cc., and as each cc. corresponds to 8·533 coulombs, the hydrogen only accounts for 283 coulombs. Similarly calculated, the oxygen is equivalent to 60·2 coulombs, and the chlorine evolved to 4·7 coulombs.

Consequently, for every 100 coulombs which were measured in the copper voltameter, only 90·4 [313 : 283 :: 100 : 90·4] evolved their equivalent of hydrogen, or 100—90·4 = 9·6 coulombs passed through the electrolytic cell without evolving hydrogen, and since when no hydrogen is evolved at the cathode, no chlorine or oxygen can be evolved at the anode with magnesium chloride solution as electrolyte, 9·6 per cent. of the current were ineffective for the production of chlorine. Another portion of the current—viz., 19·25 per cent. [313 : 60·2 :: 100]—produced oxygen at the anode instead of chlorine; this portion also was ineffective as regards production of chlorine, so that we have only 100—(9·6 + 19·25) = 71·15 per cent. of the current which really did produce chlorine.

I shall term the percentage of current which really yields chlorine, or oxygen compounds of chlorine, the efficiency of the current.

During the second stage of the electrolysis of this solution a gas was obtained consisting of 10·75 per cent. of oxygen and 89·25 per cent. hydrogen gas, and measuring 38·6cc. (reduced volume). The copper collected in the voltameter amounted to 0·1126grm., corresponding to 340 coulombs. A similar calculation to the previous one shows that in the second period, for every 100 coulombs of electricity,

13·5 per cent. did not evolve hydrogen;
20·8 „ evolved oxygen instead of Cl.

31·3 per cent. were ineffective for the production of chlorine, and only 65·6 per cent. produced chlorine.

The mean of both periods is—

11·5 per cent. produced no hydrogen.
20·02 „ „ oxygen.
68·48 „ „ chlorine.

The solution was now analysed.

The total chlorine was determined in the solution before electrolysing by means of silver nitrate.

The *available* chlorine, meaning thereby free chlorine and hypochlorites, all calculated to their equivalent of free chlorine, was determined by means of an acidulated solution of iodide of potassium, the iodine set free being titrated with sodium thiosulphate.

The total oxidising chlorine of the solution (including in this term free chlorine, hypochlorites, and chlorates, all calculated to their equivalent of free chlorine) was determined by boiling a portion of the solution with a standard solution of ferrous chloride and titrating with potassium bichromate, as the solutions must be made strongly acid with hydrochloric acid if the chlorates are to be thoroughly decomposed.

These methods of analyses were followed in all experiments, except where special points had to be settled.

The solution was thus found to contain—

Total chlorine	0·3578grm.
Available chlorine	0·0619 „
Total oxidising chlorine	0·1698 „

The electro-chemical equivalent of chlorine being 0·0003727, the available chlorine corresponds to 166 coulombs, and the total chlorine to 456 coulombs.

As during the two periods 313 + 340 = 653 coulombs had passed through the voltameter, the efficiency of the current as calculated from the analysis of the solution is—

For available chlorine	25·1 per cent.
„ total oxidising chlorine	69·7 „

whilst the efficiency from gas analysis is for total oxidising chlorine 68·48 per cent.

This approximation shows that gas analysis alone is sufficient to settle the efficiency of the current.

Before giving you the results of further experiments, it will be convenient to explain shortly the reactions which go on in the cell. I am afraid I shall trouble you with rather too elementary an explanation, but as the subject has been unnecessarily mystified in Messrs. Cross and Bevan's paper, I wish to be exceedingly careful to clear the mysteries away.

The primary result of the electrolysis of most chlorides is the separation of the atoms, the metal appearing at the cathode, the chlorine at the anode. When the metal is capable of decomposing water, the metal is separated as hydrate, and its equivalent of hydrogen is evolved at the cathode. Magnesium chloride forms no exception to this rule.

The first products of the electrolysis of magnesium chloride are chlorine gas at the anode, hydrogen and magnesia hydrate at the cathode. When the solution of magnesium chloride is alkaline the chlorine does not escape, when the solution is neutral some chlorine does escape, as the first gas analysis shows; but when chlorine and magnesia have been produced in sufficient quantity and diffused through the solution, they react upon each other in the well-known manner according to the equation: $2MgH_2O_2 + Cl_4 = MgCl_2O_2 + MgCl_2 + 2H_2O$, producing magnesium hypochlorite and chloride.

The solution then contains two salts, magnesium chloride and hypochlorite, both of which are electrolytes.

The current of electricity has now the choice of travelling by two conductors instead of only one, and according to the quantity of each salt present divides itself in a certain ratio, one portion continuing to decompose magnesium chloride, another portion decomposing the hypochlorite.

When oxygen salts are electrolysed, the usual result is the appearance of the metal at the cathode; or when the metal decomposes water, hydrogen is evolved and the hydrate of the metal formed at the cathode, while the acid separates at the anode together with the oxygen belonging to the base. Thus the electrolysis of magnesium hypochlorite produces hydrogen and magnesia at the cathode, while oxygen and hypochlorous acid should be found at the anode.

These are the primary reactions which account for the hydrogen and oxygen found in the gases, but which do not account for that part of the current which did not evolve hydrogen, nor explain why the whole of the chlorine produced is not available chlorine.

It is well known, when the solution of an oxidising agent is electrolysed, that as a secondary reaction the nascent hydrogen at the cathode reduces partially the oxidising agent. This is exactly what happens in this case; part of the hypochlorite is reduced again to chloride. The hydrogen being oxidised to water does not appear in the gaseous products. This is the explanation of the hydrogen which is missing.

While this secondary reaction is proceeding at the cathode, there is another secondary process going on at the anode. It is a well-known fact that hypochlorous acid very readily changes into chloric acid, and it is a peculiarity of the electrolysis of the hypochlorites that, instead of hypochlorous acid, chloric acid is formed at the anode. By what steps this happens is of little consequence; I will represent the results of the electrolysis of the hypochlorite by equations as follows:—

$$3MgCl_2O_2 + 9H_2O = \underbrace{3MgH_2O_2 + H_6}_{\text{Cathode.}} + \underbrace{6HClO + O_3}_{\text{Anode.}}$$

$$6HClO = 2HClO_3 + 4HCl.$$

Of course all these acids do not remain free, but soon combine again with magnesia. What I wish to point out by these equations is this: For every two molecules of chloric acid so formed there are three atoms of oxygen evolved. But whereas the six molecules of hypochlorous acid would count as available chlorine, and would be equivalent to 12 atoms of free chlorine, the two molecules of chloric acid into which they are transformed do not count as available chlorine, and consequently for every three atoms of oxygen evolved the available chlorine in the solution is reduced by an amount equivalent to 12 atoms of free Cl. If we translate this result into current efficiency, we have to remember that each atom of oxygen corresponds to two coulombs, and each atom of chlorine to one coulomb.

Consequently, we may say that for every six coulombs of the current which produce oxygen, the available chlorine which requires 12 coulombs for its production vanishes, or for every coulomb which produces oxygen the available chlorine corresponding to two coulombs vanishes.

If we review the results of the experiment in the light of this explanation, we can say that as the amount of oxygen evolved corresponds, on the average, to 20·02 per cent. of the current, that 20·02 per cent. of the current electrolysed $MgCl_2O_2$, producing oxygen and chlorate at the anode, and hydrogen at the cathode. In consequence of the reduction of hypochlorite at the cathode, 11·5 per cent. of the hydrogen due to the current was not evolved; and in consequence of the conversion of hypochlorite into chlorate at the anode, 2 × 20·02 per cent. of the available chlorine were rendered unavailable, so that of the chlorine which 79·98 per cent. of current yielded, 11·6 were reduced again at the cathode, and 40·04 changed into chlorate, leaving only 28·34 per cent. of the current useful for available chlorine. From the analysis of the solution, the efficiency for available chlorine was found to be 25·4 per cent. When we remember that magnesium hypochlorite readily changes into chlorate under ordinary conditions, the difference between the results is not important, and the experiment is a proof of the explanation given.

Experiment No. 2.—Magnesium chloride solution, containing 24·15grms. $MgCl_2$ per litre. Gas collected in two portions, and copper in voltameter weighed for each.

	1st Stage.	2nd Stage.
Total volume	37·25cc.	45·70cc.
Hydrogen	95·57	95·0
Oxygen	4·43	5·0
Cu collected	0·1189grm.	0·1459grm.

From these results we calculate that 91·16 per cent. of the current electrolysed magnesium chloride, yielding chlorine at anode, and hydrogen at cathode, and that 8·84 per cent. of the current electrolysed magnesium hypochlorite, yielding chlorate and oxygen at anode; 16·10 of the hydrogen reduced hypochlorite at cathode, and 17·68 of available chlorine became unavailable, owing to transformation into chlorate. Hence, from gas analysis, the current efficiency was: 75·06 per cent. for total oxidising chlorine, and 57·38 per cent. for available chlorine. The analysis of the solution gave—

Available chlorine	0·1171grm.
Total oxidised chlorine	0·2316 ,,

From which the efficiencies are calculated to be 77·66 per cent. for total oxidising chlorine, and 49·3 per cent. for available chlorine, much less than from the gas analysis, owing to spontaneous conversion of hypochlorite into chlorate.

Experiment No. 3.—Magnesium chloride solution, containing 68·6grms. $MgCl_2$ per litre.

Total volume of gas	84·1cc.
Containing 97·5% hydrogen.	
2·5 oxygen.	
Copper collected	0·2728grm.
Cl as available in solution	0·2116 ,,
Cl as total oxidising chlorine	0·2397 ,,

From these data the current efficiency is from gas analysis: 80·12 and 71·42; from the solution, 77·94 and 68·84 respectively, for total and available chlorine.

Experiment No. 4.—Solution containing 33·39grms. $MgCl_2$ per litre.

Gas obtained	158·1cc.
Containing Cl	1·05
Oxygen	3·95
Hydrogen	95·00
Copper collected amounts to	0·5275grm.
Available chlorine found	0·3550 ,,
Total oxidising chlorine	0·4135 ,,

From which data the efficiency is calculated to be, from gas analysis, 73·63 and 60·26 per cent.; from the analysis of the solution 69·58 and 59·7 respectively, for total and available chlorine.

I have tabulated these results so that the resemblance in the results from the analysis of gas and liquid may be perceived. I have also added the percentage of chlorine in the solution, which was converted by the current.

RESULTS OF EXPERIMENTS I.–IV.

Experiment No—		1	2	3	4
Efficiency of Current per Gas Analysis	Total Oxid. Cl	68·4	75·0	80·1	73·6
	Avail. Chlorine	28·3	57·4	71·4	60·2
Efficiency of Current per Analysis of Solution	Total Oxid. Cl	69·7	77·5	77·9	69·1
	Avail. Chlorine	25·4	49·2	68·7	59·8
Magnesium Chloride in grms. per litre		8·7	24·1	68·6	33·4
% of Chlorine converted	into total Oxid. Cl	47·5	21·0	7·9	8·7
	,, avail. Chlorine	17·1	13·3	7·0	7·5

It will be seen that in this series of experiments the results of the gas analyses tolerably well agree with the results of the analysis of the solution. But this is only so when the electrolysis has not advanced very far, as it has not done in any one of the above experiments. The method of stating the total oxidising chlorine is apt to give a very wrong impression of the composition of the solution. Thus, in Experiment No. 1 it is stated that the oxidising power of the solution was equivalent to 47·5 per cent. of the total chlorine in the solution, giving one at first sight the very erroneous impression that nearly the half of the magnesium chloride had been decomposed. In reality that very solution consisted still chiefly of magnesium chloride, for it contained, for 100 molecules of magnesium chloride, in round numbers—

$MgCl_2$	100 molecules.
$MgCl_2O_2$	10 ,,
$MgCl_2O_6$	6 ,,
$MgCl_2O_8$	(?)

When the electrolysis is pushed still further, the analysis of the gas no longer permits to form so approximate an idea of what is proceeding in the electrolytic cell: the analysis of the solution only can be relied upon, as is shown by the following experiment carried out in a different apparatus:—

Experiment No. 5.—Solution containing 25·9grms. $MgCl_2$ per litre.

Gas obtained	1380cc. corrected vol.
Containing H, 87·5%	
,, O, 12·5	
Copper collected in voltameter	4·1687grms.

The solution was found to contain:—

Chlorine equivalent to total oxidising power	2·308grms.
Available chlorine	0·630 ,,

From these results the following efficiency for the current, calculated in the same way as explained, are obtained:—From gas analysis: for total oxidising chlorine, 58·0 per cent.; for available chlorine, 11·4 per cent. From the analysis of the solution, 49·1 per cent. for total oxidising chlorine, and 13·2 per cent. for available chlorine.

In this experiment, for every 100 coulombs passed through the voltameter, 18·75 had passed without producing H in the electrolytic cell, and 23·3 had produced oxygen at the anode instead of chlorine. The total oxidising chlorine amounted to 78·2 per cent. on the total chlorine contained in solution.

From this experiment, and various differences in the others, it is evident that another reaction was going on in the cell, which had not been taken into account. In order to discover whether it was a reaction due to hypochlorites, or whether it was due to the chlorate formed, I electrolysed a solution of bleaching powder, nearly free from chlorate, which the hypochlorite solution obtained by electrolysis never is; and I also electrolysed a solution of potassium chlorate. The following are the results:—

Experiment No. 6.—Solution of bleaching powder, containing 18·193grms. available chlorine and 19·965 grms. total oxidising chlorine per litre, was electrolysed.

The gas obtained amounted to 36·5cc. corrected volume, and contained—

Hydrogen.. 41·32 ,, corresponding to 129 coulombs.
Oxygen .... 58·68 ,, 366 ,,

The copper deposited in voltameter amounted to 0·3350grm. = 1013 coulombs.

After electrolysis, it was found that the solution had lost available chlorine, corresponding to 0·390 grms. = 1046 coulombs, or electro-chemical equivalents.

These results must be interpreted as follows: Of the 1013 coulombs measured in the voltameter—

366 electrolysed calcium hypochlorite.
647 electrolysed calcium chloride.

Since only 129 coulombs of the electricity produced hydrogen, 884 coulombs have reduced hypochlorite to chloride. We have therefore—

Gain of available chlorine by electrolysis of calcium chloride	647	electro-chem.	equivalent.
Loss of available chlorine due to reduction at cathode	884	,,	,,
Due to conversion to chlorate, 2×366	732	,,	,,
	1616		
	647		
Balance of loss	969	,,	,,

According to analysis of solution, the reduction in available chlorine was 1046 electro-chemical equivalents.

Experiment No. 7.—Bleaching powder solution containing 19·30grms. available Cl per litre was electrolysed.

Gas obtained = 36·5cc. corrected vol.
Hydrogen, 36·3 per cent., corresp. to 113·5 coulombs.
Oxygen 63·7 ,, ,, ,, 397·0 ,,
Copper deposited in voltameter, 0·3170grm. = 959 coulombs.

Analysis of solution showed a decrease in available chlorine of 0·382grm., corresponding to 1024 coulombs (electro-chemical equivalents). We have, therefore, 959—113=846 coulombs passing through the cell, which reduce hypochlorite at cathode, and 397 coulombs converting hypochlorite into chlorate, equivalent to a loss of 2 × 397 = 794 equivalents available chlorine. The total loss of available Cl is therefore 846 + 794 = 1640 equivalents. But by electrolysis of 959—397 = 562 equivalents of calcium chloride we gained available chlorine, so that the real loss amounted to 1640—562 = 1078 equivalents, whereas the analysis of the solution shows the loss to be 1024 equivalents.

These two experiments show very clearly that as far as the electrolysis of chlorides and hypochlorites are concerned, the explanation given is absolutely correct, that the formation of chlorate exactly corresponds to the oxygen found in the gas, and as calcium hypochlorite does not under ordinary circumstances change into chlorate, the change must be due to the current; and that as the solution becomes richer in hypochlorites, the hydrogen evolved decreases more and more. Whereas in the experiments in which there is no available chlorine in the solution at the beginning, the current evolves about 90 per cent. of the theoretical quantity of hydrogen, in these latter experiments, where the solution contained 19grms. of available chlorine per litre, the hydrogen evolved by the current is only 13 to 15 per cent. of the theoretical quantity, and consequently electrolysis can by no possibility yield a solution in which the proportion of chloride to hypochlorite equals that of a solution of bleaching powder, since under these circumstances the current destroys more hypochlorite than it produces.

In both these experiments with bleaching powder solution there was, in addition to the loss of available chlorine, a small loss of total oxidising chlorine. I have taken no notice of it, in order not to complicate matters, as the following experiments will clearly show from what cause the discrepancies between gas analysis and analysis of solutions arise:—

Experiment No. 8.—A solution of potassium chlorate was electrolysed. The solution contained 46·0grms. of potassium chlorate per litre. During a first trial 46·4cc. of gas were collected, consisting of—

36·6 per cent. oxygen corresp. to 290 coulombs.
63·36 ,, hydrogen ,, 251 ,,

During the same time 0·1170grm. copper were deposited in the voltameter. Neither of the gases corresponded to the theoretical quantity which ought to be obtained if the electrolysis proceeds according to the equation—

$$2KClO_3 + 3H_2O = \underbrace{2KHO + H_2}_{\text{Cathode.}} + \underbrace{2HClO_3 + O}_{\text{Anode.}}$$

On interrupting the current it was found that the mercury cathode still continued to evolve gas, a phenomenon which had not in any previous experiments manifested itself. It was evident that a potassium amalgam had formed to some extent, which required time for its decomposition.

Accordingly a new experiment was made.

Experiment No. 9.—The electrolysis of a similar solution was conducted in two stages.

Owing to too small a gas burette, a small quantity of the hydrogen evolved after opening the circuit was again lost in the first period.

1st Period: Gas obtained with closed circuit, 38·8cc., increasing after opening the circuit to 50·6cc.; corrected volume = 47·5cc. Gas consisted of—

Oxygen 36·17 per cent., corresp. to 294 coulombs.
Hydrogen. 63·83 ,, ,, ,, 259 ,,
Copper deposited in voltameter, 0·1335grm. = 403 coulombs.

2nd Period: Gas obtained, 27·5cc., increasing after opening the circuit to 46·1cc., or 44·1cc. corrected volume. Gas contained—

Oxygen 26·3 per cent., corresp. to 198 coulombs.
Hydrogen. 73·7 ,, ,, ,, 278 ,,

In this case the evolution of gas had entirely ceased.

The copper deposited during this period was 0·0920grm. = 278 coulombs.

The first point I wish to draw your attention to is that in this latter period, where there was no failure, the hydrogen evolved corresponded exactly to the copper deposited, so that no reduction of chlorate takes place at the cathode. But the oxygen evolved at the anode is for both periods together 492 electro-chemical equivalents, whilst 681 ought to have been obtained according to the amount of copper deposited; the difference, 189, was absorbed in the solution.

Analysis of the solution showed that the total oxidising chlorine had decreased by an amount corresponding to 0·1037grm. of potassium chlorate. That this decrease was not due to any reduction of chlorate to lower oxides of chlorine or to chloride was proved by testing the solution for available chlorine with iodide of potassium which was not discoloured, and for chloride by nitrate of silver which gave no precipitate.

The chlorate was simply oxidised to perchlorate, which, as is well known, will not yield its oxygen to an acid boiling solution of ferrous chloride.

According to the equation $KClO_3 + O = KClO_4$, we see that for every atom of oxygen used for oxidation one molecule of potassium chlorate vanishes. Consequently, if the 0·1037grm. of potassium chlorate were oxidised to perchlorate, they required 0·0135 grm. of oxygen, which correspond to 161 electro-chemical equivalents. By the gas analysis 189 electro-chemical equivalents of oxygen had been used for oxidation. The slight difference is due partly to errors in analysis, partly to the fact that a portion of the oxygen in the gas was in the allotropic form ozone, and was not, therefore, correctly measured, a difficulty frequently experienced in electrolytic work.

Experiment No. 10.—Exactly similar to the previous one; carried out on a much larger scale. Owing to collecting the gases by displacing water in an aspirator, a correction must be allowed in the measurement of the gases. The electrolysis was divided into three stages, and the liquid analysed after the third stage only.

	I.	II.	III.
Total gas collected	2016cc.	1972cc.	1937cc.
Hydrogen..............	69·33	73·25	70·26
Oxygen	30·67	26·75	29·74
Copper collected	3·9976	4·2005	3·8262

Total copper corresponds to 36360 coulombs.
" hydrogen " " 35857 "
" oxygen " " 29380 "

This latter figure needs increasing by three per cent. owing to absorption in water of aspirator, which brings it to 30,271.

The solution was found to have lost 3·672grm. of chlorate, requiring 0·4780grm. of oxygen for oxidation to perchlorate. This amount of oxygen corresponds to 5691 electro-chemical equivalents, whereas in the gas are missing 6089. The discrepancy is due to the same cause, the formation of ozone. The perchlorate formed crystallised out, and was examined.

The important point in these experiments on the electrolysis of chlorates is, that the current very easily electrolyses them, producing its exact equivalent of hydrogen at the cathode (except at first), and nearly five-sixths of an equivalent of oxygen at the anode, the rest of the oxygen being taken up by the chlorate to form perchlorate.

It is for this reason that calculations from gas analyses, and from the analyses of the solutions, do not agree perfectly, particularly when the solution contains any appreciable amount of chlorate, because the total oxidising chlorine is reduced by 6 equivalents for every equivalent of chlorate changed into perchlorate by the current, and the gases are enriched by a certain amount of oxygen, to which there is no corresponding transformation of hypochlorite into chlorate.

What we have learnt, so far, may be summed up in a very few words. 1. There is no failure of Faraday's law in the electrolysis of magnesium chloride. 2. Owing to the presence, after some little time, of two or three other salts besides the original chloride, part of the current electrolyses them, and thus is wasted, and not only wasted, but actually undoes continuously a portion of the work which another portion of the current is doing.

If you bear in mind that in the experiments with the bleaching powder solution the result was a loss of available chlorine of nearly 35 per cent., you will the more readily see that there is a limit to the relative amount of chloride and hypochlorite in solution, beyond which electrolysis cannot go, and beyond which the current is absolutely wasted, if it is intended to prepare bleaching solutions.

The following experiment was made in a tank holding two litres, between anodes of platinum and cathodes of amalgamated zinc, the current being measured as hitherto by a copper voltameter.

The results are tabulated, and will be readily understood. The amount of solution in the tank was approximately 2 litres. The electrolysis was carried out in five periods. (See table below.)

EXPERIMENT No. 11.

(SOLUTION CONTAINED 26·6GRMS. $MgCl_2$ PER LITRE.)

PERIOD.	Total Chlorine Produced.		Copper Collected.		Cl. equivalent to Cu.	Current Efficiency.		On Total Chlorine in Solution.	
	Avail.	Total.	Each Period.	Total.		Avail.	Total.	% Available.	% Total Oxide.
	Grm.	Grm.	Grm.	Grm.	Grm.	%	%		
1	3·72	1·42	5·75	5·75	6·44	57·7	68·6	9·35	11·10
2	6 38	13·91	20·38	26·13	29·26	21·8	47·5	15·4	34·2
3	7·84	17·11	6·85	32·98	36·93	21·2	46·3	19·36	42 8
4	8·25	24·66	17·43	50·11	56·44	14·6	43·6	20·51	64·6
5	8·35	27·16	5·68	56·09	62·82	13 3	43·7	20·8	73·4

It will be evident from this table that the limit of the available chlorine worth having had been reached with a current efficiency of 22 per cent. only, after the 2nd or 3rd period; from that period the current produced an increase in the hypochlorites or available chlorine at very great cost. In order to show the intimate connection between the current efficiency and the limit to which electrolysis of the solution is pushed, I append the subjoined tables, which include all the experiments with magnesium chloride detailed in this paper, or all the experiments I have made in which the current was measured by means of the copper voltameter. I also append diagram to show the difference of the results obtained by Messrs. Cross and Bevan and myself, and their relation to the theoretical amount:—

A.—SMALL SCALE EXPERIMENTS.

(AMOUNT OF SOLUTION USED, 60—150CC. MERCURY AS CATHODE, PLATINUM AS ANODE.)

No. of Experiment—	3	4	2	1	5
Available Chlorine %	7·0	7·5	13·3	17·4	20·4
Total Oxidising Chlorine	7·9	8·7	21·0	47·5	78·2
Current Efficiency for available Chlorine %.	68·7	59·8	49·2	25·4	13·2

B.—LARGER SCALE EXPERIMENTS.

(AMOUNT OF SOLUTION USED, 2 LITRES. AMALGAMATED ZINC AS CATHODE. PLATINUM AS ANODE.)

Period of Experiment No. 11.	1	2	3	4	5
Available Chlorine %	9·3	15·4	19·3	20·5	20·8
Total Oxidising Chlorine %	11·1	34·2	42·8	61·6	73·4
Current Efficiency for available Chlorine %	57·7	21·8	21·2	11·6	13·3

I will not give the details of the following few experiments, made with a view to ascertain the influence of carbon anodes. The current was measured by the copper voltameter:—

C.—EXPERIMENTS WITH CARBON ANODES.

(AMOUNT OF SOLUTION, 150—250CC.)

	Cathode. Amalgamated Zinc.			Cathode. Mercury.
% Total Oxidising Cl......	47·2%	16·6%	.....	18·3%
Current Efficiency	1·07	13·4	......	12·7

D.—EXPERIMENTS WITH SMALL DYNAMO MACHINE.

(CURRENT MEASURED BY GALVANOMETER.)

Carbon Anodes.	Amalgam. Zinc Cathodes.		
Current Efficiency for available Cl	39·7%	......	11·3%
Total Oxidising Cl	1·07	......	3·78

I have not had time to find experimentally a satisfactory explanation why the results with carbon anodes were so much worse than those with platinum anodes. The carbon anode is rapidly acted upon, and disintegrated; the gases evolved contain carbonic acid to the amount of 3 per cent. But what are the chief products of the oxidation of the carbon, I have not ascertained. The solutions are coloured yellow when electrolysed by carbon anodes.

I have made a great many experiments with current densities, varying from ½ to 40 ampères per square foot, with vertical and horizontal electrodes, with various distances between them. There is only one result to be got, and that is a miserable current efficiency whenever you wish to reach a solution which shall equal a solution of about 1° Tw. of bleaching powder—*i.e.*, contain 5grms. available chlorine per litre.

This is as much of experimental evidence as I think is necessary to give a pretty correct idea of the commercial value of this process.

Messrs. Cross and Bevan have presented us with a calculation of the cost of producing bleaching solution by the Hermite process equivalent to one ton of bleaching powder.

They take as basis for their calculations—

(1.) One ampère-hour yields 1·47grms. of available chlorine, which, in my way of expressing results, is a current efficiency of 109·7 per cent.

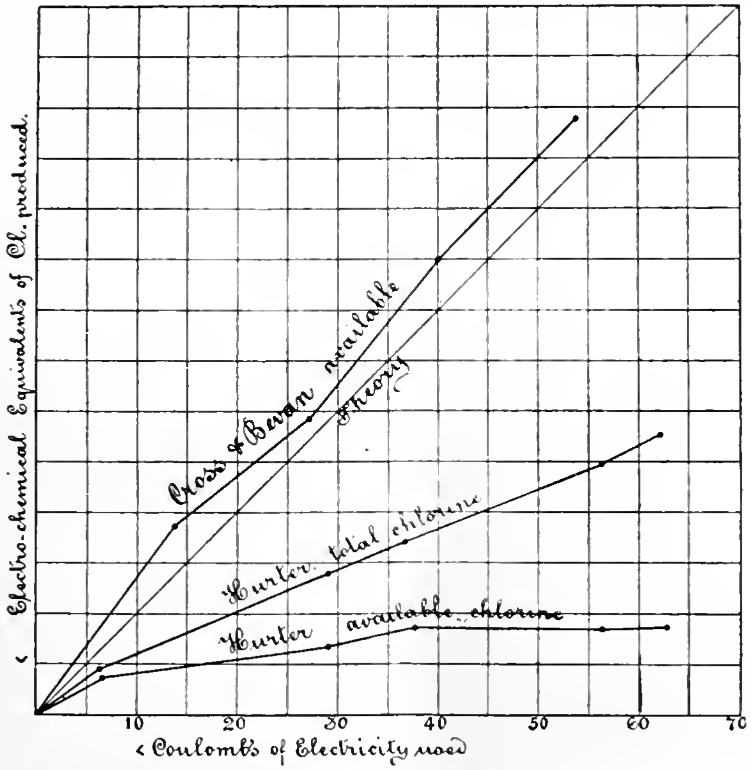
(2.) They assume that the available chlorine produced has greater bleaching efficiency than the same amount of available chlorine in bleaching powder in the proportion 3 : 5.*

(3.) They assume that the waste of magnesium chloride is inappreciable.

(4.) That an installation including dynamo for a current of 1000 ampères and 5 volts, steam engine, leads, and tanks, comprising platinum anodes, will cost £350; every such unit giving the equivalent of ⅙ ton of bleaching powder in 24 hours, or 1 ton per week.

They thus arrive at the result that the equivalent of one ton of bleaching powder costs £2 10s.

I will discuss these points one by one.



(1.) We will accept, for the moment, the basis, but

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* These two statements together mean that 1000 ampères decomposing $MgCl_2$ will give chlorine compounds of such efficiency as would equal free chlorine gas produced by 1800 ampères.

examine to what extent we should have to push the electrolysis in order to produce a bleaching solution containing, say, 5grms. of available chlorine, which is as much as a solution of bleaching powder of about 1° Tw. would contain. Since a 2½ per cent. solution of chloride of magnesium contains, in round numbers, 20grms. of chlorine per litre, we should have to carry on the electrolysis until 25 per cent. of the chlorine had become available chlorine. In none of my experiments with a 2½ per cent. solution of magnesium chloride was this result obtained, the highest being 21·8 with a current efficiency of 13·3 per cent.; and if we are satisfied with a bleach solution equivalent to a solution of bleaching powder of about ½° Tw., we may obtain it with a current efficiency of 20 per cent.

The explanation which Messrs. Cross and Bevan give for their current efficiency of 110 per cent. is that, owing to the incomplete separation of the ions, Faraday's law requires a different interpretation, and is inapplicable to the electrolysis of magnesium chloride. Professor Armstrong, in the discussion on their paper, said something must be wrong. I have clearly shown what is wrong. I have not only shown that this high efficiency is an illusion, but I have clearly shown what every single ampère has done in passing through the cell. I must, therefore, accept my own current efficiency as the only reliable one, though Messrs. Cross and Bevan assert that their measurements were accurate within 1 per cent. My experiments show that the reactions in the cell are totally incompatible with their results; that the reasons for the low current efficiencies are not to be found in mere physical or mechanical conditions, but are due to the fact which they themselves admit—the extensive complications with which this electrolysis is attended. There are certainly no indications in the inventor's specification of means to prevent the current electrolysing the very products of the electrolysis which he wishes to produce.

Thus, leaving as they stand the marvellously cheap plant, the cheap horse-power, and the extraordinary bleaching properties of the electrolysed solution, the cost of one ton of the hypothetical bleach rises in the proportion of 20:109, from £2 10s. to something between £13 15s. and £25, according as we are satisfied with a solution corresponding to a bleach solution of about ½° Tw. or 1° Tw.

(2.) The assumption of Messrs. Cross and Bevan that the electrolytic bleach liquor has greater bleaching power than a solution of ordinary bleaching powder rests probably on as insecure a basis as their statement and explanation of the high yield of chlorine. They explain that the bleaching compounds are of high tension. They assert that the solution contains hydrogen peroxide and higher oxides of chlorine. Some of the bleaching compounds were soluble in ether, and evaporated with the ether into thin air.

It is surprising to hear that the solution contains peroxide of hydrogen. Hydrogen peroxide is as deadly an enemy to hypochlorites as the Hermite process is, in Messrs. Cross and Bevan's opinion, to the present chlorine industry. The very fact that these two compounds do not exist in one solution has been made use of by Professor Lunge for a new method of estimating the chlorine in bleaching powder.* There is no chance whatever for peroxide of hydrogen to exist beside the hypochlorites. As to the higher oxides of chlorine, I have mentioned those I found. I searched for the missing one—the chlorite—but failed to prove its presence. Chlorates and perchlorates are useless to the bleacher. I am driven to the conclusion that the whole difference, if there really is one, is due to the difference in speed with which magnesium hypochlorite and calcium hypochlorite do their work, a difference which has already been noticed by other authors. Perhaps the solution contains a little free hypochlorous acid.

If bleaching is oxidation, the assumption that the magnesium hypochlorite will do 166 per cent. of the work which the equivalent amount of calcium hypochlorite would do, is as devoid of foundation as the assertion that Faraday's law did not directly apply to the electrolysis of magnesium chloride.

I for one must dismiss this higher efficiency as a basis of calculation, and I must consequently raise the price of the "hypothetical bleach" once more in the proportion of 3 : 5, which brings the price up to £22 8s. or £42, according to the strength of the solution required.

(3.) In estimating the horse-power necessary to do the work, Messrs. Cross and Bevan speak in the same sentence of using 5 volts, and of obtaining 600 Watts from 1 horse-power. If they really mean to employ a machine giving only 5 volts, they will find themselves greatly disappointed; the horse-power will yield more, nearly 400 Watts instead of 600, which will make another considerable difference in the prices calculated. And they take no notice of the resistance of the circuit, which might make very serious differences also.

Messrs. Cross and Bevan wind up by saying that the chloride of magnesium is not wasted. It is proposed to circulate the liquid between the electrolytic tank and the bleaching tank. That is very beautiful in theory, but my experiments show that it cannot work for any length of time. There would gradually accumulate chlorate and perchlorate in the solution, and the efficiency of the current would so deteriorate that I believe it will pay better to throw the solution away after using it once or twice.

That the current will electrolyse chlorates and hypochlorites as easily as the chlorides may appear strange, since it is known from Professor Kohlrausch's researches that chlorates do not conduct quite as well as chlorides, the specific conductivity of magnesium chloride being 71, that of chlorate 57. But it must not be forgotten that the final result of the electrolysis of an oxygen salt is hydrogen and oxygen evolved from liquid water, the corresponding electromotive force being 1·45 volts, while the result of the electrolysis of a chloride yields chlorine and hydrogen, the electro-motive force being 1·66 volts.

Thus, the one salt, the chloride, would require a little greater difference of potential between the electrodes than the oxygen salts.

Be that as it may, the fact is the current divides itself among the various salts, as is well known in other cases, and any accumulation of chlorates and perchlorates would mean a serious loss of efficiency. But if ⅓ of the solution has to be thrown away when only ¼ is made useful, this means an expense for chloride of magnesium, at present prices, of £2 10s. per ton of bleach produced.

We are told that the proprietors of the patent-right are fitting up a research laboratory. Let us hope they will have no cause to regret having acquired the patent-right first and fitted the laboratory last.

DISCUSSION.

Dr. Campbell Brown said he must congratulate the meeting on having the privilege of hearing a most admirable paper, which was characterised, as Dr. Hurter's papers usually were, by profound knowledge and skill, and by a most elaborate and persevering pursuit of truth through a long series of experimental observations recorded in a most precise

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* This Journal, 1886, 391.

manner. He supposed that every one who had endeavoured to decompose the chlorides of alkalis or alkaline earths had been puzzled by the apparently unaccountable proportions of hydrogen, oxygen and chlorine which were obtained. Some of them no doubt had come to the conclusion, without making quantitative determinations, that electrolysis was not satisfactory either for the production of chlorine or hypochlorite, but no one, he thought, had hitherto made quantitative experiments. Dr. Hurter had shown what really took place when the current passed through magnesium chloride, and the conclusions which he had made out were perfectly clear, and in accordance not only with Faraday's law, but with the fact, previously known, that the higher oxygen compounds of chlorine are produced by the electrolysis of chloride. Dr. Hurter certainly had advanced their knowledge of the subject very materially, and the manner in which he had done his work and placed it before them was beyond all praise. One could not avoid contrasting the clearness and precision of Dr. Hurter's paper with the absence of those qualities in the paper printed in the March number of the Journal.

Dr. Kohn remarked that the deficiency of hydrogen certainly showed that a secondary reaction had taken place with the formation of hypochlorite as shown, and asked if it might not be possible that the hypochlorous anhydride formed by the decomposition of the hypochlorite would combine with the hydrochloric acid, forming water and free chlorine. The chlorine would then act on the magnesium liberated and afterwards converted into magnesium hydrate, to form magnesium chloride, and thus account for the large percentage of this substance found at the end of the process. The cause of the deficiency of hydrogen would also be to some extent explained. As to the electrolysis of potassium chlorate, whereby oxidation to perchlorate took place, it appeared that if magnesium chlorate were formed to any extent, the deficiency of hydrogen would be to some extent made good.

Dr. Hurter, replying to the last speaker, said he presumed what was meant was that the deficiency of hydrogen could be accounted for by some hydrogen disappearing at the anode, owing to the oxidation of chlorate to perchlorate, and that there would be a deficiency of hydrogen at the cathode? That was not possible. The oxidation took place always at the anode, and when the electrolysis of chlorate proceeded they found the exact equivalent to the current of hydrogen in the gas. There was no hydrogen missing whatever. The gas which was missing in that case was the oxygen, and when they analysed the solution they found that the oxygen missing in the gas was retained in the form of perchlorate. That was the whole of the reaction that went on in the case of chlorate. In the case of hypochlorite, he understood Dr. Kohn to say that the missing hydrogen might be accounted for by the decomposition of the hypochlorite? He found that he had on the one side oxygen and chloric acid, and on the other side he ought to have its equivalent of hydrogen. With nascent hydrogen gas at the cathode, they might consider the cathode a sphere of reducing action, and a part of the work of the current consisted in reducing hypochlorite back into chloride, and he thought that the tolerably close correspondence between the results calculated from the gas analysis and on the strength of that explanation which forms the basis of the calculation, and those results calculated from the solution, showed that the explanation could not be very far wrong; and when they came to compare this statement with any number of reactions which are known to happen in the electrolytic cells—such, for instance, as the reduction of ferric chloride to ferrous chloride, the reduction of nitric acid, the reduction of chromic acid—they would find nothing strange in the fact that this very powerful oxidising agent, hypochlorite, should be reduced also. There was absolutely nothing new in his paper, as there was not much in Hermite's process. Two Russian chemists had published a book on electric bleaching ("Le Blanchiment Electrique," A Lidoff and W. Tichomiroff; Moscow, 1883), in which they showed that the result of the electrolysis was free chlorine, hypochlorites and chlorates. The circulating principle adopted by Hermite was described in *Génie Civil*, 1883, vol. iii. p. 367. There is very little new in Hermite's patent, except perhaps the fact that Hermite uses mercury as a cathode, and he did not think that was worth very much. The mercury very soon wore off the zinc plates, and there were other things just as good as pure mercury. The reactions he had explained were certainly true, and none of them new; and the only new thing, perhaps, was that he had shown the quantitative relation of the various products. It was very easy for any chemist to see that the more concentrated the solution becomes with hypochlorous acid, the more chlorate will be produced at the anode, and the more hydrogen will be oxidised at the cathode. Where the solution contains to begin with only pure magnesium chloride, there would be fully 100 hydrogen, and there would be fully 100 chlorine for every 100 coulombs, but as soon as the molecules of hypochlorites and chlorates increase in number, part of the current electrolyses them, and they could no longer expect to get 100 per cent. of chlorine from the current. Of Faraday's law there was not failure, but it is impossible to get chlorine from that part of the current which does other work than that of electrolysing magnesium chloride.

Mr. A. Watt asked, if the solution got warmed in passing a current through it, would it facilitate the formation of chlorates?

Dr. Hurter, in reply, said it would very materially. The chlorates were formed from the very beginning, and they were formed in tanks of 30 litres just as much as they were in a small cell holding 50cc.

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DISCUSSION ON MR. WESTMORELAND'S PAPER, "DETERMINATION OF SULPHUR IN PYRITES" (February Journal).

Mr. E. K. Muspratt said that in their experience as buyers they had hardly any difficulty, as their tests for the sulphur in pyrites agreed generally with that of the seller's chemist. He was not quite certain whether Mr. Claudet used exactly the same method which they did, which, he believed, was the one advocated in Dr. Lunge's Pocket-book, but the methods adopted must be sufficiently accurate, since the results really did not differ to any considerable extent. Mr. Westmoreland said that it might be supposed that these differences would operate in favour of uniform methods of analysis, but apparently Mr. Westmoreland objected to that inference, because forsooth the introduction of standard methods would result in work being done by rule-of-thumb. He did not know whether the Society would appreciate that reasoning, but he certainly could not. It was desirable that they should decide upon and adopt where possible uniform methods of analysis. That they should use the best method in preference to others seemed to him perfectly reasonable, and the only question was whether the Lunge method was better than others. If so, he thought that all chemists should adopt that method, and in that way they would arrive at a uniform method. The differences in results were now very small; probably because more or less uniform methods were now adopted. There was another suggestion which Mr. Westmoreland made, which he certainly thought would be rather impracticable; it was, that as the consumer of pyrites did not make use of all the sulphur for which he paid, the burnt ore should be analysed as well as the raw ore, and that then there should be a deduction made so that the consumer of the sulphur should practically pay upon the difference between the sulphur in the raw ore and the sulphur in the burnt ore. As a consumer of sulphur, he (Mr. Muspratt) should be very glad if such a system could be adopted, but he did not see how it could be done, and he was afraid that there would be greater differences than there are now, in the settlement of the sulphur tests. They frequently forgot, when discussing questions of commercial tests, that the great point was to have some uniform system and practically uniform results. If that uniform system gave too high a result, the consumers would very soon find it out and settle it in the price. This was commonly done by all who had a commercial knowledge. If any method of analysis gave too high a result, or if they found any analytical chemist gave a higher result than another, they would take very good care to discount that when making their bargain. It was very well known in the potassium tests, in settling the price of muriates, that Dr. Ulex's tests differed from the Glasgow tests by 1¼ to 2 per cent. Sometimes they bought their muriates by the German test, and they took good care not to pay the same price as if they bought by Mr. Tatlock's test. All they required as commercial men was that some method should be adopted which gave uniform results. Another suggestion which Mr. Westmoreland made was that an allowance should be made for the lead, lime, and zinc in the ore. This would entail considerable difficulty, since they would have to estimate the lead and zinc before they could decide upon the amount of sulphur to be paid for. For these reasons he did not think that the practical suggestions which Mr. Westmoreland made were of very much value. It was very interesting to have tabulated the practical experience of differences of tests which he pointed out. He hoped that the discussion would lead to a more uniform method being adopted.

Dr. HURTER said that Mr. Westmoreland had expressed an opinion that the introduction of standard methods would lead to the employment of chemists who would not have the ability nor the time to investigate methods for themselves. Now he (Dr. Hurter) must say that in works they had plenty of other matters to investigate beside methods of analysis, and he for one was always thankful when scientific men supplied them with methods, and saved them the trouble to investigate for themselves. As regards Dr. Lunge's second modification of pyrites assay, he had no doubt that Dr. Lunge would not have introduced it if he had not found that the other method now and then gave wrong results. Dr. Lunge, however, was able to defend himself, and would, no doubt, do so if he thought it worth while. Altogether it appeared to him that there was much ado about nothing. At present prices, 1 per cent. of sulphur was 3d. per ton, consequently ¼ per cent. was three farthings, and he really did not think it was worth while to quarrel so much about so little.

Mr. WESTMORELAND, in reply to Mr. Muspratt's observation that if results higher than the truth were returned, the buyers would very soon find it out, said that the variable results he had recorded had not been detected either by the buyers' or vendors' analysts, although the thing had been going on for years, and that if it were necessary he would give tonnages of parcels with vendors' and purchasers' names in support of his statement, and he believed that the errors were not detected simply because there was no personal incentive for anyone to trouble about the matter. His suggestion was not that each parcel of ore should be tested separately for zinc, lime and lead, but that a deduction based on an average analysis should be made; but if buyers preferred the present system, let it remain. Regarding "rule-of-thumb" methods, his experience differed from Mr. Muspratt's, for many serious discrepancies had arisen from the fact that tests were made by young and inexperienced chemists by what may be termed "standard methods." Published instances of this might be found in his (Mr. Westmoreland's) paper on copper tests (this Journal, February, 1886), where they could see the discordant results of works tests of copper samples (nearly all the results being obtained by the same well-known process). In reply to Dr. Hurter, he might say that until recently sulphur was 6d. per unit, and when errors of 1 per cent. and upwards were made, for years the matter was much more serious than Dr. Hurter seemed disposed to admit. Of course, now that sulphur was less valuable, the subject was not of such importance.

Manchester Section.

Chairman: Sir H. E. Roscoe, M.P.

Vice-Chairman: I. Levinstein.

Committee:

Dr. Bowman.
R. F. Carpenter.
C. Estcourt.
H. Grimshaw.
Peter Hart.
Dr. Gerland.

C. Schorlemmer.
Dr. Schunck.
Dr. Watson.
Wm. Thomson.
L. Siebold.
Dr. Hewitt.

Local Secretary:

J. Carter-Bell, Bankfield, The Cliff, Higher Broughton,
Manchester.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held March 1, 1887.

MR. IVAN LEVINSTEIN IN THE CHAIR.

ON THE ESTIMATION OF CAUSTIC SODA IN SODA ASH.

BY ROWLAND WILLIAMS, F.C.S.

THE author stated that the methods usually employed for estimating caustic soda in soda ash—viz., by precipitating with barium chloride, and either allowing the precipitate to subside and titrating a portion of the clear fluid with normal hydrochloric acid; or boiling, filtering, and washing the precipitate, and titrating the filtrate and washings with normal acids—gave too low a percentage of caustic alkali, due to the fact that some of it is carried down and tenaciously retained by the barium carbonate. The following method is found to give absolutely accurate results:—A weighed quantity of ash is treated with strong alcohol in a stoppered flask, frequently shaken and allowed to stand overnight; the undissolved carbonate is filtered off and washed with strong alcohol until a drop gives no alkaline reaction; the filtrate and washings are then titrated with normal acid.

DISCUSSION.

Mr. CARTER BELL said that Mr. Peter Hart had given him the process to be found in the following paper, which was considered to be both more accurate and simple than that devised by Mr. Williams. Mr. Watson Smith had also drawn his attention to his paper published in this Journal, 1882, pages 85–88, in which the subject of the retention of alkali and the conditions of such retention are fully dealt with, as well as to the accurate and very expeditious process of Winkler, described in Lunge and Hurter's Pocket-book, p. 115.

* * *

ON THE ESTIMATION OF THE RELATIVE ACCOUNTS OF CAUSTIC AND CARBONATE OF SODA IN COMMERCIAL SODA ASH.

BY PETER HART.

As a rule, the method of analysis which is quick and moderately exact is the one preferred in a works laboratory. With this view we have adopted the following method of estimating the relative proportions of caustic and carbonated soda in a sample of soda ash :—50 grains of the sample is dissolved and made up to about half or three-fourths pint of water ($\frac{1}{2}$ to $\frac{3}{4}$), a little phenolthalein added, and the test acid (1 decem = 0·5 Na_2O) slowly run in until the colour disappears. At this point all the caustic soda and *one half* the soda exisiting as carbonate has been neutralised, the number of measures—say 30—is noted. To the same solution (the soda in which now exists as bicarbonate), a little methylorange is added, and the addition of acid from same burette continued, until the usual colour reaction indicating neutrality occurs—say the burette now reads 50. Then 50 – 30 = 20 as bicarbonate which originally existed as monocarbonate in the sample. This, therefore, must be doubled = 40. This, deducted from the total number 50, leaves 10 existing in original sample as caustic soda. The first stage of this method is identical with Mr. R. T. Thompson's method (*Chem. News*, 1883, 127), but instead of using methylorange, which we prefer as being more expeditious and equally exact, he boils and adds the standard acid until the phenolphthalein is finally discolourised.

* * *

Meeting held April 5, 1887.

MR. IVAN LEVINSTEIN IN THE CHAIR.

ON A RAPID METHOD OF DETERMINING THE TOTAL ACIDITY IN FLUE GASES FROM VITRIOL CHAMBERS, ADAPTED FOR THE USE OF WORKMEN.

BY W. YOUNGER.

In the manufacture of sulphuric acid a test is usually made of the gases escaping at the chamber vent.

This test is necessary, both as a check upon the working of the chambers, and also for the purpose of keeping the escape within the requirements of the Alkali Act. One arrangement frequently employed for this purpose is what is called the constant aspirator, or self-registering apparatus for testing flue gases. It consists of an ordinary Bunsen's water pump and a wet meter.

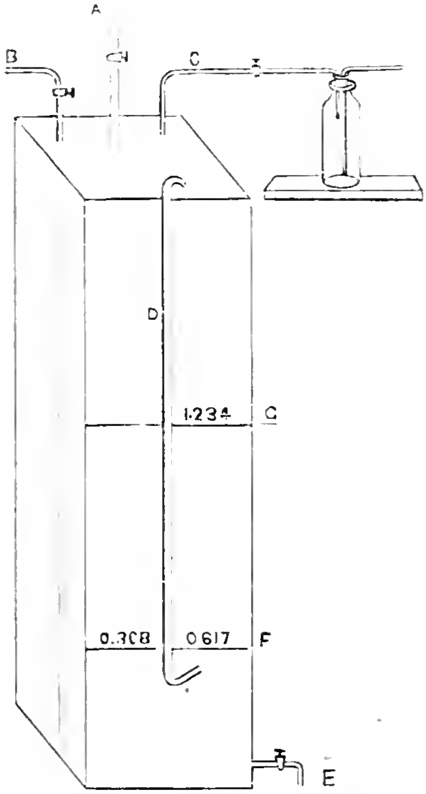
The gases are absorbed by drawing them through a measured quantity of a standard solution of caustic soda, which must be always in excess.

After taking the aspiration the solution is made up to a given volume, and a measured portion of it titrated with standard acid in order to ascertain the excess of soda left in the solution. In this way the amount of soda taken up by the gases is obtained, which after calculation is expressed in grains SO_3 per cubic foot.

This arrangement is kept constantly at work, and may be taken off once in twelve or twenty-four hours, in order to ascertain what the escape has been.

A test may be made in a similar manner to this, only using a cubic-foot box in place of a Bunsen pump, but, as this will only give you a test over a comparatively short time, say for half-an-hour or so, it is not so satisfactory as the method I have just described.

The method I am about to describe is one which was adopted for the use of the works foreman only, so that he might make a rough and ready test in order to ascertain what his escape might be.



The apparatus consists of a rectangular-shaped cast-iron box as shown in the figure. A is a water pipe for filling the box with water; B, an air pipe for allowing the air to escape; C, the tube connected to the bottle in which the aspiration is taken; D, a gauge glass for the purpose of reading off; E, the tube for running off the water in taking the aspiration.

Only one bottle is employed for absorbing. The absorbent in this case is also a measured quantity of a standard solution of caustic soda, coloured with litmus as an indicator.

In order to ascertain if the absorption of the gases be sufficiently complete for the test I had in view, a second bottle was attached containing distilled water only, when on drawing through the gases it was found that the soda in the first bottle was taken up, the solution assuming a red colour, while no acidity was shown in the second bottle containing water only.

In making a test you proceed as follows: Into a bottle are put 10cc. of a centinormal solution of caustic soda coloured with litmus. This quantity will equal 0·617 of a grain SO_3. The bottle is then coupled up to the aspirator and the gases from the chamber vent drawn through. From the top of the box down to the line marked F, represents one cubic foot; and if the solution in the bottle changed colour when the level of the water in the gauge-glass stood at this line, then the total acidity in one cubic foot of the gases would be equal to 0·617 of a grain SO_3; or again, from the top of the box down to the line marked G represents half a cubic foot, and if the solution in the bottle changed colour when the level of the water in the gauge-glass stood at this line, then the total acidity in one cubic foot would be equal to twice 0·617 or 1·234 grains SO_3, and so on, so that a table can be constructed the length of the box.

It was thought desirable that lower readings than 0·617 of a grain should be obtained, so a table was constructed down the other side of the gauge-glass, so that if a reading be not obtained when it has reached 0·617, the aspiration is stopped, the box filled up, restarted, and a reading taken down the other side. In this way readings as low as 0·308 of a grain per cubic foot can be obtained.

This is a method which makes no pretensions to any great degree of accuracy, as it was intended only for the use of the foreman to serve as a guide to him in the working of his chambers.

DISCUSSION.

Mr. R. F. Carpenter said that he had found Mr. Younger's apparatus to be very useful where foremen of works required to take rapid readings. It might be of interest to members to know that there was also another form of apparatus which seemed to him equally useful, and which had an additional advantage from the fact that the test solution used was not caustic soda, but iodine and some solvent potassium iodide. A Woulff's bottle was used, and the connection made with the exhaust by means of a thin indiarubber ball, so many squeezes of which represented a cubic foot. If one squeeze represented only four grains, the foreman then saw how many pounds of nitrate of soda were to be put into the pot, and this seemed to him quite as quick a way as that described by Mr. Younger, and it also carried the operation a little further. A knowledge of these things was a great aid in the performance of their duties.

Dr. Grossman said they were all very much obliged to Mr. Younger for bringing this apparatus before their notice, and thought it a great pity that it was not better known. It was nine or ten years since its first introduction by his (Dr. Grossman's) friend, Dr. Hurter, and the best description of it is in Wanklyn's book on "Gas Analysis." The most useful property of the apparatus was that you could easily tell how far the combustion was carried on—what fuel was used, and how much was wasted. This was a very important matter, and one which was of general use in nearly every chemical manufactory. He had been able in this way to test new furnaces in which they were blowing air through the fire instead of burning it in the usual way, and they had been able to get almost perfect combustion.

Mr. William Thomson thought Mr. Younger had not brought this apparatus forward as his own. He believed he had brought it forward to show how serviceable it was for work, and he thought simple suggestions of that sort brought before gentlemen connected with the various branches of industry were very useful. He took it to be one of the objects of the Society to bring forward any apparatus which might be overlooked by others, and which need not necessarily be something new. The arrangement of the bottle and the fact of being able to measure the heights of the liquids as they passed through the tubes, had their advantages. Mr. Younger that night had only got 19 per cent. from his air, whereas a fortnight since he obtained 22½. With regard to the other box, in which he measured the total acid passing up the chimneys, that was another useful apparatus, the application of which was most interesting to those engaged in that particular industry, where a man could stand with his neatly-appointed tap and at once weigh off the number of grains of SO_3 per cubic foot.

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ON A CONVENIENT MODIFICATION OF ORSAT'S METHOD FOR THE ESTIMATION OF OXYGEN.

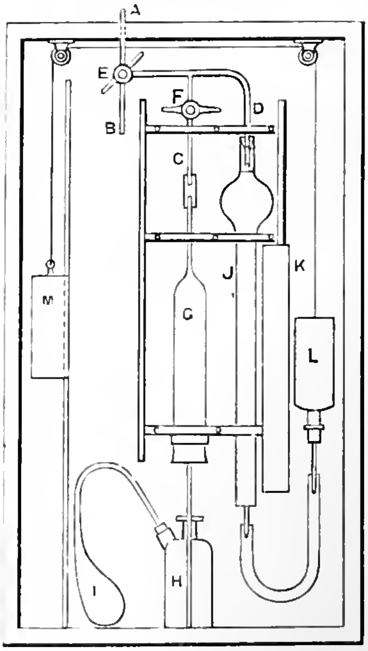
BY W. YOUNGER.

The apparatus I am about to describe to you is intended for the estimation of oxygen.

It is on the same principle as Orsat's, but of somewhat different construction.

It was first employed at the works of Messrs. Charles Tennant & Co., St. Rollox, Glasgow, but to which I have added a slight modification.

At the top of the annexed figure we have a set of tubes, one end of which, A, projects through the top of the box for the purpose of coupling it up to the source from whence the gases are to be drawn; B is another open end pointing downwards, while the other two ends, C and D, are coupled up, one to the absorbing tube, and the other to the graduated tube. E is a two-way tap, F a one-way tap. G is the absorbing tube containing the coil of copper-wire gauze; H a small Woulff's bottle containing the absorbing solution of ammonia chloride of copper; I an indiarubber ball for the purpose of forcing the absorbing solution up into the absorbing tube. J is



the graduated tube, and from zero at the bottom is graduated up to 25cc., divided into tenths, while to a mark immediately above the bulb is equal to 100cc.—the measured quantity of the gases to be operated upon. K is a scale for the purpose of reading off, which is the modification I have introduced. The lower end of the graduated tube is coupled up to a bottle L, which is inverted, through a hole in the bottom of which passes a piece of catgut knotted at the end. The catgut passes over two small pulleys, one at each corner, and to the other end of which is attached a balance-weight M, consisting of a piece of wood which slides up and down in a box. The inverted bottle L is filled, or nearly filled, with water, by lowering and raising which the gases are drawn in or expelled in making a test.

The method of using this apparatus will be apparent.

Newcastle Section.

Chairman: P. P. Bedson.

Vice-Chairman: J. C. Stevenson, M.P.

Committee:

Alfred Allhusen.
G. T. France.
John Morrison.
F. S. Newall.
John Pattinson.
J. B. Payne.
H. R. Procter.
B. S. Proctor.
W. W. Proctor.
W. L. Rennoldson.
C. T. Richardson.
T. W. Stuart.

Local Secretary and Treasurer: J. T. Dunn, 115, Scotswood Road, Newcastle.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held in the Chemical Lecture Theatre of the College of Science, Wednesday, April 20, 1887.

MR. B. S. PROCTOR IN THE CHAIR.

THE RECOVERY OF FERROCYANIDES FROM LEBLANC SODA LIQUORS.

BY F. S. NEWALL AND GEORGE SISSON.

So long as the Leblanc soda process continues to exist, the occurrence of ferrocyanide in the crude liquors produced in that manufacture must continue to have a very vital practical interest, inasmuch as such ferrocyanides are, when decomposed, the chief cause of the discolouration of the products. In fact, but for such ferrocyanides, the ordinary Leblanc ash could be made practically as white as ammonia ash.

Hence it is not surprising that many efforts have been made from time to time to remove or to prevent the formation of such cyanides, but all such attempts were processes of destruction, not recovery.

It might be well to state here, before going into a historical review of the subject, what the accepted theory of the formation of ferrocyanide in the Leblanc soda process is. The source is generally admitted to be the nitrogen of the mixing coal used in the balling furnace. This has been proved by using pitch or some such carbonaceous matter free from nitrogen as a substitute for mixing coal, when it was found that the balls contained little or no cyanide. The nitrogen of the air is no doubt capable of forming cyanides in presence of an alkali in a reducing atmosphere of carbonic oxide—for example in blast furnaces—but it has been shown that this is small in comparison with that formed from the nitrogen of the mixing coal, which contains generally from ½ to 1½ per cent. of N. The stages of formation of ferrocyanides can be shown by extracting ball soda with alcohol, the solutions showing cyanide of soda, and the extracted mass when lixiviated with water shows no ferrocyanide.

In 1853 Gossage took out a patent for separating ferrocyanide of sodium from other compounds of sodium in black ash liquors by means of repeated crystallisation, and if one may judge from the patent list, the subject appears to have been almost dropped till it was revived by the introduction of ammonia soda, making it necessary that Leblanc soda makers should improve the colour of their ash.

In 1866 Williamson proposed to remove the ferrocyanides by heating the liquors to 155° C. under pressure in an iron boiler, but this was given up on account of the hard crusts which formed in the boiler, rendering the process both difficult and dangerous to work.

The next process of interest was Pechiney's, which was introduced into England in 1877 by the late Mr. Walter Weldon, and consisted in adding, just before drawing the batch, sodium sulphate, which oxidised the cyanide into cyanate, and thus prevented the after-formation of ferrocyanide. Even this process leaves some ferrocyanides in the resulting liquors stated to be at least 0·03 per cent., and often 0·25 per cent. of the total alkali.

Several patents were taken out in 1878 and 1879, bearing more or less on Pechiney's, which were never worked commercially, and need not be more than mentioned here.

Gaskell in 1878 took out a patent for blowing a current of air and steam into the revolver during the working of the batch, for the purpose of oxidising the cyanide into cyanate, but the main reaction of the revolver being a reducing one, it is very difficult to make it slightly oxidising also.

In 1879 a patent was taken out by Messrs. Carey, Gaskell and Hunter for oxidising the liquors by injection of flue gases, and then pumping the liquors through coils of pipes at a temperature of 150° C., thus converting the ferrocyanide into sulphocyanate. This was a practical success so far as the destruction of the ferrocyanides went.

Mention should be made of the Thelen pan for evaporating the tank liquors, fishing and drying the salt at a temperature below 150° C., thus preventing the decomposition of the ferrocyanide, and so the discolouration of the ash.

Also of apparatus devised and patented by MacTear, for breaking into small pieces the batch as it was emptied from the revolver, thus exposing a large surface to the air. We tried this before MacTear, and found that the proportion of cyanide was much reduced.

Most of these processes seem to have expired, and the plan now is to allow the ferrocyanides to be destroyed in the calcining furnace, when a more or less red ash results; if white alkali is required, to redissolve this and separate the oxide of iron and other impurities by filtration or settling.

We will now describe a process which we have worked satisfactorily at Washington, and which we believe to be quite new, and as it has not been patented, we give it now without reservation, and for what others may consider it worth.

In making soda crystals direct from tank liquors, that is without previous calcination, it was found, naturally enough, that the whole of the ferrocyanide was concentrated in the mother liquors, which, on being evaporated and dried in the usual way, gave a weak alkali—not as is usually the case white, but a dark red or brown, which necessitated redissolving it to produce white alkali.

The amount of soda ferrocyanide was sometimes as much as 5 per cent. on the total alkali present, so that it seemed worth while to separate and use it in some way, and after very many trials the following process was adopted :—

The mother liquor from the crystals was run into a cast-iron cylinder, fitted with an agitator, and treated with a zinc salt in excess of the ferrocyanide present, and any caustic soda present in the liquor removed by CO_2 gas blown in till some bicarbonate of soda was formed. As a matter of fact the caustic rarely reached 1 per cent. on account of the thorough previous carbonation of the tank liquors by flue gases.

The zinc salt thus added completely removed the ferrocyanide from solution as zinc ferrocyanide, the latter being filtered off by means of a filter-press, and washed free from soda. The filtrate on being boiled down and calcined gave white alkali direct. The cakes in the press, consisting of zinc ferrocyanide, were treated with a boiling solution of caustic soda so as to obtain the ferrocyanide in a soluble form, and filter pressed, giving cakes of zinc oxide. Lastly, the solution of sodium ferrocyanide was added to a ferric salt — made from copperas, nitrate of soda, and H_2SO_4—giving a pure Prussian blue which was filter pressed into paste for the use of papermakers, etc.

The recovered ZnO in cakes from the press was made into a cream with water or the crude mother alkali liquors, and used for treating a fresh portion of liquors. Thus the zinc can be used over and over again, the mechanical loss having to be made good with fresh zinc salt.

It will be noticed that in the above process an equivalent of caustic soda is used in the treatment of the zinc ferrocyanide cakes, and as caustic soda is rather an expensive base, it was thought desirable to find a cheaper one, this being found in a soluble sulphide of calcium, large quantities of which we were then and are still making.

The calcium sulphide acts quite easily and completely on the zinc ferrocyanide, producing zinc sulphide and calcium ferrocyanide, which is quite soluble, and can be easily separated by a filter-press, and used equally well for making paste blue.

There is another form of cyanide occurring in such liquors—viz., sulphocyanate. After the removal of the ferrocyanide, the sulphocyanate still remains, and on acidifying and adding ferric chloride, a blood-red precipitate is produced, without any blue precipitate: but as this salt remains perfectly white on calcining, or rather is probably converted into sodium carbonate, no efforts were made to remove it.

Of course it will easily be seen that prussiate of potash could be made instead of Prussian blue, by treating the calcium ferrocyanide solution with sulphate of potash, filtering off the calcium sulphate and separating the prussiate of potash by crystallisation in the usual way.

The sample of blue on the table is from many tons made by the calcium ferrocyanide method.

The process depends on—

1. The stability of zinc ferrocyanide in a cold solution of soda, free from caustic.

2. The readiness with which zinc ferrocyanide is decomposed by caustic alkali or alkaline sulphides, or calcium sulphides.

The tests we used were—

For caustic, a solution of barium chloride, about twice normal, added in excess to a portion of liquor, and well shaken. A few drops of an alcoholic solution of phenol-phthalein gives a pink colour as long as any caustic is present.

For ferrocyanide, a portion of liquor filtered, acidified by HCl, a drop or two of ferric chloride added will give a blue precipitate so long as any ferrocyanide exists in the liquor. When all is removed, a clear red colour of ferric sulphocyanate is produced.

In treating zinc ferrocyanide with calcium sulphide, the reaction is complete when a well-boiled portion filtered, shows slightly black with lead acetate.

The ferrocyanide in the liquors was generally estimated by acidifying, and precipitating with ferric chloride, and washing the Prussian blue precipitate, decomposing with a little caustic soda, and titrating with standard permanganate of potash, standardised by pure crystallised potassium ferrocyanide.

SAMPLES.

No. 1.—Liquor showing ferrocyanide, and sulphocyanate.
 ,, 2.—Liquor showing sulphocyanate only.
 ,, 3.—No. 1, dried below 150° C., as in Thelen pan.
 ,, 4.—No. 3 calcined, showing red oxide of iron from decomposition of ferrocyanide.
 ,, 5.—No. 2 calcined, showing no red oxide.
 ,, 6.—Zinc ferrocyanide.
 ,, 7.—Prussiate of soda crystallised.
 ,, 8.—Prussian blue paste.

DISCUSSION ON DR. SMITH'S PAPER (READ AT FEBRUARY AND MARCH MEETINGS).

MR. JOHN PATTINSON asked if Dr. Smith's method was applicable to the analysis of organic mixtures: it seemed to him that it would only be practicable by it to determine the amount of a single known substance where nothing else oxidisable by permanganate was present. He referred to Dr. Smith's strictures on the use of permanganate in water analysis, and pointed out that though the results were empirical, yet it afforded good comparative estimates, especially in successive examinations of the water from a single source. He had formerly employed it for estimating organic matter in the effluent water from paper works, and other sources, and had found it give very satisfactory results. He noticed that Dr. Smith spoke of the precipitated oxide as having a composition corresponding to the formula MnO_2. He had formerly experimented on the precipitation of manganese in this form with a view to its determination, and had found great difficulty in obtaining it as MnO_2. On reducing permanganate with alcohol, the precipitate contained only about 84 per cent. of the available oxygen corresponding to MnO_2: and on precipitating manganese salts in presence of bleaching powder or bromine, the precipitates always exhibited a deficiency of oxygen until the idea of adding ferric chloride or zinc chloride suggested itself.

DR. SMITH said the method was as yet in an experimental state: ultimately, he hoped to be able to determine the carbon dioxide produced in the oxidation, in which case there would be two data, giving the means of determining each substance in a mixture of two known bodies. Of course the nature of the substances present would have to be known before the method could be applied. Former methods making use of permanganate had been in error owing to the loss of oxygen, which he had been able to overcome. He could confirm Mr. Pattinson's statement that great difficulty is experienced in oxidising a manganous salt completely to the form of MnO_2 by means of permanganate, without employing a certain excess of the reagent.

MR. DUNN had formerly had occasion to make some experiments, which bear somewhat upon the question of the composition of the precipitate. He had boiled together solutions of permanganate, and of manganese sulphate. He found that when the respective molecular proportions of the two were as 2 to 1, the reaction was represented by the equation—

$$2KMnO_4 + MnSO_4 = 3MnO_2 + K_2SO_4 + O_2.$$

and that as the proportion of the permanganate was lessened, so also was the amount of oxygen evolved, till when the proportions were two molecules to three, there was no oxygen given off, and the reaction was as follows:—$2KMnO_4 + 3MnSO_4 + 2H_2O = 5MnO_2 + K_2SO_4 + 2H_2SO_4$. Analysis in all these cases showed the precipitate to consist of MnO_2. When the proportion of permanganate was lessened (or that of the sulphate increased) beyond this, still no oxygen was evolved, the whole of the available oxygen of the permanganate going to form an oxide, but this oxide invariably now contained less oxygen (or rather, perhaps, more manganese) than corresponded with MnO_2. Possibly this arises from the feebly-acid nature of MnO_2, which enables it to decompose some of the sulphate, taking its MnO as base; and probably the effect of Mr. Pattinson's addition of ferric or zinc chloride, is due to his substitution of another base, enabling the whole of the manganese to play the acid part as dioxide. It would be interesting to know whether Mr. Pattinson's precipitates contain any iron or zinc. When the permanganate, in the above-quoted experiments, was in the proportion of four molecules to one of sulphate, the first of the above reactions still took place, the whole of the excess of permanganate remaining unacted on. From this he was inclined to suppose Dr. Smith in error in attributing the loss of oxygen in his earlier experiments to action of dioxide on permanganate, considering it rather due to the action between permanganate and manganese sulphate, when the former was present in greater proportion than that represented by the second of the above equations. He desired lastly to enter a mild protest against Dr. Smith's use of the word "normal." That word having been appropriated to signify a solution containing the equivalent in grms. of some substance per litre (though he admitted there was occasionally a little looseness exhibited in determining on what basis the solution should be made, whether, for example, grms. of permanganate, or grms. of available oxygen per litre), it seemed a pity to use it for solutions of arbitrary strength, where the word "standard" would be equally applicable.

Dr. Smith thought that Mr. Dunn's results were explicable, if the acidity or alkalinity of the solutions was taken into account. He had shown that there was no less of oxygen in neutral or alkaline solutions, and it would be noticed that as the proportion of permanganate increased, the acidity of the solution, after reaction, diminished, till at the proportion of $2KMnO_4$ to one of $MnSO_4$, the free acid was neutralised, and no addition of permanganate beyond the actual point of neutrality would cause any additional loss of oxygen. He agreed, however, with Mr. Dunn that the acid character of MnO_2 had much to do with the reaction, and was rather inclined to think that the formation of a compound such as $K_2Mn_5O_{11}$, would mark the final stage in the decomposition (although, not having tried Mr. Dunn's experiment, he could not speak definitely), and that doubtless the formation of corresponding compounds with zinc and iron, explained Mr. Pattinson's results; but that could not be the explanation of the action of the ferric salt in stopping the evolution of oxygen in his (Dr. Smith's) method, for in that case zinc, like iron, should have been efficient, which was not at all the case. In regard to the use of the word "normal," it was usual on the Continent to apply the term to such permanganate solutions as these mentioned in the paper. They were of convenient strength; and if you adopted the other plan you must often, for convenience, make use of half, quarter or deci normal solutions.

Errata.—In Dr. J. H. Smith's paper (Feb. Number), p. 101, 1st column, 23rd line, *for* "excess" *read* "access." P. 105, 1st column, the equation should read $K_2Mn_2O_8 + nMnO_2 + H_2SO_4 = (n+2)MnO_2$, etc. P. 107, 2nd column, 13th line, *for* "1cc." *read* "1·1cc." P. 109, 1st column, 10th line from bottom, *for* "108cc." *read* "51cc."

Glasgow and Scottish Section.

Chairman: J. Neilson Cuthbertson.
Vice-chairman: Prof. Mills.
Hon. Vice-chairman: E. C. C. Stanford.

Committee:

J. B. Adam.
J. Addie.
Prof. Crum-Brown.
J. Y. Buchanan.
J. Christie.
W. J. Chrystal.
W. S. Curphey.
Prof. Ferguson.
J. Fyfe.
R. Irvine.
T. P. Miller.
J. M. Milne.
J. Pattison.
R. Pullar.
R. R. Tatlock.
A. Whitelaw.

Hon. Treasurer:

J. J. Coleman, Ardarroch, Bearsden, near Glasgow.

Local Secretary:

G. G. Henderson, Chemical Laboratory,
University of Glasgow.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

The Seventh Meeting of the Fourth Session of this Section was held in the Societies' Rooms, 207, Bath Street, Glasgow, on Tuesday, May 3, 1887.

MR. J. NEILSON CUTHBERTSON IN THE CHAIR.

ADDENDUM TO DISCUSSION ON MR. SUTHERLAND'S PAPER ON "SCALE TESTING" (THIS JOURNAL, VI. 271)

Mr. Hunter agreed with Mr. Hamilton as to the changes which had come over the paraffin industry. There was no doubt that only one or two unimportant works were now producing scale likely to go into the market as "scale." All the larger works were now making preparation for making candles, and in that way were using up their own scale. It was, therefore, not such an important question as it was a few months ago. Referring to the presses adopted, the number or size of men had always, he said, been an unknown quantity in testing scale. Definite results could never be got even by screwing the press up to a certain point, as it was well known how results obtained by screw-presses varied. A year or two ago his colleagues Mr. J. Falconer King and Mr. Wm. F. King had worked out a press which fulfilled all the purposes required. It was exceedingly simple, but very efficient, and the pressure exercised upon a given surface could always be got to an ounce. It consisted simply of a bent railway iron bar with a steel face let in. There was also a long beam with a knife edge working on the steel face, and on the end of the beam weights were hung. The screw, which was used only for keeping the beam in a horizontal position, rested on the top of the disc, and the conditions were the same in every respect as in the present press, except that there was no friction whatever. The direct pressure exerted on the square inch could be weighed to an ounce, and in that way it was a distinct advance on any other method adopted in scale testing. All the necessary precautions alluded to by Dr. Wallace were adopted, and the press could be arranged to any required temperature by means of a trough of brine, or glycerine, surrounded by a freezing mixture, circulating through the plates. He was in the habit of pressing scale at a temperature of 60°, and no difficulty was experienced in keeping the temperature constant. The press was, in his opinion, a great advance upon any other method; that at present adopted by the oil trade was very absurd.

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DISCUSSION ON MR. STEUART'S PAPER ON "BROXBURN PETROLEUM" (THIS JOURNAL, VI. 128).

Mr. Hamilton assumed that it would be well known that Broxburn had been surrounded by five or six different shale mines all on fire, and that consequently there was a certain amount of that shale oil in the strata which was constantly percolating through it. He regretted Mr. Steuart's absence, as he should like to have known whether or not this brine and petroleum occurred in the same place, or whether the petroleum did not occur near some place where a shale fire had been raging, and was it not simply the result of distillation of the shale by means of the destruction of another part? The oil more resembled an artificially-distilled oil than any natural oils he ever saw.

Mr. Hunter concurred in the remarks of the previous speaker. He had seen and examined this so-called petroleum. There was not the slightest doubt about it being paraffin oil that was discovered, and it was also perfectly well-known that in different directions where fires had occurred it was semi-solid paraffin. Mr. Steuart mentioned in his paper that it was of high viscosity to pump. It was certainly of high viscosity, as it was not petroleum, but partially filtered oil. The brine to which reference had been made was similar to that found in pits in many other places, and was in no way proof of petroleum.

Dr. Wallace said that when Boghead coal was first discovered, there was also a discovery at Binnie Quarry, near Bathgate, of a kind of bitumen which, on distillation, gave a large quantity of oil, and that bitumen was certainly an indication that petroleum might exist in some of the strata. The occurrence of that bitumen was, of course, before the paraffin industry commenced, or at the very commencement of it. He thought, therefore, that while it might be correct that this particular sample of petroleum was the result of fire in the mines, it was not at all impossible that petroleum might be found in Scotland. The occurrence of bitumen in Binnie Quarry was a certain indication that there was something of the kind in the strata.

Mr. Steuart, in reply, said that Mr. Hamilton suggested that the oil was distilled from shale by the burning mines of the neighbourhood. From the circumstances of the case this seemed quite impossible. If there had been workings in the lower seams into which the oil could have percolated, then something might have been said in favour of this view; but there were no such workings. When a bore was sunk through the strata in question, water and gas rose to the surface, showing the high pressure under which fluids in them existed. To saturate such a stratum with crude oil the oil vapour must have been produced under tremendous pressure. No burning workings could produce a pressure worth mentioning, as there would always be easy outlet into the workings themselves. In 1883 there was a fire in old workings within half a mile of where we found the petroleum, but it was put out in a fortnight. It was quite inadequate to produce either the crude oil or the pressure required. In the two places, about 950 yards apart, where the petroleum was found, it was the same stratum that yielded the petroleum. There was no crude oil seen in the old workings in which the fire was, and that the crude oil should have appeared at a considerable distance away, in a stratum that lies 85 fathoms lower, seemed quite absurd to anyone that knew anything about this mineral field. That the oil should have been produced by more distant fires, such as North Greendykes open cast, or Meldrie, seemed even more absurd. It was possible, perhaps, that this petroleum was produced by distillation of shale, but not from the puny fires connected with human operations, or in recent times; but in the bygone ages when the coal and shale of some localities here were coked by the subterranean heat. The smell, bromine-absorption, and other properties, indicated a natural petroleum, and not a crude shale oil. The amount of solid paraffin in it was no argument against it being a natural petroleum, for in nature we have all grades represented between the solid ozokerite of Binny Sandstone Quarry, mentioned by Dr. Wallace, with melting point 200° F., and the Russian petroleum, which has no solid paraffin. There is only one shale worked in this mineral field —namely, the Broxburn seam.

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DISCUSSION ON MR. TATLOCK'S PAPER ON "THE ESTIMATION OF SMALL PROPORTIONS OF IRON" (THIS JOURNAL, VI., 276).

Mr. E. C. C. Stanford pointed out particularly the great value in any colour reaction of being able to dissolve it and bring it right out of the solution, because the trouble with many colouring matters was the difficulty of seeing them, especially where the solutions were—as they often are—rather turbid; and where the colour was taken out in another liquid, it afforded an opportunity of comparison which could not be shown in any other way.

Mr. J. Christie had pleasure in bearing testimony to the accuracy and beauty of this test, as applied in public works. For a great many years he had adopted this method for testing crystal alums and sulphate of aluminium, and he had found the great advantage of this test over the Prussian blue iron test, that was formerly used. One great novelty to him in this paper was the application of ether, which seemed to concentrate the colouring matter and increase the delicacy of the test. He had not tried this, but would do so in order to see what improvement it was over the old method of oxidising the iron, which existed, as a rule, in crystal alum in the ferrous condition.

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NEW METHODS OF ESTIMATING ARSENIC IN PYRITES, Etc.

BY JOHN CLARK, PH.D., F.C.S., F.I.C.

Of the various processes for the estimation of arsenic in pyrites, the one which is based on the conversion of the arsenic into an alkaline arseniate by fusion with nitrate of potash and carbonate of soda, seems to have found most favour, especially that modification which consists in precipitating the arsenic as arseniate of silver and titrating the silver by Volhard's method. In most cases this is an excellent and reliable process, especially where the quantity of arsenic is considerable, as has been clearly demonstrated by Leroy McCay's experiments (*Chem. News*, *48*, 7), but it is open to two objections. 1st, The liability to estimate phosphoric acid as arsenic: and 2nd, The difficulty of determining very small quantities of arsenic in pyrites, owing to the large proportion of alkaline salts, and the solubility of the arseniate of silver in nitrate of ammonium, which is greater than Mr. McCay's remarks (*Chem. News*, *48*, 7) would lead one to suspect.

These objections may to a large extent be avoided by the following precipitation process, which is specially applicable to pyrites rich in sulphur, such as is used in the manufacture of sulphuric acid, and well adapted for the estimation of small quantities of arsenic.

Precipitation Process.

A weighed quantity of the pyrites (about 50 grains, or 3grms.) in a fine state of division is mixed in a platinum crucible with four times its weight of calcined magnesia and sodium hydrate free from arsenic (prepared by grinding together in a porcelain mortar equal parts of freshly-calcined magnesia and pure sodium hydrate), and the open crucible is placed for about 10 minutes over a moderately low Bunsen's flame. The mixture in the crucible shrinks somewhat, but no liquefaction takes place, and the contents of the crucible are easily extracted with boiling water. After the removal of the insoluble, the filtrate, which should be green in colour, owing to the presence of a little iron, is acidified with HCl, which causes an abundant disengagement of H_2S, and the solution, which is now nearly colourless, is boiled for a few minutes, when the sulphide of arsenic will separate along with a little sulphur. In most cases the whole of the arsenic is thrown down in this way, but to ensure complete precipitation it is always advisable to saturate the solution with H_2S gas. The precipitate is then thrown upon a filter, washed, the sulphide of arsenic dissolved out with ammonia, and the ammoniacal solution evaporated to dryness on a water bath. The residue is treated with a little strong nitric acid, in which everything dissolves, and the arsenic either estimated as ammonio-arseniate of magnesia or precipitated as arseniate of silver, and the arsenic calculated from the silver as determined volumetrically by Volhard's process, or gravimetrically by cupellation as recommended by Richter.

This process, which has been in use in my laboratory for some time, gives very accurate results, as I have proved by experiments made on pyrites mixed with pure sulphide of arsenic. On account of the large quantity of pyrites which can be manipulated without inconvenience, and the concentrated form in which the arsenic is obtained, very minute quantities can be determined in this way.

By fusion with nitrate of potash and carbonate of soda, with subsequent precipitation as arseniate of silver, I have found it impossible to estimate the arsenic in pyrites containing only about 0·1 per cent., whereas by the process which I have just described 0·03 per cent. can be determined without difficulty.

Of the other methods of estimating small quantities of arsenic in pyrites, those involving distillation are the most important. These processes are all based on the conversion of the arsenic into arsenic acid, its subsequent reduction to arsenious acid, and its volatilisation as chloride. Emil Fischer (*Ber. d. Deut. Chem. Ges.* 1880, 1778) was the first to show that the arsenic acid could be reduced and converted into chloride by ferrous chloride and hydrochloric acid, and afterwards either precipitated as sulphide or titrated with iodine. The results so obtained are described as accurate. But F. Hufschmidt (*Ber. d. Deut. Chem. Ges.* xvii. 2245) found it necessary to use HCl gas, or strong solution of HCl instead of the 20 per cent. HCl employed by Fischer, as otherwise the whole of the arsenic is not volatilised, even after ten distillations. Messrs. Classen and Ludwig (*Ber. d. Deut. Chem. Ges.* 1885, 1104) also insist on the necessity of using HCl gas or strong HCl, and they recommend sulphate of iron or the double sulphate of iron and ammonia as the reducing agent.

In carrying out the process the pyrites is either dissolved in nitric acid and the excess of nitric acid removed by repeated evaporation with sulphuric acid, or the arsenic is converted into arsenic acid by the action of caustic potash and chlorine, and the chlorate decomposed by HCl. After the removal of nitric acid or decomposition of the chlorate, the arsenic is converted into chloride by means of HCl and the ferrous salt. In either case the removal of the last traces of the oxidising agent occupies a good deal of time, and the presence of free sulphuric acid is objectionable, if the arsenic is to be titrated with iodine, as sulphurous acid is apt to be evolved when the distillation is carried too far.

In the new process, which I am about to describe, the oxidation of the arsenic is effected without the use of nitric acid or chlorine, and there is a considerable saving of time. On a former occasion I pointed out that when pyrites is heated with an intimate mixture of sodium hydrate and calcined magnesia, the sulphur is oxidised to sulphuric acid. Under the same conditions the arsenic is completely converted into arsenic acid, and can be afterwards reduced and distilled over as chloride. In the determination of sulphur, I recommended the use of the muffle to avoid the sulphur from the gas, but in estimating arsenic I prefer the Bunsen flame, as it is more generally available.

New Distillation Process.

The finely-pulverised pyrites (generally about 25 grains or about 1·7 gramme) is introduced into a platinum crucible with six times its weight of a mixture of pure sodium hydrate and calcined magnesia (prepared as above described) and well stirred with a glass rod. The open crucible is then placed over a moderately low Bunsen flame for a hour, at the end of which time oxidation is complete. The contents of the crucible, which have not fused, but simply shrunk in bulk, are easily broken up with a spatula, and transferred to an ordinary wash bottle flask, moistened slightly with water to prevent the evolution of too much heat, and then dissolved in strong HCl. For this purpose I usually employ 1000 measured grains, or about 70cc. The crucible is also washed out with strong HCl, and the contents of the flask are heated gently till there is no further action. The flask, which is fitted with a funnel tube, having the end drawn to a point and dipping under the liquid, is then connected with a small glass worm condenser, to the end of which a straight chloride of calcium tube is attached, and by means of the funnel tube a considerable excess of the reducing agent, dissolved in strong HCl, is introduced. The reducing salt,* which I prefer for this purpose, is cuprous chloride,

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* Since reading this paper I have received a letter from Professor Dittmar, stating that he has been in the habit of using cuprous chloride for the reduction of arsenic acid, and although he has not published this in any journal, it will be found in his Exercises on Quantitative Analysis, page 94.

because it forms a very soluble double salt with chloride of sodium, and its reducing action is at least equal to that of the ferrous salts. A mixture of cuprous and ferrous chloride obtained by dissolving copper in ferric chloride is also an excellent and suitable reducing material. The contents of the flask are then slowly distilled into water for an hour, when a fresh quantity of strong HCl (about an ounce) is introduced, and the distillation continued for another half-hour. The whole of the arsenic will now be found in the receiver, but it is always advisable to add a little more HCl, change the receiver, and test the distillate. The arsenic is then precipitated as sulphide, and collected on a weighed filter, or it is titrated with iodine in the usual way. When the quantity of arsenic is large, I prefer the iodine process, but it is more satisfactory to precipitate minute quantities of arsenic as sulphide.

For the purpose of verifying the accuracy of this process, and testing its suitability for the determination of arsenic in various substances, the following experiments were made :—

I. Two quantities of arsenious acid, each weighing 3·96 grains, were fused with magnesia mixture, distilled with cuprous chloride, and titrated with iodine, with the following result :—

	Per cent.
(*a*) Arsenious acid	3·94
(*b*) „ „	3·90

II. An arseniate of soda which contained no arsenious acid, and gave by the ordinary precipitation process 50·03 per cent. of arsenic acid, yielded when distilled with cuprous chloride and titrated with iodine :—

	Per cent.
(*a*) Arsenic acid	50·15
(*b*) „ „	50·33
(*c*) „ „	50·00

III. A sample of Kupper-nickel fused with magnesia mixture, and distilled with a mixture of cuprous and ferrous chloride, gave :—

	Per cent.
(*a*) Arsenic weighed as sulphide	40·06
(*b*) „ „ „	40·06
(*c*) „ titrated with iodine	40·35

The same sample fused with nitrate of potash and carbonate of soda, precipitated as arseniate of silver, and titrated with sulpho-cyanide, gave :—

	Per cent.
Arsenic	40·13

IV. A sample of Spanish pyrites gave the following results with different processes :—

	Arsenic, per cent.
(*a*) Clark's precipitation process weighing as ammonia arseniate of magnesia	0·55
(*b*) Clark's precipitation process, combined with precipitation as arseniate of silver and titration with sulpho-cyanide	0·57
(*c*) Clark's distillation process, weighing the arsenic as sulphide	0·56
(*d*) Clark's distillation process, weighing the arsenic as sulphide	0·56

V. In another pyrites used in the manufacture of sulphuric acid, and certified by a well-known French chemist as free from arsenic, I found the following results by different processes :—

	Arsenic, per cent.
Clark's precipitation process	0·119
„ „ „	0·119
Clark's distillation process	0·117
„ „ „	0·112
Fusing with KNO_3 and precipitation as arseniate of silver	0·008
Fusing with KNO_3 and precipitation as arseniate of silver	None.

The importance of estimating correctly small quantities of arsenic will be best appreciated by those who know the difference in the commercial value of a pyrites which is absolutely free from arsenic, and one which contains even a minute quantity.

The distillation process can also be applied conveniently for the estimation of arsenic in metallic copper. As far back as 1863 Odling (*Chem. News*, No. 189, p. 27) pointed out that metallic copper dissolves in ferric chloride, and that when the solution is heated the chloride of arsenic distils over, and can be detected in the distillate. In discussing Pattinson's process (*Chem. News*, vol. xlv. p. 218) Gibb refers to the use of this method for the quantitative estimation of the arsenic, but I am not aware that the details of the process have been given, or the results obtained published. The following is an outline of the process which I adopt. 100grs. of the copper in the form of shot or turnings are heated gently with a strong HCl solution of ferric or cupric chloride (containing about 200grs. of iron or copper and free from arsenic) in the same apparatus that I employ for pyrites, and the vapour which comes off, after passing through the condenser, is collected in water. After all the copper has dissolved, which usually takes about an hour, an ounce of strong HCl is added by the funnel tube, and the distillation continued for half-an-hour. The receiver is then changed, a fresh quantity of HCl added, the distillation continued, and the distillate tested. The arsenic is then precipitated as sulphide and collected on a small weighed filter.

To test the accuracy of this process, Mr. Inglis, the chief of the Tharsis Company's Laboratory, very kindly furnished me with various qualities of copper, which had been analysed in the Tharsis Company's Laboratory in another way.

The following are the results :—

	Clark. Arsenic per cent.	Tharsis Compy. Arsenic per cent.
No. 1. Tough ingot copper	0·11	0·12
„ „	0·11	0·13
No. 2. B.S. copper	0·02	0·04
„ „	0·024	0·03
No. 3. Tough cake	0·68	0·71
„ „	0·65	0·71
No. 4. Tough cake	0·27	0·33
„ „	0·29	0·32

These figures, which agree closely with those obtained by the chemists of the Tharsis Company, who may be regarded as specialists, speak for themselves, and indicate the accuracy with which the arsenic in copper can be estimated by the distillation process, and perhaps it is only proper to mention that I was not aware of the Tharsis Company's results till my analyses were completed.

In conclusion, I would only add that in my opinion these distillation processes occupy less time than any other known method for the estimation of arsenic in pyrites or copper, and they are inferior to none in point of accuracy.

DISCUSSION.

Mr. R. R. TATLOCK considered that any method—if it was at all accurate—for the estimation of small proportions of arsenic in pyrites, would be hailed, at the present time, with satisfaction, especially when pyrites, which was alleged to be arsenic free, was beginning to make its appearance as against ores, in which they had been accustomed to find great quantities of arsenic. No doubt could exist regarding Dr. Clark's statement on the older methods, particularly those which were based upon fusion with nitrates, which, if applied to such ores as the Spanish ores (used to such a large extent in this country), would give excellent results, but when applied to ores containing only minute quantities, seemed utterly to fail, and to this fact he could testify from recent experience of them. Dr. Clark had, in his opinion, put together a series of operations which justified him in recommending his process, as the combined process was one certain to give—from what he had seen of it—very accurate results. There was all the difference possible between pyrites containing very small quantities of arsenic, and one which was entirely arsenic free, so much so that a very minute proportion, even 0·01 per cent., would be sufficient to disqualify it for sale as arsenic-free pyrites. There seemed little doubt that this combined process would give accurate results when applied to pyrites containing such very minute proportions; and the substitution of cuprous chloride for ferrous sulphate was, in his opinion, a very important one, as there were great objections to ferrous sulphate which had not been enumerated.

Dr. **Clark** pointed out that by this process it was quite easy to detect arsenic in commercial caustic soda. It was well known that a great deal of caustic soda was made with pyrites vitriol, and lately he had been enabled to prove, in caustic soda, as much as 0·02 per cent., which seemed to escape the various processes through which the soda was passed. It was absolutely necessary, therefore, in working this process, that the various materials employed should be tested for their absolute purity from arsenic.

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NOTE ON AN IMPROVED APPARATUS FOR THE MANUFACTURE OF REFINED PARAFFIN WAX.

BY R. TERVET, F.C.S.

So far as I am aware, there has been nothing of a practical nature brought before the Society, dealing with the manufacture of refined paraffin wax. In asking you to consider the merits of the apparatus devised by myself for that purpose, it will perhaps be necessary to briefly describe some of the more common methods and arrangements in use. Before doing so, however, I will ask your attention to the nature and composition of the substance as we find it in commerce.

It is well known that crude paraffin oil, as distilled from shale, is a series of oils differing from each other chiefly by gradual increments of increase in boiling point and specific gravity, and a parallel decrease in vapour tension, etc.

The various refined oils, which we find in commerce, are fractions of the crude oil, and take the form of burning oil, lubricating oil, etc. They have, therefore, corresponding compositions, only limited by their mean density. The solid portion of the oil—that is, the paraffin scale—is also a fraction of the crude oil, and is separated at one or other of the several stages, in the process of refining, by cooling and crystallising. If we fractionate this solid paraffin by distillation or fusion, we find it also to be a mixture of bodies having a gradual increasing melting point and specific gravity.

When these fractionations are conducted so as to give an equal quantity in a given time, for each fraction, it will be found that the several fractions differ, and increase by equal increments, whether it be for the specific gravity of an oil or the melting point of a paraffin. The several fractions do not, however, by any means represent an oil or a paraffin having constant conditions, but rather systems, having all the characteristics of the original body, only limited by being isolated from the extremes.

The ranges of temperature through which the melting points of a paraffin scale run, differ with different crude oils. The following numbers may be taken as representing the composition of a paraffin scale derived from a well-known shale:—

Analysis of Scale No. 1.		Analysis of Scale No. 1.	
5 per cent. Fractions.	Melting Point.	5 per cent. Fractions.	Melting Point.
No. 1	93·0	No. 11	114·5
2	95·0	12	116·0
3	97·0	13	118·0
4	199·0	14	120·5
5	100·0	15	123·0
6	103·0	16	123·5
7	105·5	17	125·0
8	108·0	18	126·5
9	110·5	19	127·0
10	112·5	20	128·0

These figures show all the paraffin scale contained in the crude oil available for the manufacture of refined wax suitable for candle making. The oil refiner separates the scale from two or more fractions of the oil, which yield scales of different melting points. The following figures may be taken as representing the composition of the above when separated from two fractions of the oil:—

Analyses of Scale.	No. 2.	No. 3.	Analyses of Scale.	No. 2.	No. 3.
5 per cent. Fractions.	Hard Scale.	Soft Scale.	5 per cent. Fractions.	Hard Scale.	Soft Scale.
	Melting Point.	Melting Point.		Melting Point.	Melting Point.
No. 1	101·0	80·0	No. 11	120·0	99·0
2	106·0	83·0	12	120·5	101·5
3	108·0	86·0	13	121·0	103·0
4	110·0	88·0	14	122·0	105·0
5	112·0	89·0	15	122·5	107·0
6	112·5	91·0	16	123·5	109·5
7	114·0	93·0	17	125·0	112·0
8	116·5	95·0	18	127·0	114·0
9	117·5	96·0	19	129·0	116·0
10	119·0	97·5	20	130·0	118·0

The manufacture of wax is simply a process of fractionating, having for its end the separating of the oil and the softer or more readily-fusible portions of the scale. To see this fully, we have only to compare the composition of the refined substance with the crude material. And for this purpose I have tabulated three analyses of refined wax of different melting points. (See table top of following page.)

These analyses show that the melting points of the more fusible constituents are more akin to the mean melting points of the wax than the corresponding fractions in the crude scale.

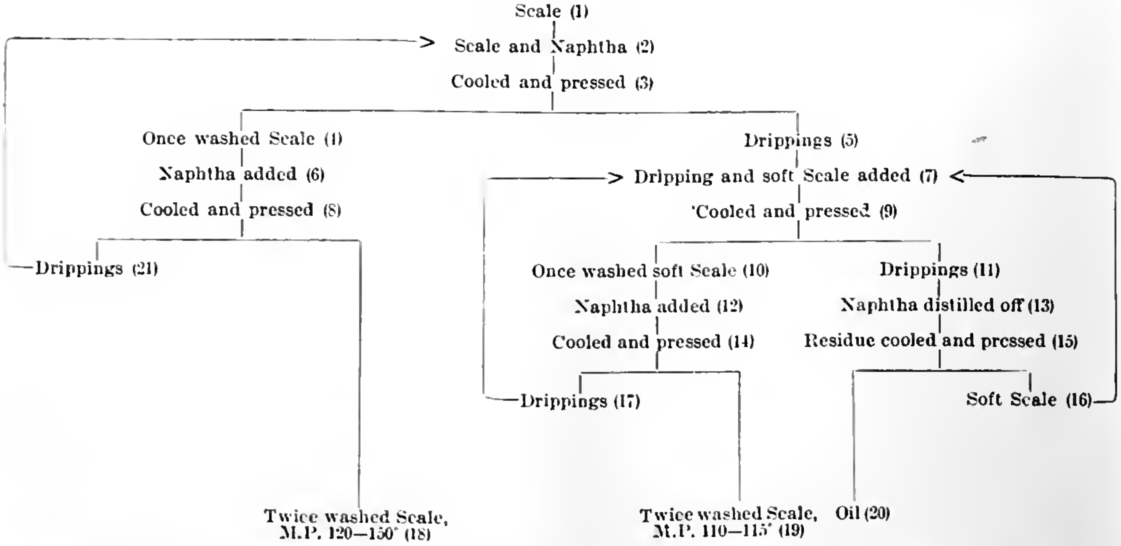
There are a great number of methods in use for the refining of paraffin scale, which differ considerably in detail. But they may be divided into two processes, which are distinctly different in their mode of treat-

ANALYSES OF REFINED WAX.

	No. 4.	No. 5.	No. 6.
Mean Melting Points.	126°.	111°.	102°.
5 per cent. Fractions.	Melting Point.	Melting Point.	Melting Point.
No. 1	119·0	103·0	91·0
2	120·0	101·0	91·0
3	120·5	104·5	95·0
4	121·0	105·0	96·0
5	121·0	106·0	96·0
6	121·0	107·0	97·5
7	121·5	107·5	98·0
8	122·0	108·0	98·5
9	122·5	108·5	99·0
10	123·0	109·0	99·0
11	124·0	110·5	100·0
12	125·0	112·0	102·0
13	126·0	113·0	103·5
14	127·0	113·5	105·0
15	128·0	114·5	106·5
16	129·0	116·0	108·0
17	130·0	117·0	109·0
18	132·0	119·0	110·0
19	134·0	123·0	112·5
20	138·0	125·0	113·0

ment. We have first the naphtha process, which depends upon the solvent power of the naphtha for dissolving out the oil and that portion of the scale which requires to be removed in order to attain that melting point which may be required for any given quantity of wax.

DIAGRAM A.



In carrying out this process in practice, the scale is melted and a given proportion of naphtha added. The mixture is either allowed to cool in suitable vessels, or it may be cooled by artificial means. The cooled mixture is subjected to hydraulic pressure, when the objectionable portion is carried away by the naphtha. This operation is twice or three times repeated, or until the desired degree of purity is obtained. The explanatory diagram below will make the process clear.

As it is necessary to use a considerable proportion of naphtha in the above process, and as naphtha is a very powerful solvent for paraffin, a modification of the above is to use less naphtha, and hot hydraulic press the mixture; in other respects the process is much the same.

The other method of refining is what is called the "sweating process," in which no naphtha is used. The purification of the paraffin scale is effected by exposing the recrystallised paraffin scale to a temperature which must depend upon the fusing point of the first 10—15 per cent. of its bulk. The heat liquefies this portion, and it acts as a vehicle in carrying away that portion which requires to be separated.

As it is in relation to this latter process that my improvements have been suggested, I shall deal with the working details and the arrangement of plant as it is in some of the principle refineries, a rough outline of which is shown on sketch.

The crude paraffin scale is melted and heated to a temperature of 170—180° F., after which it is allowed to repose until every trace of water and separable impurity has settled out, the presence of which would hinder crystallisation. It is run into cooling pans which hold from one to two gallons; these pans are generally furnished with overflows, and are arranged as shown at A in Fig. 1. A stream of the melted paraffin is directed into the top pans by the taps *b*, and continued until the whole vertical series is full. They are then left to cool very slowly in order to promote crystallisation. When cold, the solid cakes of paraffin are taken out of the pans and placed in the ovens, which are fitted with shelves, the latter having a slight inclination to the one corner, and on which is laid a coarse mat of cocoa fibre to prevent the paraffin from being in direct contact with the metal surface. The cakes are exposed to a given temperature until the desired degree of purity and melting point is attained, the source of heat being a course of steam pipes laid on the floor of the ovens. The portion that has been fused out of the paraffin in the course of sweating is again treated in the same manner, only at a lower temperature suited to its mean melting point. The drainings from this latter cannot again be very profitably sweated, as it contains the whole of the oil originally present in the scale, and also the greater proportion of the paraffin of low melting points. It is, therefore, cooled in a separate series of pans, and then hydraulic pressed to get rid of the oil. The solid pressed paraffin obtained is either returned to the next make of crude scale, or it may be finished off separately as a low melting point wax, the proximate composition of which is shown in analysis No. 6. It is usual to allow a certain proportion of the paraffin of intermediate melting points to pass to this stage, in order to give solidity and maintain a suitable melting point for the finished product.

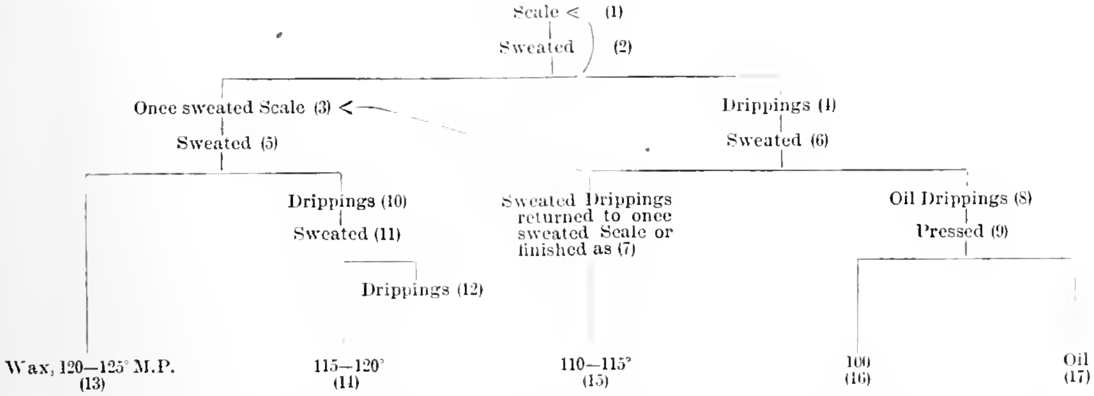
The following diagram gives a rough outline of the several stages of wax refining by the sweating process :—

wood, are placed, and which extend right across the lower openings. It is evident that when pressure is applied by screws or otherwise to the side A which forms the end of the system, the strips of soft wood which go to cover the openings of the cells will rise slightly, while the iron strips which cover the blank spaces between will correspondingly fall.

This arrangement I find is more than sufficient to seal the openings of the coolers. The wood after being sometime in use becomes very pliable, and easily adapts itself to form a perfect covering for the openings.

To empty the coolers it is only necessary to relax the screws *b*, and draw forward the strips of wood, when the cooled paraffin cakes are free to descend into the sweating cells, after which the strips are pushed into their place and the screws tightened, when the cells are again ready to be filled. Another method of sealing the openings is shown at D, but this latter would require to be made very uniform throughout, as any irregularity between the two surfaces would cause leakage.

DIAGRAM B.



It is obvious that when any considerable quantity of material has to be dealt with, the amount of individual handling in the way of filling and emptying the pans, transferring the cakes to the ovens, and taking them out again, must be enormous.

The apparatus which I have ventured to bring before the Section is designed to diminish the amount of labour inseparably connected with the present mode of working.

It is also constructed so that the sweating may be obtained simultaneously from both sides of the paraffin, and which permits of it being done at a much lower temperature and with greater rapidity. Besides, the cakes can be made of much greater thickness than at present, the comparative power being thereby increased. Further, the process can be made continuous by duplicating the cells, vertically, in which the sweating is conducted. This is obtained by taking advantage of the gradual diminution in bulk which the paraffin undergoes in the course of sweating. Although this latter advantage effects no great economy, yet it makes the production of the full proportion of first-class wax obtainable from crude scale by one operation a possibility.

By reference to the rough sketch Fig. 1, it will be seen that the coolers A are set directly above the cells in which the sweating is conducted. The cooling and sweating cells may be made of any convenient size. The size proposed for any single operation might advantageously be 3ft. broad by 6ft. high. The way in which the coolers are sealed at the bottom is made to depend upon the shape in which the alternate strips of soft wood and iron, or soft wood and hard

In order to facilitate the dropping of the cakes from the coolers, a very slight taper is put upon them, which need not be more than $\frac{1}{16}$in. per 12in. in height. The distance between the coolers and the sweating cells is less than the height of the cell. In arranging it thus it gives direction to the cakes of paraffin, as in passing from the coolers to the sweating cell it has entered the latter before leaving the former.

The sweating cell B is constructed of wire netting or perforated sheet metal; inside of which is hung a coarse woven cloth of any description, but preferably of woollen plaiding. On the top of the cell there is set a light iron casting which goes to form the entrance, and assists in keeping it in position. At the bottom there is another casting *c* with an opening the same size as the cell, the edges of which are turned up all round, both in and outside, forming a channel gutter which is provided with an outlet leading to the rhone *d*. The cell is set within this channel, and as the cloth extends to the bottom, the liquid portion which is fused out of the paraffin is conducted to the channel by the capillarity of the cloth. In order to prevent the solid cake from falling through the lower opening, there is provided a sliding door *e* of thin sheet iron, the sides of which are turned down and over-lap the inner sides, covering it like a lid. The passage for the edges of the door is therefore between the inner sides of the gutter and the cloth. This gives direction to the liquid portion, and effectually hinders any part of it from finding an outlet other than to the gutter.

In adapting this apparatus for a continuous or fractionating process, it is necessary to have two or more sweating cells in height, and a proper means of regulating the temperature. All the parts and arrangements remain the same as described, only the doors in the upper cells may, if thought proper, be dispensed with, as the paraffin in its plastic condition moulds itself to the irregularities of the cell, and effectually stops any passage to the one beneath.

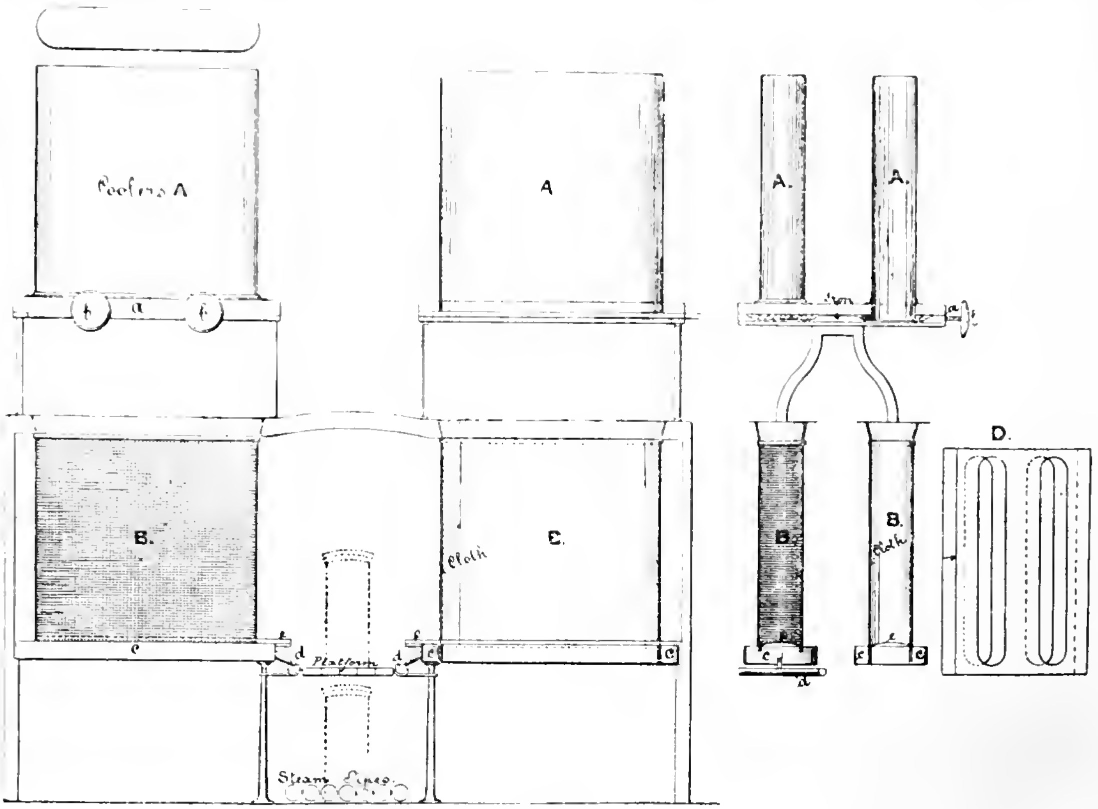


FIG. 1.

Suppose such an arrangement be constructed of three cells as shown (Fig. 2), and that the temperature is under proper control. It is evident that the most and grosser part of the impurities will be drained away in the first or uppermost cell, and that the cake will have correspondingly diminished in bulk before passing to the second or middle cell, where the soft and intermediate soft paraffin would be sweated out. Again, on passing to the third cell, the cake of paraffin will not be more than 65 per cent. of its original bulk, but containing all those hard intermediate fractions which correspond with No. 3 (shown on Diagram B), and which after further sweating and the proper melting point attained may be discharged by withdrawing the bottom door. There is not the slightest danger of the partially-sweated paraffin falling out, as the descent of it is only gradual; indeed, one important feature in this arrangement—either as a simple or complex structure—is that the cake will not come out until it is perfectly sweated, which is only attained at a temperature which if prolonged would result in the complete fusion of the paraffin.

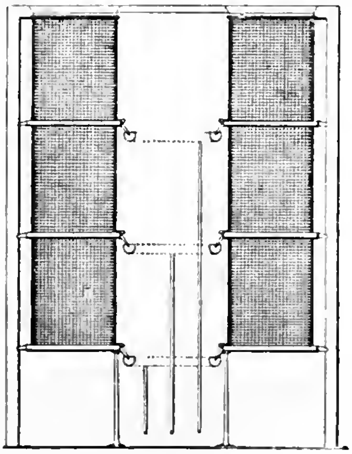


FIG. 2.

In working with an apparatus constructed of three cells, I find it can be charged and discharged every four hours, beginning with a scale of melting point 112—114° F., and finishing with a wax of melting point 126° F. As the drippings are separately fractionated out in three grades of purity, it facilitates their subsequent treatment to have them always of a uniform composition and melting point.

DISCUSSION.

In the absence of Mr. Tervet, it was agreed to postpone the discussion till the next meeting of the Section.

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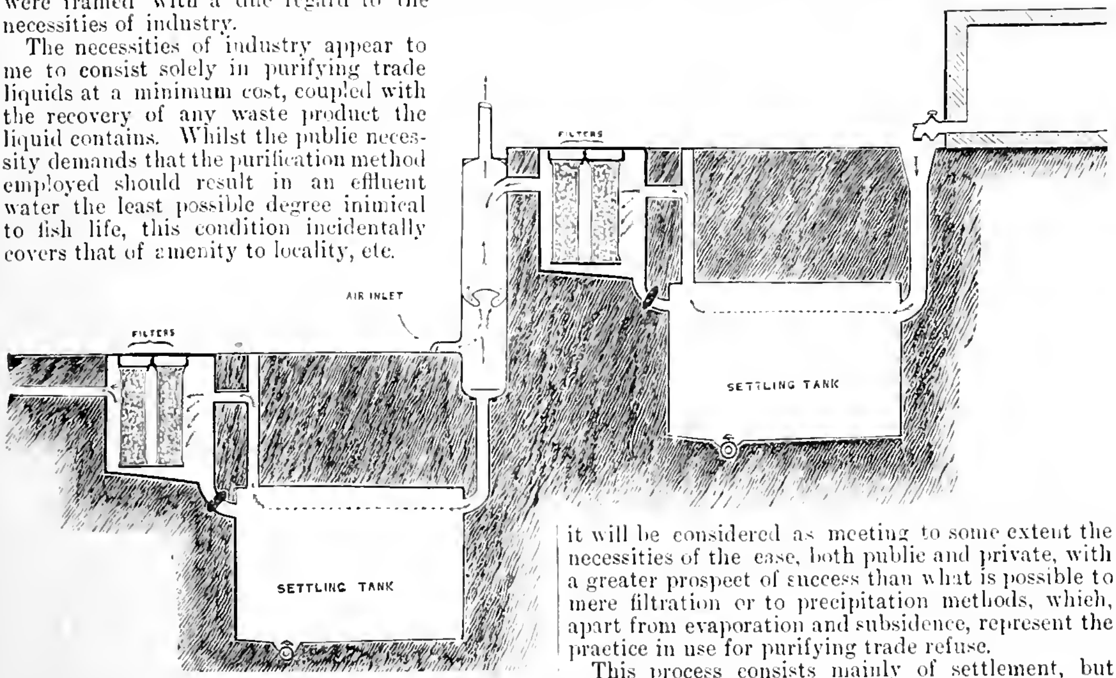
RIVER POLLUTION BY TRADE LIQUIDS.

BY W. H. HARTLAND, C.E.

SIR HENRY ROSCOE, M.P., moving the rejection of Sir Edward Birkbeck's River Purification Bill, in the House of Commons last year, said he desired to point out that whilst the Act of 1876 discriminated between the pollution caused by sewage and that produced by manufactures and mines, no such distinction was drawn by the Bill proposed. Such a distinction was, however, absolutely necessary, for whilst sewage had everywhere an approximate composition, and was, therefore, capable of treatment by similar methods of purification, manufacturing pollution was of the most varied description, as was seen in the case of breweries, alkali works, dye works, etc.; so that not only were the methods which should be employed different, but the standards of purity must also be different. Further on he remarked that science was in a position to deal satisfactorily with sewage at a certain cost, but as regarded manufacturing pollution the same could not be said. The first conclusion of Sir Henry is somewhat open to doubt, but the latter will be generally accepted as correct. In concluding his speech against the Bill, he said, speaking on behalf of manufacturers interested in the question, he desired to say they were in no sense hostile to measures of river purification, provided these measures were framed with a due regard to the necessities of industry.

The necessities of industry appear to me to consist solely in purifying trade liquids at a minimum cost, coupled with the recovery of any waste product the liquid contains. Whilst the public necessity demands that the purification method employed should result in an effluent water the least possible degree inimical to fish life, this condition incidentally covers that of amenity to locality, etc.



I admit that fish life may be possible even in presence of a chemical effluent when diluted by the natural water of the stream into which it discharges; but something more than this is required. You must take into account the "cumulative effect" of sewage or a chemical discharge for long periods. Then, again, other trades on the same stream should be considered, especially those requiring comparatively pure water. A chemical discharge on the upper reaches of a stream is often as unjust to other trades lower down as it is to the public in destroying fish life, etc.

Pollution by trade liquids takes two forms, or that in suspension and solution. We may also divide trade liquids another way, or those which are worthless from those which contain a waste product of more or less value, if we could but succeed in recovering it. For the former class the purification method should be of a simple automatic nature, as the cost of working, however slight it may be, means so much extra cost on the manufacture; but for the more pernicious class of refuse the case is different, and each one must be judged on its merits. But it is almost safe to assume that the more pernicious the liquid the greater the probability it contains an element of value which, if recovered, might be sufficient to repay the cost of purification. It was solely on the grounds that no means were known—except, perhaps, evaporation—whereby this class of liquid could be purified, that led to the rejection of the Rivers Pollution Bills of Mr. Hastings and Sir E. Birkbeck in the last sessions of Parliament.

The process of purification and results of experiments I have to lay before you appear to go a considerable way in the direction required, inasmuch as they seem to meet the case of both classes of liquid, but especially so in the case of all those where the polluting matter is in suspension, whilst in the case of solutions any matter recoverable by the process is recovered in the form in which it exists in the liquid, which admits of its use if possessing a value—or if not, its bulk is reduced to a minimum, and so is the cost of disposal, and as the treatment is purely natural and accords with the public necessity of restoring fish life to our rivers and streams, I shall hope it will be considered as meeting to some extent the necessities of the case, both public and private, with a greater prospect of success than what is possible to mere filtration or to precipitation methods, which, apart from evaporation and subsidence, represent the practice in use for purifying trade refuse.

This process consists mainly of settlement, but under somewhat peculiar conditions, or what I will term equilibric subsidence, under which the full effect of the laws of gravity may be obtained in freeing a liquid from suspended impurity. The apparatus employed is simply a true gravitation siphon, consisting of two parts—the first a catchpit or settling tank, whilst the second part serves the purpose of a "wash-out" or flushing tank for the catchpit when the sediment is removed; and by means of two vertical lines of filtering obstruction, which serve to convert the tank into a siphon as well, it throws back on the catchpit an equal pressure, which prevents channelling, and produces an "equilibric line" level with the lower end of the siphon necks or the inlet and outlet. Below this line the water is still, and allows of the collection of matter to take place continuously until it reaches the practically "inert water" passing above.

Whenever the sediment is removed from the catchpit, the effluent water standing in the "high-level tank" may be precipitated into the catchpit, the opposite end being flushed by admitting a sufficient quantity of liquid by the inlet. Both these operations are performed by simply moving a couple of valves. The catchpit siphon is in duplicate, so that when one becomes full of sludge the stream of sewage is diverted through the other; that full, being cut off from the wash-out tank, which serves the same purpose for both.

The degree of subsidence necessary to suit the different circumstances of the various liquids is quite under control, being regulated by the velocity of the liquid passing through, and by the counteracting influence of the filters on the hydrostatic head or pressure of inflowing water; but in any case this process of settling succeeds in the automatic division and collection of two separate sediments of different degrees of sp. gr. from any liquid exposed to its influence. This feature of separating the matters contained in a liquid is important, and within it, perhaps, we may find the solution of the problem of utilising the products of either sewage or trade liquids, as it enables us to use that which is useful and reject that which is not.

The filters of the wash-out tank, of course, may be either neutral or neutralising as required. They also serve to arrest all floating matter, and admit of the purified effluent being discharged at about the same level at which the raw sewage enters the catchpit part of the siphon. This is also a feature of importance in preventing impoundage where this occurs, and also by reducing to a minimum the cost of pumping to avoid its influence. These features will, I hope, be considered as steps in the right direction.

In support of this view, I may just draw your attention to the local case at Crosshill, where a similar contrivance was constructed to carry the sewage across the railway cutting. The contrivance, although an unequal-sided siphon, I believe, quite refuses to pass matter heavier than the water in which it is carried. The first siphon, or the catchpit and wash-out combined, is simply the Crosshill siphon carried out to its logical conclusion, and would possibly prove sufficient for the recovery of all descriptions of suspended matter from trade liquid.

For dealing with the more serious class of liquids or matter in solution, I propose a double siphon, coupled with the process of aëration between the two. Experiments on various liquids tend to show that, after the heavy suspended matter has been removed, the fine organic matter, which is not amenable to either subsidence or filtration, or the process of the first siphon, is usually developed by aëration sufficient to cause it to subside in the second catchpit or wash-out. I am aware that this effect is somewhat opposed to the generally accepted idea of the "effect of the process." I may also point to the general idea regarding subsidence. Most persons, if asked to define perfect subsidence, would at once say perfect rest in a subsidence tank. The law also accepts this idea as to perfect settling. Still, I beg to take exception to the view, and you will be able to form an opinion from the results of experiments.

But on the question of Aëration v. Oxidation, I may say a few words. You are aware, no doubt, that the Metropolitan Board of Works contemplate a very large outlay and annual cost to chemically treat the London sewage. The treatment proposed is in general opposition to precipitation methods, being mainly devised for oxidation.

Mr. W. J. Dibdin, F.C.S., etc., the principal chemist to the Board, and author of the treatment proposed, read a paper recently to the Institute of Civil Engineers. In explaining his reasons for using so small a quantity of chemical as 1 grain sulphate of iron and 4 or 5 grains of lime per gallon of sewage, he said the matters in an actual "putrescent state" were the only ones which required immediate destruction, and these were insignificant compared with the "total organic" matter present. Consequently, the quantity of chemical required was but a fraction of what would be necessary for its complete destruction.

He then went on to say that aëration had recently been put forward under the title of oxidation. This was "a misnomer." True, the ultimate object was oxidation, but if the idea was to be retained that a very partial aëration of a strongly alkaline effluent was "equivalent" to complete aëration of a neutral effluent free from actual putrescent matter, a powerful blow would be struck at the system, which, when properly carried out, was incontestably one of the utmost importance.

These remarks, by so distinguished an expert, tend to show, in my humble opinion, that a real inquiry into the true function of the natural process would prove of great advantage. So far as my experiments go, the effect of aëration is dependent on the process adopted before and after its application. I confess I do not understand Mr. Dibdin's remarks, as, in the first place, there is no "strongly alkaline" effluent to aërate outside trade liquids, except from a chemically treated sewage, and if this can be sufficiently oxidised within financial limits, why should it be aërated? whilst, if the ultimate object of aëration is oxidation, why chemically treat the sewage at all? Because it requires no technical skill to understand that a "naturally" oxidised effluent is, at the worst, perhaps a dirty but practically harmless water, and, therefore, not inimical to fish life, whilst the same cannot be said of any description of artificially produced effluent.

The experiments carried out prove that under certain conditions the effect of aëration is entirely opposite to the destroying effect attributed to artificial oxidation, it being, in fact, an almost purely developing effect, both as regards sewage and the various descriptions of trade liquids on which experiments have been made.

In giving the results of these, I have selected a few as being representative of the worst class of pollution from trade refuse. The results are from practical experiments on quantities of either 3 or 5 gallons, the apparatus employed being about double the size of drawing. The weights per gallon are for dry matter, except in two cases to be mentioned, and are exclusive of matter lost in the filtrates; whilst those for soluble matter represent about 70 per cent. only of the quantity actually recoverable, as nearly one-third of sample is left in the first siphon. The weights are the result of evaporating the sediment collected in the catchpits only.

EXPERIMENTS.

First is an acid solution, containing salts of iron. The filter media in this case was simply lumps of natural chalk. The recovery of matter reckoned as a thick paste was—

Before oxidation	120	grains
After ,, ...	160	,,
Or a total of	280	,, per gallon.

The next is a solution containing soluble salts of potassa. The matter recoverable by perfect rest for 24 hours was 144 grains, reckoned as a paste about the consistency of tar, whilst the recovery under equilibric subsidence was 292 grains; whilst after oxidation it gave up a further quantity of 219 grains; and on repeating the process of oxidation and settling, it gave a further quantity of 233 grains, or a total of 744 grains per gallon.

The next experiment is on the putrescent liquid from a tannery and skin works. One sample gave up 547 grains before and 146 grains after oxidation. Another gave 583 grains per gallon by equilibric settlement alone. These liquids combined are settled in the ordinary way, the effluent being afterwards treated with alumina. The sludge from both processes is filter-pressed, resulting in about 470 grains of sludge cake. Even if this is reckoned as dry matter, the loss in the effluent is probably two-thirds of the whole matter actually present in the liquid, though it is doubtless bleached by the chemical treatment, and not apparent to the eye.

The next are dyes. The chemical Turkey-red gave 39 grains before and 21 grains after aëration, or a total of 60 grains per gallon. The yellow dye give by equilibric settlement alone, 65 grains per gallon; whilst the original Turkey-red dyes gave 47 grains before and 20 grains after aëration, or a total of 67 grains per gallon. This matter, I understand, is principally boiled blood.

The last is the dreg or pot ale from distilling. This gives 55 grains per gallon after having settled in the ordinary way for several days. Oxidation in this case does not develop much matter (10 grains per gallon), but what little is recovered is peculiarly nasty; the same may be said of the gas. I should just remark that when the whole process is employed, in addition to recovery of four different solid products, we may also obtain the gas which is ejected in the process of aëration. Aëration also recovers oil in solution in the last siphon. I think I may say all the products mentioned are practically new, and samples are here for inspection. I may also suggest that the four products which may be recovered from sewage seem to offer grounds for believing that a financially valuable product may possibly be recovered from this source at last, in place of the ordinary sludge as at present.

DISCUSSION.

Mr. Christie considered that the nation would be indebted to Mr. Hartland if his process could accomplish all that had been said of it. The difficulties he had to speak of were in reference to dye works in the neighbourhood of the Leven, where a great deal had been done to grapple with the waste discharge from dye works. The chief difficulty was in the soapy solutions holding a small quantity of free oil in suspension. Mr. Hartland had spoken of 400 grains down to 60 grains per gallon, if he had followed him properly; but in the Leven the waste products leaving the works were much more dilute, and only carried from 5 to 15 grains per gallon. The works for the purpose of dealing with the discharged liquids were unfortunately situated on a very low level, so that any method for treatment must follow the pumping to a height of from 10 to 20 feet of the liquids discharged from the dye-houses, and when it was considered that in his own works four million gallons of these refuse liquors were discharged per day, it was evident the treatment with either acid or salts of lime or magnesia must necessarily involve great outlay by reason of the dilution of the material discharged. A great deal had been done at his works in the way of chemical treatment, but so far it had failed to deal successfully with the enormous quantity of liquid discharged into the river. Within the past year his attention had been turned to subsidence, and he agreed with Mr. Hartland that the subsiding system seemed to indicate that more successful results might follow from that method of treatment, if a chemical could be found suitable for the precipitation of the soapy liquors and fats in a fine state of division—that should as far as possible increase the specific gravity of the resulting compound in order to facilitate the subsidence, as the difficulties are accentuated from the fact that the fats have a specific gravity less than water; and as the refuse liquids contain say, on an average, 10 grains per gallon, the precipitant put into this enormous volume of liquor effected precipitation rather slowly, and in such a fine state of division, that great difficulty is experienced in getting it to subside, and the success of the process must naturally depend on the effectual subsidence of this compound, with a specific gravity as far as possible above that of water. The method of aëration would have, he was afraid, no effect upon the soapy liquors. The colour discharged with the soap was not capable of being acted upon by aëration so far as his experience went.

Mr. Tatlock asked how long it would take to treat a large quantity of liquid in the manner described?

Mr. Hartland replied that for a large body of liquid a number of apparatus would be required, but with the apparatus described 10,000 gallons per day could be dealt with automatically. The apparatus was only 21 feet long by 6½ feet broad in its broadest part; in practice each apparatus would extract from the main body of liquid a certain quota, according to its capacity, so that quantity of liquid was immaterial. For instance, a stream of sewage of 100,000 gallons per day could either be treated by one apparatus of 100,000 gallons capacity, or by two of 50,000 gallons, or by 10 of 10,000 gallons per day capacity.

Mr. Liversedge asked what kind of filtering medium was employed?

Mr. Hartland replied that broken bricks or raw chalk might be employed, but in the case in question common ashes were used, which were very rough in the first two filters, and finer in the last two.

Mr. Cuthbertson inquired if the process was applicable on a much larger scale?

Mr. Hartland replied that on a larger scale it would necessarily be much better, because the deeper one went the better the law which governed the system was brought into operation.

Mr. Tatlock believed that experiments on a somewhat extensive scale had been made by the Corporation of Glasgow with regard to the effect of aëration on the town sewage. The apparatus employed was one of the most perfect forms of oxidisers known, and consisted of a screw revolving vertically at a high rate of speed in the cylinder containing the sewage matter, by which the air was beaten down into the liquid and, so to speak, "atomised." The appearance of the liquid under aëration was that of milk, arising from the air being churned up with it, and the effect in that case was not very encouraging, so much so that the process was not adopted. It was found that after settling the solid matter from sewage and treating it in as clear a state as it could be got, it began, after some time, to smell again, and hence if it were applied to sewage matter before being discharged into the river Clyde, by the time the purified or aërated sewage had been carried up and down several times by the flow of the river and backwash of the tide, the smell would begin again. Oxidation by that means was also found to be rather expensive, and from some experience he had had he believed he was justified in saying so. He was quite pleased with the description given of the apparatus, but he thought that as far as aëration was concerned it had hitherto not been found successful for treating sewage, although further experiments in that direction were very desirable.

Mr. A. J. Liversedge believed that no question could exist as to the extreme importance of the subject. As far as he could understand the process, from the description given, it was simply a precipitation process combined with filtration and aëration. The sewage was in the first place allowed to settle in a large tank, but Mr. Hartland would not claim any originality as to that, as it was the first step taken by anyone who attempted to deal with sewage or similar substances. Afterwards, the partially cleared sewage (which was not even free from the whole matter in suspension) was to be passed through a filter, and that also had been tried on a large scale in several places, though, as far as he knew, the only filtering process which had been found valuable was simply to allow the sewage to be passed through land. All other filtering processes, whether tried on crude sewage or partially cleared sewage, appeared to have failed, owing to the filtering mediums having become rapidly choked up and useless, and to the trouble and cost of cleansing and renewing them. Experiments on a large scale had been tried at Crossness to filter sewage sludge through filter-presses, but it was found in that case absolutely impossible to filter the sewage without first treating it chemically, as otherwise the cloth used became quite slimy and useless in the course of a very short time. Referring to Mr. Hartland's precipitation tank, the settled matter in that tank would contain at least 75 per cent. of water. Mr. Hartland dissented from that, but in that tank he had simply the action of gravity, and even when you employed great pressure in order to separate the liquids from the solids of sewage, the substance obtained contained from 50 to 60 per cent. of liquid; and he would like to ask what would be done with this sludge from the tank? Mr. Hartland had not explained in detail the apparatus he proposed for forcing air amongst the sewage for his final process, nor given the quantity of air required to effect the necessary aeration or the cost of the apparatus for that purpose. He was convinced that if Mr. Hartland would work out the cost of treating sewage in any district by his apparatus, he would be greatly surprised at the amount of money it would come to. He would instance the experiments made by the Metropolitan Board of Works, who had tried probably every method that had been suggested that contained any promise of success, and whilst many methods had been proposed and had given fair results on a small scale, it was found that when they came to be multiplied, and to deal with 80 or 100 million gallons per day, the cost became so enormous as to put them out of the question. It was not merely a question in the case of sewage of separating the solid matters from the sewage, but what was Mr. Hartland going to do with the recovered sludge obtained in his precipitation tank—which must contain a large amount of water,—especially seeing that he did not advocate chemical treatment? That was a most important question; but there were many other points in connection with the process Mr. Hartland had sketched—for example, the nature of the filtering medium, the method of cleansing, the cost of renewing, the details of the final aëration, the length of time necessary to obtain a particular result, the cost for treating any given quantity of average sewage, and so on—upon which further information was desirable.

Mr. Hartland pointed out that his paper dealt with trade liquids, whereas the discussion had veered into a question of sewage, which was a totally different thing from trade liquids. In the first tank proposed, there could be got what was dredged up from the bed of the Clyde, and it could be dealt with in exactly the same way; but supposing this system was in operation in Glasgow, the sludge might just as easily be sent down by the barges, but instead of dredging it out of the bed of the river it could be dredged out of the tank in question. The system applied to sewage aimed at recovering a product of some value, the tanks being designed so as to separate by gravity the constituents of sewage into three different forms of deposit, so that they might use what was good and reject that which was not, meaning the ordinary sludge. He placed no value on this material; indeed, if it entered the manure at all, it would first be burnt to an ash. He might, however, remark, that if they burned the small quantity of coarse sludge there is by this system compared with others, then the two important sanitary features of pumping (water in this case) to obviate impoundage by tidal or other influence, as well as the forced ventilation of sewers, become feasible and easy operations, whilst he submitted the destruction of sludge was the only permanent mode of disposal, and which sooner or later must be adopted.

Erratum.—Mr. Tatlock's paper, "On the Determination of Minute Proportions of Iron, with Special Reference to Alum and Sulphate of Alumina," April number, p. 279, third line from conclusion of article, *for* "0·00004grm." *read* "0·00001grm."

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A LECTURE ON FLAME.*

BY LEWIS T. WRIGHT.

I want to call your attention particularly to the fact that sometimes flame travels rapidly and sometimes slowly. This subject is one of some importance, and is what we call the velocity of propagation of flame. We can prepare, with coal-gas, mixtures having flames that travel at from 6ft. to 1ft. per second. And I want you to distinguish between the quiet, uniform, and slow propagation of flame that takes place in the first half of this 13ft. glass tube, which is measurable to the eye, and the extremely rapid and detonating explosion sometimes taking place in the second half of the tube. The first I will call an explosion of the first order, the second, infinitely more rapid, I will call an explosion of the second order. Let us suppose I have an explosion of the first order taking place in this tube that does not exceed the velocity of 4¼ft. per second. I can arrest it—put it out by inserting a small piece of metal gauze in the tube. We learn then that when the flame is travelling at a speed of less than 4¼ft. per second the gauze will arrest its passage. I will now endeavour to prepare a more explosive mixture, having a velocity of propagation of flame of more than 4¼ft. per second, and you will, perhaps, find the flame penetrating the gauze as though it were not there. We have learnt a very important fact. I want to show you, if I can, in a more marked manner how an explosion of the first order becomes connected with one of the second and more terrible kind. Here we have a mixture, the flame of which lodges in the tube, and is not, as at first, a very thin surface of flame, but occupies, perhaps, ½ an inch of the length

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* This lecture, of a semi-popular character, was delivered on the 18th March, by invitation of the Nottingham Section of the Society. The extract given contains an account of important original investigations described by the Lecturer.

of the tube. This flame is in a violent state of oscillation. When its tremor is sufficiently violent, explosion of the second order will be initiated. There are two points here to observe: that a definite explosive mixture may have a velocity of propagation of flame when it is undergoing explosion of the first order, that is, as low as 1¼ft. per second, but when it becomes sufficiently agitated to give an explosion of the second order the rate of propagation of flame is several thousand feet per second.

The following table sets forth the particulars of the experiments made in a glass tube 13ft. long and 0·75 inch in diameter:—

Mixture.		Lineal velocity of efflux of Mixture.	Rate at which Explosion of first order travels in tube.	Total velocity of propagation of Flame.
Gas.	Air.	Feet per second.	Feet per second.	Feet per second.
10·3	89·7	1·21	1·1	2·31
12·2	87·8	1·21	2·0	3·21
15·0	85·0	1·28	3·0	4·28
17·7	82·3	1·32	4·8	6·12
19·6	80·4	1·35	3·0	4·35
21·2	78·8	1·38	2·1	3·78
22·1	77·9	1·39	1·3	2·69
23·0	77·0	1·41	Stationary.	—

In thinking of explosive mixture you must bear in mind the difference due to the mixture and the difference due to the class of explosion. Some years ago I was connected with a large gasworks, and there we had a great number of safety lamps, as there were innumerable places where it would have been fatal to enter with a naked light. The lamps were in the charge of a most competent man, and were carefully examined and tested before being sent out for use on the works. Well, one morning before daybreak a larger purifier exploded just as the men were going to work on it. One man, who was carrying a safety-lamp, was knocked down, and others were burned. The lamp in its fall had its gauze injured. The explosion was looked upon as most mysterious, and some thought that the hole in the gauze had not been caused by the fall of the lamp on a sharp piece of iron, but had been there when it left the lamp-room. It was an unpleasant occurrence, that never became satisfactorily cleared up. Amongst experienced men there had always been a feeling of distrust regarding these lamps in circumstances where there was known to be much gas about, and an old hand might be known by his habit of leaving his lamp outside if called upon to enter any building in the dark where gas was escaping. Some time after a similar explosion occurred by a young man placing a safety-lamp near a current of gas which ignited, burning him severely. The lamp was rigorously examined, but no defect could be found in it, and it stood the test well. I may say that the test was really inefficient. I determined to thrash the matter out, and trying the lamps by various methods at last found out a means of blowing them all up. Not one could resist the new test, which was simply this: By creating an explosion inside the lamp, by a sudden application of the explosive mixture to it, the flame was passed through the gauze, igniting the mixture outside. This was a serious revelation, and exposed the deficiencies of the old test for soundness, which was, that the lamp should be put out by being smothered with gas. I am going to show this experiment in an exaggerated manner. Here we have a hollow tin vessel covered on the top with gauze. I am going to create an explosion inside it, and I hope you will be able to see the flame as it passes through the gauze. That the flame is projected some distance, I will prove by causing it to light an unignited stream of gas at a distance of 4 feet. I found out that the Davy lamp gauze would not always resist the passage of the flame resulting from a small explosion in the lamp. Of course now a-days we know much more of the Davy lamp than we did, and the ordinary forms are not considered safe in what we might call moderate currents. In a current of gas about 4 or 5 feet per second the flame is blown through the gauze. This is well known I believe now, but I do not think the circumstances of an explosion inside the lamp blowing the flame through is so well known. It is evident, then, that when the rapidity with which the flame is moving exceeds a certain rate it is blown through the gauze. When I discovered that an explosion inside the safety-lamp was sufficient, with coal gas at least, to pass through the gauze, I felt I had made an unpleasant discovery, and thought that perhaps there was something wrong with the material. I tried all sorts of makes of various meshes. There was nothing to choose between them. It was no use having finer mesh, for this reason: as you reduced the size of the apertures you reduced the thickness of the wire and its weight, so it was as broad as it was long. Still flame will not touch a cold metal surface. If I hold this flame against this metal plate, there is a space between that is not flame. You will see that, as flame to be flame must be hot, it cannot touch this cold metal, because the metal will cool it below the temperature at which this gas can give the phenomena of flame. Often, in these tubes, I find if I let the flame go slowly up to the gauze that it is extinguished before it quite touches it. When the flame is travelling in the direction of the gauze, the question whether it will pass or be extinguished is simply a question of the rate at which the flame is travelling, and the rate at which the gauze is cooling—a battle between the velocity of propagation of flame and the rate of cooling that the gauze can exert, which will be decided in favour of the most powerful. Davy lamp gauze is made by interlacing about twenty-eight wires of $\frac{14}{1000}$ths of an inch diameter, forming the warp over and under twenty-eight wires of woof of same diameter, and the result is a number of square apertures slightly larger than the thickness of the wire, being about $\frac{21}{1000}$ths of an inch across. Two adjacent wires of warp are separated from each other by a little more than the thickness of the wire forming the woof, and *vice versa*, because the wires of the woof bend under and over the wires of the warp, just as the wires forming the warp bend under and over the wires of the woof—so you see if, with this system of weaving, we wish to obtain smaller apertures, we must employ thinner and lighter wires, having less cooling power. However, let us suppose that the wires of the woof are very strong, and will not bend at all; the wires of the warp only bend under and over the straight woof wires. Then you see that the warp wires can touch each other, and you get rid of the square apertures. We can also get, by employing very stiff wires one way, and very thick, soft wires the other, a heavy gauze, with no direct openings, but small, tortuous ones. We can do what we could not do with the other mode of weaving—viz., procure extra weight of metal, at the same time reducing the apertures. This method of weaving is called basket-work, because baskets are made like that.

By taking off the old Davy lamp gauze from our lamps, and replacing it with the heavier basket-work, I secured lamps that would stand any test I could apply, and I had gas from a compressing engine, at a pressure of 20lb. and more on the square inch, blown on them, and they did not fire. My object of procuring a safe lamp was satisfied, and I may say that attempts to make the lamp safe by using two or three instead of one layer of the ordinary Davy lamp gauze were not successful.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

An Improved Filter for the Purification of Water and other Liquids. P. Hikely and J. Radcliffe, Rochdale. Eng. Pat. 4623, April 2, 1886. 6d.

The improved filter consists of a cylindrical or other shaped vessel provided with an upper part for the admission of water and a lower part for the outlet. Between the two is the filtering body secured in a slide fitting into two grooves in the body of the filter; the cover of the slide is held in position by a cross bar and centre screw.—C. C. H.

Improvements in Filters. C. E. Gittins, London. Eng. Pat. 5343, April 16, 1886. 8d.

Two bowls or dish-like cylindrical bodies are screwed together with the filtering media between them; this consists of charcoal, porous earthenware, or sandstone. —C. C. H.

Improvements in Filtering Apparatus. C. W. Rabitz, Hamburg. Eng. Pat. 5669, April 24, 1886. 6d.

A number of perforated hollow drums covered with felt are strung upon a hollow shaft capable of rotation; the shaft carries a number of brushes the ends of which rest on the filtering drums. The whole is enclosed in a tight vessel into which the unfiltered material is forced. The filtrate escapes from the apparatus by the hollow shaft. The residue is removed from the surfaces of the filtering drums by the rotation of the brushes.—C. C. H.

Improvements in Filter-presses for use under High Pressures. H. E. Newton, London. From A. L. G. Dehne, Halle-on-the-Saal, Prussia. Eng. Pat. 6628, May 17, 1886. 8d.

The improvements specified consist in the use of a U-shaped packing ring of leather or rubber placed in a groove between the joints of the plates or chambers. The patentee also claims as novel the use of a finely-grooved filter-plate covered with gauze or sheets of perforated metal for the support of the cloths.—C. C. H.

Improvements in Filter-presses and the Mode of Charging the Same. E. Jones and A. Beech, Tunstall. Eng. Pat. 9759, July 29, 1886. 8d.

In the old form of wooden filter-press the chambers are much weakened by the passage of the inlet nozzle through the strengthening strip on the edges of the chambers. The present invention obviates this by using a cranked instead of a straight nozzle, which avoids the cutting away of the strengthening strip. —C. C. H.

Improvements in Boiler-cleaning Compounds. A. J. Boult, London. From S. W. Merryman, Baltimore, U.S.A. Eng. Pat. 1582, Feb. 1, 1887. 4d.

The new composition consists of tannin, ½lb.; terra japonica, 1lb.; West Virginia oil, 1 gallon; and soda ash, 90lb. The terra japonica is dissolved in water, the oil added, and the mixture passed over the soda ash; the tannin is finally added.—C. C. H.

Improvements in Funnels. A. Gersdorf, Washington, U.S.A. Eng. Pat. 1970, Feb. 8, 1887. 6d.

The shank of the funnel is made triangular in section, to permit the escape of air from the bottle in which the filtrate is received. The upper edge of the body is turned inwards to prevent splashing when the liquid to be filtered is poured hastily into the interior of the funnel.—C. C. H.

II.—FUEL, GAS, AND LIGHT.

Improvements in Coke Ovens. T. F. V. C. Otto and Dr. C. Otto & Co., Dalhausen, Germany. Eng. Pat. 5522, April 21, 1886. 11d.

According to this invention the gases evolved from the ordinary Beehive oven, after being scrubbed for the recovery of the by-products, are brought back and burned underneath the oven. The air required for the combustion is heated by a regenerator arrangement, the waste heat from the burning gases being utilised for this purpose. Drawings are given with the specification. —A. R. D.

An Improved Method of Manufacturing Gas from Benzoline or other similar suitable Oil, and in Apparatus employed therein. T. Drake, Huddersfield. Eng. Pat. 7733, June 9, 1886. 8d.

Atmospheric air, dried and heated, is driven by a Root's blower through benzoline contained in a tank. The air current is distributed by being made to pass through a number of canvas diaphragms placed horizontally in the liquid. As the resulting gas is very explosive, the gas pipes must be provided with wire-gauze checks on the same principle as the Davy lamp. —A. R. D.

Improvements in and Apparatus for obtaining Gas for Illuminating, Heating, and other Purposes. H. Williams, Stockport. Eng. Pat. 8895, July 7, 1886. 11d.

The inventor generates hydrogen gas from fragments of zinc or iron and dilute sulphuric acid in an apparatus similar in principle to that commonly employed in the laboratory for the same purpose. It consists of a tank to contain the dilute acid, and an inverted vessel standing gasometer-wise within this. The inverted vessel carries within it a tray on which is placed the zinc or iron, and is provided in its upper portion with an outlet for the gas. It is supported by a cord or chain passing over pulleys and carrying equivalent weights at the other end. This arrangement is to secure a uniform pressure of gas. The gas may be carburetted by passing through a chamber wherein strips of absorbent material are hung in such a manner that the course is rendered as tortuous as possible. The lower edges of the strips dip into the carburetting liquid, which is maintained at a constant level by means of a ball tap.—A. R. D.

Improvements in the Removal of Ammonia from Coal Gas, and in the Manufacture of Ammoniacal Salts therefrom, and in Apparatus employed in such Process. J. Hepworth and E. Marriott, Carlisle. Eng. Pat. 5858, April 30, 1886. 11d.

The object of this invention is the recovery of ammonia from coal gas, without the use of lime, stills and saturators. Instead of water for washing the gas, a neutral solution of any suitable salt of ammonia is introduced

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* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.........	½d.
Above 8d., and not exceeding 1s. 6d...	1d.
" 1s. 6d., " " 2s. 4d...	1½d.
" 2s. 4d., " " 3s. 4d...	2d.

into the scrubber, whereby the ammonia is absorbed. This solution, thus charged with an excess of ammonia, is neutralised and then again used as absorbing agent in the scrubber, until its density rises to about 40° Tw., when it is evaporated in the usual manner. The gases liberated during the neutralising process are carried forward into a purifier of usual construction. In the annexed drawings (Figs. 1 and 2), *a* represents the scrubber, and *b* the pipe leading to the purifier *c*. The latter contains separate boxes or neutralisers *d*, where the liquor from the scrubber meets a regulated supply of acid from the tank *g*, the gases evolved passing through the pipe *i* into the purifier *k*. The neutralised liquor can be pumped up through the pipe *e*, and sprinkled in the tops of the scrubbers *a* to absorb more ammonia and be neutralised as before. If more ammoniacal liquor is produced than can be treated in this apparatus, an additional closed vessel *m* is used, fitted with a perforated bottom, below which leads a pipe *n* from the scrubber outlet. The vessel is filled with ammoniacal liquor, and heated by a steam coil *o*, and the gas bubbling through it, extracts the ammonia absorbed in the liquor and acts likewise as a carrier to convey the gas to the scrubber inlet through the pipe *p*.—S. H.

FIG. 1.

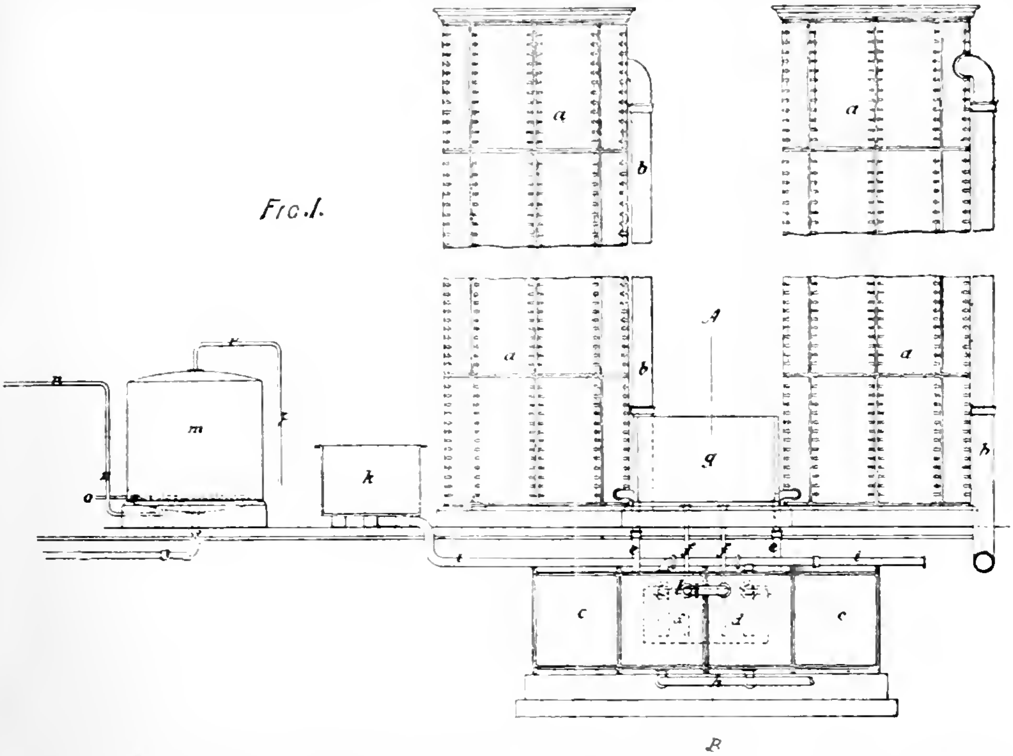
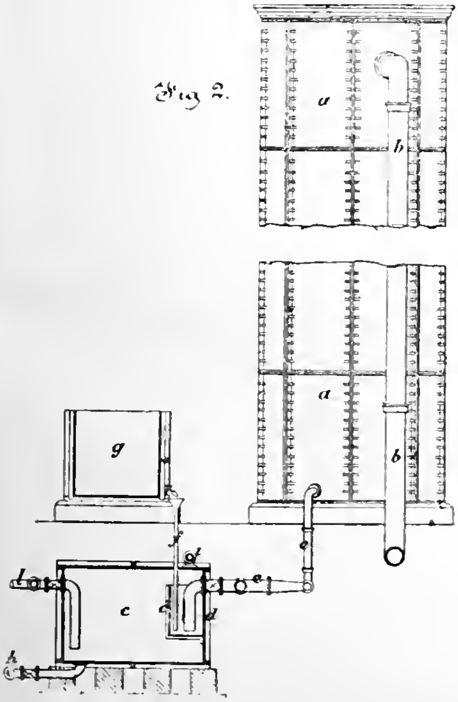


Fig. 2.



Improvements relating to the Treatment of Gas Carbon, and to the Manufacture of Articles therefrom. F. H. Snyder, Jersey, U.S.A. Eng. Pat. Feb. 1, 1887. 8d.

GAS CARBON is finely pulverised and washed, to remove soluble salts. It is then separated into the qualities represented by the densities of the different particles, either by elutriation, or, in the dry state, by an air blast. The product is available for most purposes where heat-resisting qualities are advantageous—such as safe linings, crucible linings, paint, etc., etc. The dry material is mixed with coal tar or other suitable cementing liquid, to facilitate the moulding. The tar is afterwards removed by baking.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Lutidines of Coal Tar. G. Lunge and J. Rosenberg. Ber. **20**, 127—137.

THE sulphuric acid, after being used for purifying tar oils, contains a considerable amount of bases and sulphonic acids of hydrocarbons. It was diluted with three or four times the volume of water, left for several days and filtered. The filtrate was evaporated, saturated with sodium hydrate, and the resultant dark oil separated, and distilled with steam. The oily distillate was then dried over caustic potash. Twenty litres of sulphuric acid gave 800grms.

of purified bases. The latter were then subjected to fractional distillation. The fraction boiling between 141—144 yielded by precipitation with mercuric chloride (Ladenburg and Roth's method, this Journal, **4**, 394) lutidine mercurio-chloride, from which the pure base was separated by treatment with potassium hydroxide and distillation with steam. The fraction boiling at 153—156 gave by precipitation with mercuric chloride and isolation of the base a colourless liquid boiling at 156—157°, which was found to be α γ-lutidine. This was oxidised with potassium permanganate, α-lutidinic acid being obtained. This acid, although identical with Ladenburg's and Roth's lutidinic acid, differs in physical properties. It forms colourless microscopic crystals melting at 223°, and gives a blood-red colouration with ferrous sulphate, whilst the acid isolated from animal oil crystallised in lustrous scales melting at 235°, and yielding a reddish-yellow colour with ferrous salts. When the fraction boiling at 156—170° was oxidised with potassium permanganate, α-lutidinic and isocinchomeronic acids were obtained. The formation of the latter acid points to the presence of α-β-lutidine in the mixed bases.—D. B.

Ortho- and Parachlorodimethylaniline. T. Heidlberg. Ber. **20**, 149—151.

Orthochlorodimethylaniline—$C_6H_4Cl.N(CH_3)_2$, is obtained by heating the hydrobromide of orthochloraniline with rather more than two molecules of methyl alcohol in sealed tubes at 145°. It forms a colourless liquid base boiling at 206°—207°. The hydrochloride crystallises in white hygroscopic needles. The platino chloride forms lustrous yellow prisms. The nitroso-compound crystallises from alcohol in yellow needles which are readily decomposed. It is a very feeble base.

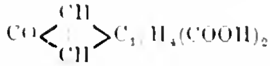
Parachlorodimethylaniline was prepared according to Sandmeyer's method by sustituting chlorine for the amido group in paramidodimethylaniline. It crystallises in large, lustrous, flat needles soluble in alcohol, benzene and ether, and insoluble in water. It melts at 35·5° and boils at 230°—231°. The hydrochloride forms a difficultly crystallisable syrupy mass; the platino chloride $[C_6H_4Cl.N(CH_3)_2]H_2PtCl_6$ crystallises in gold coloured prisms and the nitroso compound forms splendid orange yellow needles melting at 56°. It is soluble in alcohol, ether, benzene and petroleum spirit.—D. B.

Action of Sulphurous Anhydride on Benzene. C. E. Colby and C. S. M'Loughlin. Ber. **20**, 195—198.

ON heating a mixture of benzene (100grms.) and aluminium chloride (35grms.) on a water bath, and introducing sulphurous anhydride until absorption of the latter is complete *diphenylsulphoxide* $C_6H_5SO.C_6H_5$ is obtained, which crystallises from xylene in small transparent yellow crystals melting at 70—71°, belonging to the triclinic system. It is readily soluble in alcohol, ether, glacial acetic acid and benzene, sparingly soluble in cold petroleum spirit. When oxidised with potassium permanganate diphenylsulphone is obtained. It forms crystalline laminæ, melting at 128°. When reduced with sodium, diphenylsulphide melting at 272° is obtained. Diphenylsulphoxide may also be prepared by the action of thionylchloride on benzene in the presence of aluminium chloride. When equivalent quantities of diphenylsulphoxide and sodium nitrate are dissolved in concentrated sulphuric acid, and the two solutions mixed and heated at 100° for two hours, a product is obtained which can be fractionated by crystallisation into the following nitro compounds:—(1) Yellow crystals sparingly soluble in alcohol, readily soluble in glacial acetic acid, melting at 163° apparently identical with Gericke's dinitrosulphobenzide (*Annalen*, **100**, 211). (2) Yellow, indistinct microscopic crystals melting at 116°, soluble in cold alcohol, readily soluble in ether, benzene, glacial acetic acid, and carbon bisulphide. This was found to be the dinitro compound of diphenylsulphoxide $(C_6H_4NO_2)_2SO$. (3) An oil not yet further investigated. —D. B.

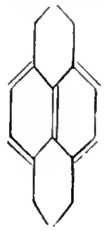
Constitution of Pyrene. E. Bamberger and M. Philip. Ber. **20**, 365—371.

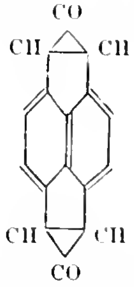
THE formation of naphthalenetetracarboxylic acid by the oxidation of pyrenic acid shows that the latter has the constitution $C_{10}H_4(C_2H_2.CO)(COOH)_2$. The fact that the two pairs of carboxyl groups in naphthalenetetracarboxylic acid have the ortho position points to pyrenic acid having the constitutional formula—



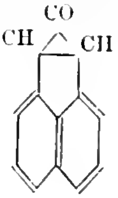
$$\mathrm{CO}{<}\begin{matrix}\mathrm{CH}\\ \mathrm{CH}\end{matrix}{>}\mathrm{C}_{10}\mathrm{H}_4(\mathrm{COOH})_2$$

[C_2H_2 : CO = 1 : 1′ and COOH : COOH = 4 : 4′]. The constitution of pyrene is represented by a combination of a naphthalene nucleus with two benzene nuclei thus:





Pyrenequinone.



Pyreneketone.

The constitutional formulæ of pyrenequinone and pyreneketone are respectively as above given.—D. B.

Notes on the Chemistry of Coal-tar Constituents. K. E. Schulze. Ber. **20**, 409—414.

Neutral Oils boiling at 170—210°.—This fraction consists of about 50 per cent. of resinifiable oils, 15 per cent. of trimethyl-benzenes, 15—20 per cent. of tetramethylbenzenes, and 15—20 per cent. of naphthalene.

Phenols.—The three cresols in coal-tar are present in the following proportions:—Metacresol about 40 per cent., orthocresol about 35 per cent., and paracresol about 25 per cent. The author finds that amongst the hydrocarbons and phenols in coal-tar meta-compounds predominate, thus of the xylenes the quantity of metaxylene is much greater than that of otho- or para-xylene; of the trimethyl-benzenes the 1 : 3 : 5 compound (containing 3 meta-positions) is largely in excess of the 1 : 3 : 4 and 1 : 2 : 3 compounds (containing each 1 meta-position). The same applies to the cresols and xylenols, the quantities of meta-cresol and 1 : 3 : 5 xylenol being much larger than those of ortho- or para-cresol and 1 : 2 : 4 xylenol.

Pyridine Bases.—The author has isolated from coal-tar pyridine Ladenburg's α-α¹-lutidine (this Journal, 1885, 394), α-γ-lutidine and γ-picoline.—D. B.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

A Novel Utilisation of Woods. J. Hlousek, Klein-Cerma, Bohemia. Eng. Pat. 6421, May 12, 1886. 4d.

WOOD-WOOL is spun into yarns either by hand or machine, after having been previously "moistened" or oiled.

Twined yarn is then prepared, and from the same carpet-like fabrics, figured fabrics, laces, cords and ropes are made.—H. A. R.

Improvements in the Treatment of Vegetable Textile Materials and of Threads and Fabrics made therefrom. F. Mollett-Fontaine, Madeleine-les-Lille, France. Eng. Pat. 7278, May 31, 1886. 8d.

THE object of this invention is to effect, in one single operation, the complete bucking (débouillissage) of vegetable materials, such as threads, etc., and so to obtain superior white goods in one bleaching either by means of the chlorine or by the electric process without affecting the fibre.—H. A. R.

VII.—ACIDS, ALKALIS, AND SALTS.

Observations on a Series of Bleaching Powder Chambers. L. Jahne, Petrowitz. Dingl. Polyt. J. **263**, 387.

THE series of bleaching powder chambers which served for the purpose of the experiments consisted of four chambers connected with each other by pipes. The chambers worked in such a manner that, while the first or strong chamber received an excess of chlorine, the unused portion of the gas passed into a second, third, or even fourth chamber, meeting there fresh lime by which to be finally absorbed. If a sample of the first chamber showed that the powder had attained the strength required, the gas from the stills was passed into the second chamber, which thus became the first or strong chamber. The gas in the chamber, now disconnected from the series, was allowed to act for some hours longer on the lime, and then drawn by means of the chimney draught over the fresh lime in the last chamber. Hereby the atmosphere of the chamber was freed from chlorine: no nuisance was created on opening the chamber for the purpose of packing; and, lastly, the residual chlorine was made available in the most rational form. A chamber was finished every 12 or 14 hours according to the quantity of lime, being a single or double charge.

1. *Observations on a series of chambers, one of which was finished every* 12 *hours.* (Single charge of lime. Designation of the chambers: A, B, C, D):—

Monday, 6 a.m.—A was emptied, filled, closed at noon, and remained the fourth of the series until 4 p.m. Direction of gas current: B, C, D, A. The gas was then aspirated from B to A.

6 p.m.—Sample from A=7 per cent. Cl; it now became third chamber. Gas current: C, D, A. B was opened and freshly charged.

12 midnight.—Sample from A=11·5 per cent. Cl. At 4 a.m. A became second chamber. The gas was then aspirated from C to B. Gas current: D, A.

Tuesday, 6 a.m.—Sample from A=12 per cent. Cl. Gas current: D, A, B. C was opened and freshly charged.

12 noon.—Sample from A=13·7 per cent Cl. D was disconnected at 4 p.m., and A became first chamber. Gas current: A, B, C.

6 p.m.—Sample from A=14·5 per cent. Cl. D was opened and freshly charged and connected as fourth chamber at 9 p.m. Gas current: A, B, C, D.

12 midnight.—Sample from A=35 per cent. Cl. A remained first chamber until 4 a.m., when it was disconnected and freed from gas.

Wednesday, 6 a.m.—A was opened and packed. A careful average sample showed the bleaching powder to contain 35·5 per cent. Cl.

These experiments show that the residual chlorine in a finished chamber may cause the formation of bleaching powder, containing 7 per cent. available chlorine in the last chamber. The powder in the second and third chambers increases in strength only to a moderate degree, until it receives the gas directly from the still, when it comes up to strength rather quickly.

2. *Observations on a series of chambers, one of which was finished every* 24 *hours.* (Double charge of lime. The gas from the stills acted on each first chamber from midnight until the following midnight):—

Monday, 8 a.m.—Gas current: C, D, A. B finished. Sample from surface of C=30·8 per cent. Cl; from bottom of D=5 per cent. Cl; from surface of A=11 per cent. Cl. Average sample of B=37·5 per cent. Cl. At 8 a.m. C had been first chamber for 8 hours. The gas from B was aspirated to A from 4 to 7 a.m., whereby the lime in A rose to 11 per cent. available Cl.

Tuesday, 8 a.m.—Gas current: D, A, B; C finished. Sample from bottom of D=22·2 per cent. Cl; from surface of A=15 per cent. Cl; from surface of B=5 per cent. Cl. Average sample of C=38·45 per cent. Cl.

Wednesday, 8 a.m.—Gas current: A, B, C; D finished. Sample from surface of A=34·3 per cent. Cl; from surface of B=6·7 per cent. Cl; from surface of C=11 per cent. Cl. Average sample of D=39·4 per cent. Cl.

Thursday, 8 a.m.—Gas current: B, C, D; A finished. Sample from surface of B=32·4 per cent. Cl; from surface of C=16 per cent. Cl; from surface of D=4 per cent. Cl. Average sample from A=36·9 per cent. Cl.

A rose in 4 days thus	11	15	34·3	(36·9) Cl
B " "	5	6·7	32·4	(37·8) Cl
C " "	11	16	—	(38·4) Cl

A statement is sometimes found in text-books that bleaching powder loses bleaching chlorine if the powder be treated with a very large excess of chlorine. This could not be confirmed on the large scale.—S. H.

On the Action of Sulphur on Ammonia and on Certain Metallic Bases in the presence of Water. J. B. Senderens. Compt. Rend. **104**, 58.

BRUNNER'S statement that sulphur is unacted on by aqueous ammonia below 75° C. is erroneous. Such a mixture, allowed to stand at the normal temperature, became yellow in colour in the course of three weeks, and red in a year, and was then found to contain ammonium polysulphides and hyposulphite (thiosulphate), which are, according to Flückiger, the usual products of the reaction, when effected in a sealed tube at 100° C. Sulphur is deposited from the solution on exposure to air. Precisely similar reactions, whether boiling or in the cold, result from the addition of sulphur to aqueous solutions of the alkali-earth bases. It is usually accepted that in the presence of water, sulphur is also without action on other metallic oxides, unless the oxide thus becomes reduced and sulphuric acid is formed. The author finds, however, that lead, silver, mercuric and cupric oxides, and red-lead under these conditions, in a sealed tube at 100° C., give sulphides and sulphates thus—$4PbO + 4S = 3PbS + PbSO_4$. Ferric oxide is but slightly, and zinc oxide not at all, decomposed. From thermo-chemical observations, it would seem that an insoluble base is thus decomposed by sulphur in presence of water at 100° if its heat of formation be relatively low; the decomposition requires a long contact, especially in the case of absolutely insoluble oxides, when it is important to first triturate the sulphur well with the oxide and a little water.—W. G. M.

On the Decomposition of Sodium Chloride by Phosphoric Acid. L. Blum. Publ. de l'Inst. R. G. D. de Luxembourg, 1886, 177.

FROM the author's experiments it is seen that sodium chloride may be decomposed by phosphoric acid in three ways. With the right proportions of the substances, the following reactions are possible:—

$$4NaCl + 2H_3PO_4 = Na_4P_2O_7 + 4HCl + H_2O.$$
$$2NaCl + 2H_3PO_4 = 2NaPO_3 + 2HCl + 2H_2O.$$

On evaporating a solution of sodium chloride with an excess of tribasic phosphoric acid, hydrochloric acid vapour escapes, increasing in quantity as the solution becomes concentrated. From this it would appear that sodium orthophosphate is formed at the outset, since orthophosphoric acid only passes into pyrophosphoric acid between 200° and 300° C.—W. G. M.

Improvements in Treating Hydrochloric Acid to obtain Chlorine, using the said Chlorine in the Manufacture of Bleaching Powder, and in Apparatus employed. J. Hargreaves, T. Robinson, and J. Hargreaves, Widnes. Eng. Pat. 5673, April 27, 1886. 6d.

HYDROCHLORIC ACID GAS, whilst hot, is mixed with a small quantity of copper chloride vapour, and passed through the decomposer of the Deacon apparatus, by which means the rate of decomposition is increased. The chlorine formed is passed into a bleaching powder chamber of special construction, so as to produce bleaching powder. Owing to a large amount of inert gases accompanying the chlorine, the chamber employed for the absorption of the gas by the lime contains a number of shelves. The weak chlorine enters at a distance of several shelves from the bottom, whereas strong chlorine, to be obtained as described further on, is introduced over the bottom shelf, and the weak bleaching powder formed on the top shelves is constantly stirred and exposed to strong chlorine gas until bleaching powder of high strength is obtained. The strong bleaching powder is then made to fall, by means of scrapers, into an air-tight box, from which it is conveyed directly by mechanical means into casks, where it is automatically pressed. Strong chlorine, to be used as previously described, is obtained by absorbing a separate portion of the dilute chlorine in milk of lime, and decomposing the solution of calcium hypochlorite thus obtained with hydrochloric acid in stoneware stills. Any copper chloride volatilised from the Deacon decomposer is condensed along with the hydrochloric acid in the wet purifier, and will therefore be found dissolved in the liquor of the stills, from which it may be precipitated and recovered.—S. H.

Improvements in Treating Pyrites and in Apparatus employed therein. Jas. Hargreaves and T. Robinson, Farnworth; and Jno. Hargreaves, Widnes. Eng. Pat. 5681, April 27, 1886. 6d.

This specification describes in full detail the arrangement of pyrites burners, regenerators and condensers, and the modifications of them recommended to suit various practical requirements, which constitute the twenty-two claims of the patentees.—W. G. M.

Improvements in the Manufacture of Sulphates of Soda and Potassa, and in Apparatus therefor. J. Hargreaves, T. Robinson, and J. Hargreaves, Widnes. Eng. Pat. 5682, April 27, 1886. 8d.

The invention relates to improvements in apparatus used in the Hargreaves' process. As a means of economising fuel, and to avoid leakage of air and products of combustion into the cylinders, and for increasing the rate of decomposition of sodium or potassium chloride by sulphurous acid, the latter is maintained in the cylinders under pressure. If there be no objection to the presence of a small quantity of iron in the resulting sulphate, as is the case when the sulphate is to be used for the manufacture of sodium hydrate or carbonate, the salt before entering the drying oven is moistened with the waste liquor running away from copper extracting works. The rapidity of the decomposition is augmented by the small quantity of iron present. To avoid the escape of noxious gases into the atmosphere when a cylinder recently finished is to be opened, such a cylinder is connected with another one filled with fresh salt, and after the doors at the bottom of the newly-charged cylinders are closed, the lid from the bottom discharging door of the finished cylinder is withdrawn, whereby the noxious gases from the finished cylinder pass to the bottom of that newly charged, where they are absorbed, at the same time heating the salt. As a means for internally heating the cylinders by means of fire, an arrangement of flues and heating chambers with an iron pipe or brick flue in front of two rows of cylinders is used. Every succeeding erection of cylinder apparatus demonstrates the economy in still further increasing the diameter of the cylinders. This, however, increases the difficulty of adequately supporting the cover of the cylinder, which is very heavy. It is now recommended to support the cover from the interior, by at least four columns, placed in such a position that the pillars stand beneath the joints, and the pillars themselves rest upon a part of the cylinder bottom, which rests immediately upon solid masonry. The pillars are made hollow and long enough to pass through the cover to the working floor on the top of the cylinder, so as to render visible the temperature of each part of the cylinder. The increased height and diameter of the cylinders also necessitate an arrangement to avoid an excessive pressure on the lower portion of the salt in the cylinders. They are therefore divided in several compartments by two or more grids, a working door being fitted opposite to each grid.—S. H.

Improvements in Apparatus for effecting the Absorption of Gases by Liquids. F. N. Mackay, London. Eng. Pat. 6282, May 10, 1886. 8d.

In refrigerating machines made upon the ammonia absorption plan, weak ammoniacal liquor is produced. The patentee deals with this by distillation in a still heated by an internal steam coil. An improved form of absorber is described consisting of a series of pipes cooled on the exterior by water; the ends are connected by bend pipes so that several are joined in series. The weak liquor fills the interior of the pipe, and the ammonia vapour is passed in through a perforated annular pipe; the excess gas in the first absorption tube is passed into the next by a bend communicating with another annular perforated pipe and so on; strong ammonia liquor flows off from the last of the series.
—C. C. H.

Improvements in the Manufacture of Bichromate of Potash. W. Simon, Baltimore. Eng. Pat. 6463, May 13, 1886. 4d.

Sodium chromate is converted into bichromate by the addition of a mineral acid, and to the solution of bichromate thus obtained, potassium chloride is added, when the decomposition takes place according to the following equation:—$Na_2Cr_2O_7$ and $2KCl = K_2Cr_2O_7$ and $2NaCl$. Potassium bichromate crystallises out on cooling, and whilst sodium chloride is removed by salting out, the mother liquor yields another crop of potassium bichromate crystals.—S. H.

Improvements in the Manufacture of Sulphurous Acid and other Sulphur Compounds, and in Apparatus employed in such Manufacture. J. M. Walton, Glossop. Eng. Pat. 16,491, Dec. 16, 1886. 8d.

The object of this invention is the manufacture of sulphites, etc., by a continuous process. The apparatus employed consists of a series of closed vats arranged in gradations, so that the water or alkaline solution to be impregnated with sulphurous acid descends continuously from one vat to the other, whilst the gas being admitted to the bottom of the lowest vat ascends continuously in the opposite direction. For this purpose the vats are connected by pipes for the flow of the liquor, and by another set of pipes for the passage of the gas. Each vat is also fitted with a mechanical agitator.—S. H.

Improvements in Apparatus used in the Manufacture of Ammonia Soda. T. Capper, Northwich. From Dr. S. Pick, Szczakowa, Galicia. Eng. Pat. 4388, March 29, 1886. 8d.

The invention relates to an apparatus for the continuous saturation of ammoniacal brine with carbonic acid (Figs. 1 and 2), and to a column for distilling ammoniacal liquor, having a mechanical agitator, and divided into two parts, in one of which ammonium carbonate is driven off, and in the other fixed ammonium salts are decomposed by milk of lime (Fig. 3). The vessels of the saturation apparatus (Figs. 1 and 2) are filled with ammoniacal brine, and the carbonic acid is forced in through the pipe B. The vessels are so arranged that the gas passes from one to another in such a manner that the fresh carbonic acid comes in contact with the most saturated liquor, and the most exhausted gas passes into the fresh ammoniacal brine. Three vessels are always working in one series, the fourth is filling with brine, and the fifth is emptied. For a better distribution of the gas, several perforated shelves D (Fig. 2) are fixed in the saturators, the holes being of a conical shape, in order to allow the bicarbonate to fall. After the saturation, the liquor is introduced into the pipe C of the distilling column A (Fig. 3) for the recovery of the ammonia. It drops from one section to the other, falling upon rounded plates H, and, being dispersed by them, comes in intimate contact with ammonia and steam, proceeding upwards from B. In this manner the volatile ammonia compounds are driven off. The liquor

FIG. 1.

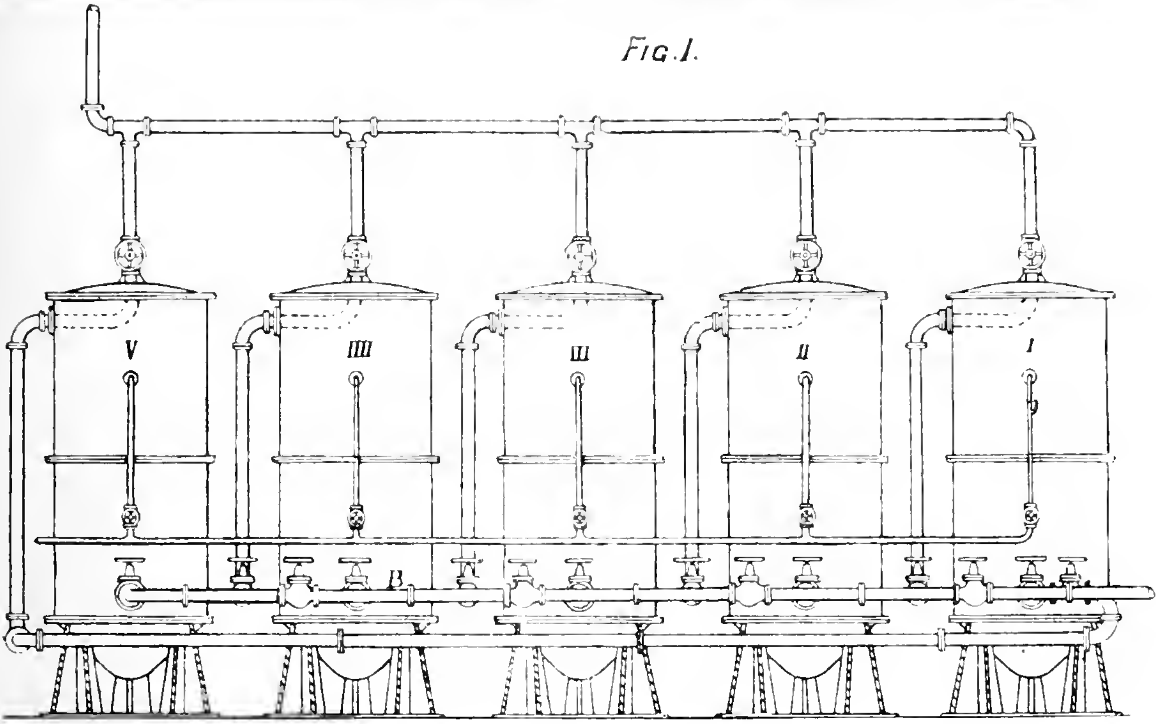


FIG. 2.

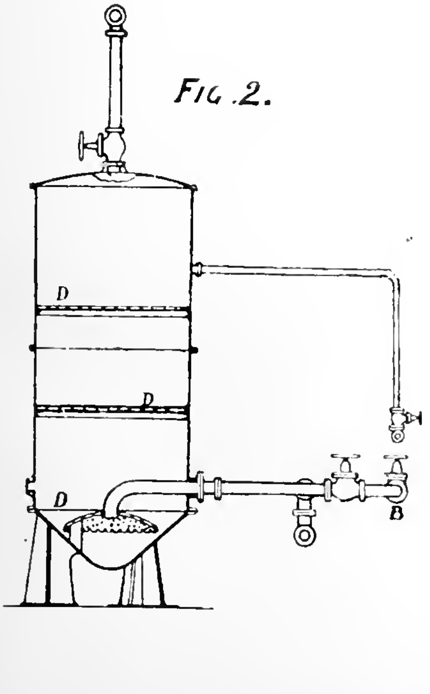
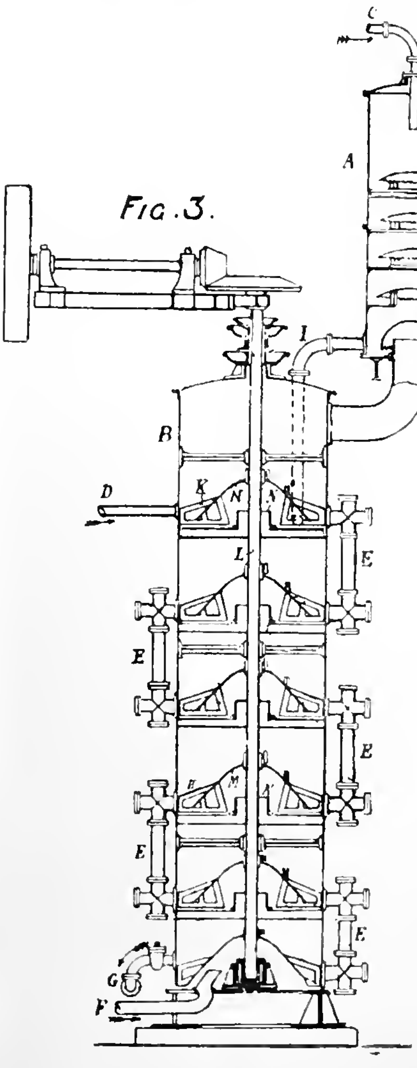


FIG. 3.



then descends into the top section of B, where it is treated with milk of lime, which is forced in at D and mixed with the liquor by the agitator K, fastened on the vertical shaft L. On this shaft there is, in each section, a fixed cap M, which covers the pipe N carrying the steam from the lower section. The steam is thus compelled to pass through the liquor. Overflow pipes E convey the liquor to the lower sections. The steam enters through F, whereas the waste liquor runs away through the pipe G.—S. H.

Process of making Pure Sulphuric Acid and Strong Sulphuric Acid in one Continuous Operation. A. M. Clark, London From J. Herreshoff, H. Nichols and G. Nichols, Brooklyn. Eng Pat. 1998, Feb. 8, 1887. 6d.

Sulphuric acid is first concentrated up to 86 per cent. SO_4H_2 in a suitable concentrator. The acid is then conveyed into another vessel, where it is compelled to flow in a zig zag course, being meanwhile exposed to heat to such an extent as to be further concentrated to about 95 per cent. to 96 per cent. SO_4H_2. Thence it flows into a third vessel of similar construction, which is heated high enough to drive off one half to two-thirds of the acid as a vapour, which is collected in a condenser, where it will be found to be sulphuric acid of 93·5 per cent. SO_4H_2 (66° B.) and of great purity. The remaining portion contains about 98 per cent. SO_4H_2.

—S. H.

Erratum.—April number, p. 292, 10th and 11th lines from bottom of 1st column, *for* "Three of these machines . . . length," *read* "One of these machines is sufficient for a chamber of 100ft. in length provided with three lute holes, as shown in Fig. 2."

VIII.—GLASS, POTTERY, AND EARTHENWARE.

An Improved Method of Annealing Glass or Articles manufactured therefrom. J. D. Watson, Glasgow. Eng. Pat. 15,099, Nov. 20, 1886. 4d.

The glass while in its plastic state is placed in moulds and deposited in a tank of boiling tallow, which is kept in its boiling state for a length of time depending upon the thickness of the glass to be annealed. Afterwards, before removing the glass, the tallow is allowed to cool slowly.—B. T.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Sugar as an Addition to Mortar. Zuckerind. **12**, 18.

Herzfeld has experimented with this mixture, recently reported to be so successful in India, on the new buildings of the Berlin Natural History Museum. To every 100 parts of a thick paste consisting of 1 of lime to 3 of sand, he added 2 parts of solid sugar (free from invert sugar) and, without further addition of water, used the mixture to plaster a wall. On the following day the plaster had hardened completely, as also a mortar made in a similar manner, and used in the building of a brick pillar. This mortar, which must be freshly made, and without too large an addition of water, is very binding and, as far as may be judged after a two months' trial, promises to be very durable. Good molasses gave a result apparently equal to the solid sugar.—W. G. M.

Improvements in the Manufacture of Cement or Plaster. C. J. Howe, London. Eng. Pat. 5843, April 29, 1886.

Gypsum or anhydrite, suitably broken, is boiled under pressure with an alkaline silicate, aluminate or borate, or of borax, or of borax and cream of tartar, or of sulphate of zinc or iron, or of barium hydrate or lime-water, or a combination of these ingredients. The fluid is then withdrawn, and if necessary a current of carbonic acid gas is first blown through the mass of gypsum, and next a blast of heated air or jet of superheated steam. The material is now calcined and reduced to powder. The method of manufacture may be modified in various ways.—E. G. C.

Improvements in the Manufacture of Cement. A. J. Boult, London. From A. Grasset and A. C. Mallat, Paris. Eng. Pat. 5975, May 3, 1886. 4d.

A powder, consisting of 8 per cent. of zinc oxide, 10 per cent. of minium, 5 per cent. of yellow ochre, and 5 per cent. of plumbago, is mixed with a liquid consisting of 99 per cent. of chloride of zinc, and 1 per cent. of perchloride of iron solution. The result is a cement which sets in about 30 seconds, adheres strongly to wood, glass, or metal, and is impermeable to water.

—E. G. C.

X.—METALLURGY, Etc.

On the Distillation and Electrolytic Treatment of Zinc-scum. B. Rosing. Zeits für Berg. Hütten. u. Salinenwesen, 1886, and Dingl. Polyt. J. **263**, 87—94.

In the desilvering of lead by means of zinc, a zinc-scum is obtained, from which part of the lead is first removed by cupellation. The concentrated scum, which varies in different works from 1½ to 10 per cent. of the lead worked, generally contains from 8 to 25 per cent. of zinc, 45 to 90 per cent. of lead, and 5 to 2·5 per cent. of silver. The oldest method of treatment, and that generally employed, consists in distilling off the zinc at a high temperature. This operation is performed in tilt or fixed furnaces, the latter being in the form of muffle, crucible, or tube furnaces, heated by coke or gas. The tube furnaces are nearly always heated by gas. The zinc is condensed in suitable receivers, and either used again for desilvering fresh quantities of lead, or converted into oxide by allowing it to burn in the air as it issues from the furnace. The lead containing 1 to 4 per cent. of silver is then run out. The fuel employed varies from 40 to 170 per cent. of the charge, according to the form of furnace used. The cost of working (wages, fuel, etc.) with a gas furnace amounts to about £1300 per 1000 tons of material. The distillation method is preferable to Flach's process (*Dingl. Polyt. J.* **225**, 67), and to Schnabel's steam and ammonia method (*Dingl. Polyt. J.* **240**, 149). The electrolytic process appears to be the most suitable of all the methods at present known. In this process the zinc-scum is spread out in powder upon a lead plate lying at the bottom of a wooden vat containing a solution of zinc sulphate. On passing an electric current through the fluid, the lead plate forming the anode, zinc is deposited from the solution upon the cathode, whilst a corresponding quantity of zinc is dissolved up from the zinc-scum. The action stops when the surface of the particles has become free from zinc. The mass is then heated in a cupellation furnace, and again electrolysed, the operations being repeated alternately until the zinc and lead have both been removed.

—A. G. G.

On the Behaviour of Pig-iron when heated in Wood Charcoal. A. Ledebur. Stahl u. Eisen, 1886, 777.

In earlier experiments conducted by the author on this subject (this Journal, 1886, 493), the samples of pig-iron employed contained but little manganese and phosphorus, and were comparatively rich in silicon ; he has, therefore, made experiments with low silicon metals, with varying amounts of the other elements. Nine test pieces of various kinds were packed separately, amidst small fragments of charcoal, in a pot such as is used for making malleable castings ; they were then heated to about 1000° C. for 108 hours. On examining the samples, it was found that in all malleable irons the percentage of carbon had increased ; thus in—

Fibrous wrought-iron	from	0·10 to 0·58	per cent.
Thomas steel	,,	0·11 to 0·26	,,
Cast steel	,,	0·40 to 0·65	,,

Similarly in a manganiferous (2·75 per cent. Mn) cast iron for the Thomas process the carbon had increased from 2·63 to 3·27 per cent., whilst in a refined Lowmoor-iron, with but a trace of manganese, it was constant at 3·5 per cent. ; in all the other specimens there was actually a diminution in the amount of carbon. Thus, although confirmatory of previous experiments, no further light is thrown on the cause of the decrease noted with so many samples of cast-iron. The silicon and phosphorus percentages alike remain unchanged. With the alteration in composition was a corresponding change in the appearance and in the physical properties; all specimens with less than 1 per cent. of manganese having become granular, soft and comparatively tough, whilst the manganese Thomas cast-iron, above alluded to, remained unaltered in fracture and in brittleness.—W. G. M.

Improvements in the Smelting and Refining of Gold, Silver, Copper, Zinc, Lead and Tin Ores, and in Furnaces therefor. J. M. Bennett, Ruchill, Lanark, N.B. Eng. Pat. 6300, May 10, 1886. 8d.

A CUPOLA, with closed bell and hopper top, has tuyeres for the admission of air and steam throughout its height; in front at the bottom is a closed receiving chamber, provided with slag and tap-holes, and communicating with the cupola; and on either side of the base is an open hearth furnace of suitable size and shape, so arranged that the gases, which pass downwards from the cupola, are utilised as a source of heat, the whole products being finally passed from the flues through some form of condenser or dust-collecting apparatus. The metal which has accumulated in the receiver may, if desirable, be there subjected to the action of an oxidising blast; it is then tapped, and ladled into one of the reverberating furnaces, which, in dealing with gold and silver ores, would be constructed as a bone-ash refining furnace, with copper ore as a copper refinery, or with other metals according to their requirements.—W. G. M.

Improvements in the Manufacture or Production of Metallic Alloys. T. Slater, London. Eng. Pat. 6550, May 15, 1886. 6d.

A MIXTURE of 55 per cent. of chromium oxide, 33 of ferric oxide, 18 of alumina, and smaller proportions of borax, calcined aluminium sulphate, silica, manganic oxide, and magnesium carbonate, are to be added in the form of powder to metals or alloys. The powder is to be added very gradually, and with constant stirring, with the object of hardening and increasing the tensile strength of the metal.—W. G. M.

Improvements relating to Amalgamating Apparatus for Separating Metals from their Ores. H. H. Lake, London. From W. White, New York, U.S.A. Eng. Pat. 463, Jan. 11, 1887. 6d.

A SHALLOW circular pan, with inwardly re-curved edge, is rotated by suitable mechanism from beneath. Within the pan, and shaped conformably, is a stationary disc, having concentric but broken ridges on its lower side, which at all points are nearly in contact with the bottom of the pan, the alternate rings being broken in different positions. Mercury is poured between the pan and the disc, ore is fed in through a central hopper in the latter, when, by the centrifugal action of the former, it is forced towards the circumference, and, by the aid of the broken ridges, takes a zig-zag course, always in contact with the mercury, and finally overflows from the curved edge. The amalgam may be drawn off through a cock beneath. —W. G. M.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

Vaselin. C. Engler and M. Boehm. Dingl. Polyt. J. **262**, 468—475 and 524—530.

VASELIN is the substance extracted from petroleum residues, whilst the mixture of heavy mineral oil (*paraffinium liquidum*) with ceresin (*paraffinium solidum*) is called "artificial vaselin" by the authors. For the preparation of vaselin two kinds of Galician petroleum oil were employed. Both oils were highly dichroic, had a green colour by reflected light, a colour varying from yellowish to brownish red by diffused light, and yielded the following, when subjected to fractional distillation:—

	Specific Gravity at 15°.	Fraction below 150°.		150—290°.	
		Per cent. by vol.	Per cent. by weight.	Per cent. by vol.	Per cent. by weight.
Oil I.	0·812	30·2	26·7	35·9	35·5
Oil II.	0·820	21·8	20·0	51·7	51·2

	290—340°.		Above 340°.	
	Per cent. by vol.	Per cent. by weight.	Per cent. by vol.	Per cent. by weight.
Oil I.	5·3	6·5	27·7	31·1
Oil II.	8·8	9·4	17·0	18·9

For the manufacture of vaselin from these oils, two processes were employed. (1) The oils were distilled until the residue assumed a butter-like consistence. The residue was then dissolved in petroleum spirit, bleached by passage through animal charcoal filters, and the solvent expelled by distillation with steam. The vaselin thus obtained is a colourless, translucent ointment melting at 32° and exhibiting no crystalline structure. (2) The oils were bleached and subjected to distillation in a vacuum (column of mercury 10—15mm.) to 250°. The product is colourless, translucent, free from odour and exhibits the following properties:—

	Yield.	Specific Gravity.	Melting point.
Oil I.	13·8	0·8809	30—31°
Oil II..........	13·2	0·8785	30—31°

The composition of these vaselins is illustrated in the subjoined table:—

	From Residues.		From Oil I.			From Oil II.	
	I.	II.	III.	IV.	V.	VI.	VII.
C	86·99	86·67	86·30	86·51	86·55	86·14	86·17
H	13·14	13·15	13·99	13·73	13·74	13·50	13·72

It will be seen from these results that vaselin is composed entirely of hydrocarbons; moreover, the oils obtained by subjecting the bleached petroleum to fractional distillation, were found to contain carbon and hydrogen exclusively, both oxygen and sulphur being absent. The bleaching process appears to remove all oxygenated constituents, and increases the amount of saturated hydrocarbons, by retaining the less highly hydrogenated hydrocarbons. Attempts were made to increase the melting point of vaselin by distilling part of it over in a vacuum. It was not, however, possible to raise the melting point more than 2 or 3 degrees, whilst on continuing the distillation, the melting point was actually reduced, probably owing to the decomposition of the product. By dissolving vaselin in ether and subjecting the ethereal solution to fractional precipitation by means of alcohol, the authors succeeded in separating vaselin into a solid and a liquid portion. 100grms. of vaselin from oil II. gave 40·8grms. of solid vaselin having a sp. gr. of 0·8836 and melting at 40°, and 59·2grms. of liquid vaselin having a sp. gr. of 0·8809 and solidifying at —10°. Both vaselins were similarly constituted and had approximately the same boiling points. American vaselin, melting at 32—33°, gave 14 per cent. of solid vaselin melting at 49—50°, and 86 per cent. of liquid vaselin. Although artificial vaselin could be separated into solid and liquid products, a wide difference was observed between the chemical and physical properties of the component parts. On subjecting the solid and liquid portions of natural vaselin to distillation, both began to boil at 240—245°, the solid yielded 66 per cent. of distillate at 340°, and the liquid 75 per cent. The residue from the solid portion was amorphous and had a melting point of 40—41°, whilst the distillate was crystalline and melted at 36—37°. Both the residue and distillate of the liquid vaselin were fluid. From the fact that the solid hydrocarbons present in vaselin are amorphous and only assume a crystalline structure when subjected to distillation, the authors conclude that paraffin does not, as a rule, exist in crude petroleum in a crystalline form; moreover, they consider the solid hydrocarbons found in the crude oil to be chemically identical with ozokerite, which is frequently regarded as petroleum in a dried-up condition. It is, of course, possible that in isolated cases paraffin may exist in petroleum, in a fully developed state. The authors are, however, of opinion, that as a rule it occurs in a transition form. The difference between natural and artificial vaselin is considerable. Artificial vaselin is resolved into oil and ceresin when subjected to distillation, and differs sensibly in viscosity, as shown by the following figures obtained with Engler's apparatus and compared with water as the standard:—

	45°	50°	80°	100°
Natural American Vaselin ..	1·8	3·7	2·1 ..	1·6
Artificial Vaselin	Ceases to run out.	Ceases to run out.	1·5 ..	1·2

From a series of experiments made with a view to ascertain whether vaselin acquires an acid reaction by keeping, it is inferred that lard has a greater tendency to become acid than natural or artificial vaselin, whilst of the latter, the artificial product absorbs the least amount of oxygen.
—D. B.

Separation of Stearic and Oleic Acids. Dingl. Polyt. J. **263**, 48 and 49.

In the ordinary method of separation from the mixture of fatty acids, which is obtained by saponification of tallow or palm-oil by means of lime, the solid stearic acid (so-called "stearin") is removed by passing through a filter-press at the ordinary temperature. Under these conditions a considerable quantity of stearic acid remains dissolved in the liquid oleic acid. By moderate cooling, a further quantity of this stearic acid can be obtained without solidification of the oleic acid. For this purpose a revolving drum A is employed (Fig. 1), containing cold water supplied from a cooling machine through the tube *c*, and carried off by another tube. The drum dips into the trough *f*, containing the liquid fatty acids, which are carried round in a thin layer upon the surface. During the revolution the oil solidifies, and is scraped off by the scraper *h* into the reservoir F, from which it is pumped through a Farinaux filter-press (Figs. 2 and 3). An increased yield of 4 per cent. on the raw material is obtained, and the oleic acid has a higher value on account of its greater clearness.—A. G. G.

Fig 1.

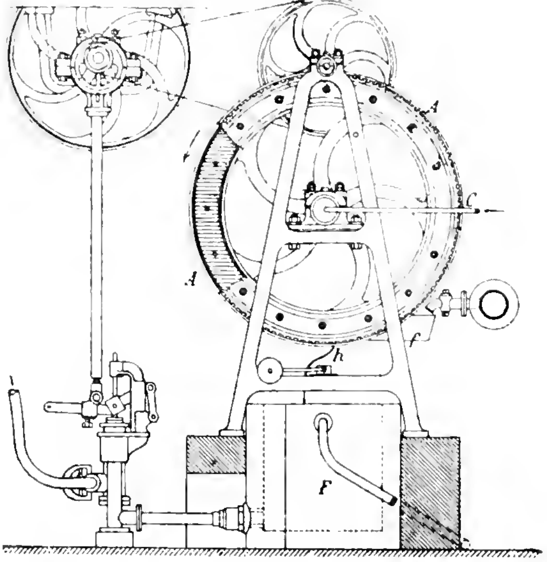


Fig. 2.

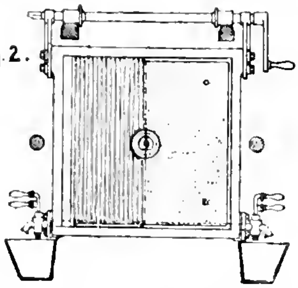
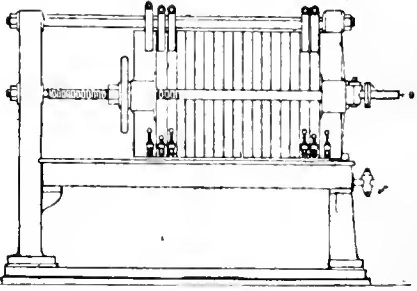


Fig. 3.



On the Oil of the Japanese Sardine Villon. Corps. Gras. Ind. 1887, 178.

This oil, which was introduced into Europe two years ago, but which found little acceptance on account of its most unpleasant smell, due to the crude manner of its extraction, is considered by the author to be capable of profitable application in dyeing, and in the stearine and soap manufactures. The oil is chiefly obtained from the island of Yesso, and from the peninsula of Ava, near Yokohama, and is extracted from the fish, either by boiling with water or by allowing them to rot in heaps, when the greater part of the oil flows out, the residue being obtained by pressure. This oil contains about 30 per cent. of solid fat, and begins to run at 20—22° C. It is refined in Yokohama by being heated for an hour at 50—60° C., in iron boilers of 100 litres capacity, and then run off into wooden vessels, where it soon separates into three layers. The upper layer is liquid and clear oil, the middle layer consists of solid fat, and the lower is water, with albuminous substances and portions of the fish. The liquid oil, when light, costs in Hamburg 40 marks per 100kilos., and about 37·5 marks when brown. The solid fat is re-melted, filtered and run into boxes, in which it solidifies. This fat is yellow, and is sold in Rotterdam as fish-stearin or fish-wax, at 43 marks per 100kilos. In the Indo-Chinese colonies, and especially in Cambodia, the production of this fish fat might be very considerable, about 400,000kilos. a month could readily be exported. Experiments as to the application of this new product would be of great value.—W. D. B.

Improvements in Apparatus for the Extraction of Oils or other Vegetable Juices. A. J. Boult. From E. Oppelt, of Alors, Spain. Eng. Pat. 5792, April 28, 1886. 8d.

THE apparatus, of which a drawing is given, consists essentially of a hollow cylinder, the sides of which are formed of rings in parts, placed one above the other, and joined by bolts, and also fixed by bolts to a bedplate. The first set of bolts serves also to regulate the space between the rings for the escape of the extracted liquid, while the second set serves as hinges for opening or closing the segments of the rings. Pressure is applied by hand, steam, hydraulic or other convenient power, the material to be pressed being divided into layers by metal discs.—W. L. C.

Toilet and Washing Soap. R. Wright. Eng. Pat. 16, Jan. 1, 1887. 4d.

FOR mixing borax with soap.—W. L. C.

Method for the Separation of Cholesterin Fats from Commercial Wool Fats, and from the Lyes of Wool-washing Works. H. G. Laogbeck and R. E. Ritsert. Eng. Pat. 6210, May 7, 1887. 4d.

THE raw wool fats are treated with boiling alcohol, containing 10 per cent. of ether. Free fatty acids, free cholesterin, isocholesterin, and volatile fatty ethers, are dissolved, the residue being mainly true cholesterin fats. Or, the whole raw fat may be dissolved in ether, and the cholesterin fats precipitated therefrom by the addition of alcohol.—W. L. C.

XII.—PAINTS, VARNISHES, AND RESINS.

Improvements in the Manufacture of Oxide of Iron Pigment Colour. R. Lavender, Talywain, Monmouthshire. Eng. Pat. 6370, May 11, 1886.

COPPERAS is spread on heated iron plates, and the water of crystallisation thus driven off. Cast-iron trays, containing the crushed material in layers of less than an inch thick, are then introduced into retorts set in a furnace, like gas retorts, and heated to a full red heat, but not beyond. The retorts are connected with a sulphuric acid chamber, air having free passage through the retorts during the operation. This is essential for the complete removal of the sulphur. The pigment is produced in a condition ready for use and requires no lixiviation or other preparation.—E. G. C.

A Novel Protective Varnish. W. Dick, Leytonstone. Eng. Pat. 2498, Feb. 17, 1887. 4d.

TWELVE POUNDS of Egyptian asphaltum are kept at the boiling point for four hours; to this, three pounds of red lead and four pounds of litharge are added during the first two hours. Three gallons of boiled oil, three pounds of very-finely ground plumbago, and six pounds of finely pulverised Italian asbestos, are next introduced into the mixture. Finally, a solution of indiarubber (one pound of finely-cut virgin indiarubber in two pounds of benzene) is poured in, and the solution is now kept boiling, with constant stirring, for one hour, at the expiration of which it is allowed to cool. If necessary, the varnish may be thinned with turpentine.—E. G. C.

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

Improvements in Tanning and Stuffing Leather. A. M. Clark, London. From J. B. West, Durant, Mississippi, U.S.A. Eng. Pat. 13,283, Oct. 18, 1886. 6d.

THIS is an improvement on Peter's process for tanning and stuffing leather. The principal differences are:—(1) The hide is soaked in clear water, the hard flesh removed by a light currying knife, and the hide again soaked in clear water before liming. (2) After liming and removing the hair it is bated in water only instead of with the addition of sulphuric acid, bran, and buttermilk. (3) The hides are tanned in the following mixture, which is strengthened as required during the process: 8 gallons water, 3lb salt, ¼lb. saltpetre, 10lb. gambia, and 1lb. sulphuric acid. When half-tanned the hides are taken out, beamed, and again immersed in the tan liquor. (4) They are soaked for 30 to 60 minutes in lye (1lb. caustic to 20 gallons water), and next in clean water for one or two days; after which they are sleeked and brushed and hung up to drain. (5) Boiling hot tanners' oil (fish oil and bees wax) is poured on to the grain side and well brushed in. Twelve hours afterwards a boiling hot mixture of 1 part tar, 1 part tallow and 2 parts tanners' oil is brushed into the flesh side. By using these mixtures hot the hide is much more thoroughly permeated, and rendered waterproof.—R. L. W.

XIV.—AGRICULTURE, MANURES, Etc.

Composition and Formation of "Acid Soil" in Dutch Alluvial Districts. J. M. van Benmelen. Bied. Centr. **15**, 795—806.

THIS communication contains the results of extensive investigations on "acid soils" in various alluvial districts in Holland. The changes occurring in clay soil under the influence of brackish or sea-water and decaying vegetable matter; the migration and transformation of the substances produced; the microscopic character of the "acid soils;" their chemical composition at different depths, and the origin of the most characteristic constituents; and the effect of aeration and drainage are described more or less in detail and explained. The formation of "acid soils" is observed to take place in four stages. During the first stage the ground is covered with reeds and saturated with water containing gypsum. In the second stage the air is excluded from the soil, gypsum disappears; iron sulphide, free sulphur with little or no iron sulphate replace it, and the soil is either not acid at all or only slightly so; such soils, for instance, are soils in a state of transition between clay and moorland, or the soil from the lower layers of "acid soils." In the third stage the air has limited access to the soil, and the quantity of iron sulphate has increased, whilst pyrites and sulphur have diminished. In the fourth stage in the aeration and drainage pyrites and sulphur have entirely disappeared, and the soil contains large quantities of basic iron sulphate; if, however, sulphates and sulphuric acid gain access, even in this stage, iron sulphide is formed from part of the sulphuric acid. The layers of soil are acid when they do not contain a sufficient quantity of bases in combination with carbonic, humic, or silicic acids: but when they contain these substances in sufficient quantity they are not acid, but are rich in gypsum.—D. A. L.

Experiments with different Phosphates and Chili Saltpetre on Moorland. V. Photz-Pollingen. Bied. Centr. **15**, 826—828.

THE experiments were conducted on recently reclaimed and previously unmanured moorland. Eight plots were arranged; all received three centners of kainite per morgen, one without other manure, three with the addition of 40 pounds (German) phosphoric acid as basic slag, two with this amount of phosphoric acid as precipitated calcium phosphate; of the other two one received in addition ½ centner Chili saltpetre, and one a double dressing of phosphate. As a matter of profit the slag was the most remunerative; from a manurial point of view the two forms of phosphates were of equal value, whilst both the double dressing and the nitrate proved superfluous. Cultivated moorland which had already yielded some crops produced last year, when manured with four centners kainite and two centners basic slag per morgen, 1360 pounds of wheat, 800 pounds rye, 98 centners (magnum bonum) potatoes, 80 centners sugar-beet. (See also this Journal, 1886, 541.)—D. A. L.

Tetracalcium Phosphate and Basic Slag. E. Jensch. Ber. **19**, 3093—3097.

IT is now well known that the phosphoric acid of basic slag is present in a state differing both in appearance and chemical behaviour from tricalcium phosphate, and it has been suggested it is present in the slag in the form of tetracalcium phosphate. The author of the present note has attempted to synthesise this compound by strongly igniting tricalcium phosphate with lime prepared from marble, and although he has not succeeded in reproducing a phosphate in the crystalline form observed in basic slag, he has nevertheless effected a chemical change. The unignited mixture contained 0·26 per cent. of citrate soluble phosphoric acid; after exposure to the air for a quarter of a year it had absorbed 1·20 per cent. of water of hydration, 2·19 per cent. of carbonic anhydride, and the citrate soluble phosphoric acid had increased to 0·38. Portions of the same mixture after ignition yielded 3·84 per cent. citrate soluble phosphoric acid, and after the quarter year exposure to air had absorbed 0·92 per cent. water of hydration, 2·04 per cent. carbonic anhydride, whilst the percentage of citrate soluble phosphoric acid had increased to 5·62 per cent. From evidence afforded by numerous analyses of basic slag the author is of opinion that after the formation of the tetracalcium phosphate there is little or no uncombined lime present in the slag, it being in fact in combination as silicate, ferrate, manganate, etc. A careful inquiry into the question as to the presence of iron phosphide in the slag leads to the conclusion that the quantity is at any rate but small, and may possibly amount to 1·5 per cent. of the phosphoric acid found. It is, moreover, shown by experimental plot cultivations of oats in garden soil and in loamy sand soil, that under the influence of the chemical agencies of the soil plant-roots and Chili saltpetre iron phosphate is decomposed and rendered soluble within three months.—D. A. L.

Experiments on Iron Sulphate as a Manure during 1886. A. B. Griffiths. Jour. Chem. Soc. 1887, 215—224.

THE experimental plots were in all cases an acre each in area. The plot of grass grown with farmyard manure only yielded 3496lb. hay; a similar plot with ½cwt. ferrous sulphate in addition yielded 6962lb. The latter hay (dried) contained 13·01 per cent. albuminoids, and 48·29 per cent. soluble carbohydrates; the former 9·68 per cent. albuminoids, and 46·24 per cent. carbohydrates; the ash of the untreated hay contained 1·22 per cent. Fe_2O_3 and 5·36 per cent. P_2O_5, of the hay receiving iron sulphate 4·46 per cent. Fe_2O_3 and 7·67 per cent. P_2O_5.

Two plots of mangel wurzel were grown with 10 tons farmyard manure, and top dressed with a mixture of kainite, nitrate of soda, superphosphate, and salt. One of them received in addition ½cwt. ferrous sulphate. The latter yielded 97,682lb. roots, and the former 78,369lb., a difference in favour of the iron sulphate of six tons per acre. The roots grown with this salt contained 2·89 per cent. albuminoids, and 11·21 per cent. soluble carbohydrates; the ash of the roots 4·25 per cent. Fe_2O_3, and 12·24 per cent. P_2O_5; and the ash of the leaves 5·42 per cent. Fe_2O_3. The roots grown without ferrous sulphate contained 1·90 per cent. albuminoids, and 9·32 per cent. soluble carbohydrates; the root ashes 2·42 per cent. Fe_2O_3, and 9·96 per cent. P_2O_5; and the leaf ashes 3·29 per cent. Fe_2O_3.

The plot of beans grown with farmyard manure only, yielded 4726lb. dry crop: that with ½cwt. ferrous sulphate in addition, 5929lb. dry—50 bushels of beans against 30 bushels. The beans and straw grown with iron sulphate showed also a slight superiority in albumenoids and soluble carbohydrates. The ash of the beans from iron sulphate contained 4·821 per cent. Fe_2O_3, and 40·65 per cent. P_2O_5; the ash of those grown without iron sulphate contained 1·099 per cent. Fe_2O_3, and 37·424 per cent. P_2O_5. These results obtained with beans in 1886 are exactly similar to those obtained in 1883 and 1884.

Tried on palms and indiarubber trees in the house, ferrous sulphate also showed good results; the ashes of the leaves of these plants also contained more Fe_2O_3 than those untreated with $FeSO_4$.

Half a cwt. of ferrous sulphate tried against 2cwt. kainite on potatoes which were grown with farmyard manure gave nine tons tubers against six tons with the kainite: the same excess in albuminoids, soluble carbohydrates, ferric oxide, and phosphoric acid were noticed in this case as in the others.

All the experiments which have been made with iron sulphate appear to show that it increases the quantity of chlorophyl formed in the leaves, and in this way augments the assimilating power of the plant. It has also antiseptic and antifungoid properties, and the potatoes grown with it were quite free from disease, whereas those grown with the kainite showed signs of disease.

—J. M. H. M.

XV.—SUGAR, GUMS, STARCHES, Etc.

Raffinose. Haedicke and Tollens. Ztschr. f. Zukerind. **37**, 17.

THE authors have investigated the products formed by the inversion of raffinose. On treating 40grms of raffinose with 400cc. of water and 25cc. of sulphuric acid of 1·156 sp. gr., and heating on a water bath for 3½ hours, the rotatory power was reduced from $[\alpha]D = +104·5°$ to $[\alpha]D = +21·46°$. The solution was then neutralised and evaporated to a syrupy consistency. On cooling galactose crystallised out. Its rotatory power was found to be $[\alpha]D = +80·33°$ to $+80·71°$. It is bi-rotatory, reduces Fehling's solution, and on oxidation with concentrated nitric acid yields 74—78 per cent. of mucic acid. On treating 60grms of raffinose with 540cc. water and 30cc. of sulphuric acid, *i.e.*, inverting the raffinose more slightly, the mixture yields levulose when heated for one hour at 80°. On reducing the inverted syrups with sodium amalgam, a mixture of equal parts of mannite and dulcite is obtained melting at 160°.

—D. B.

Levulinic Acid. Block and Tollens. Ztschr. f. Zuckerind. **37**, 27.

WHEN this acid is saturated with baryta, and the mixture kept at rest for a few months, the barium salt crystallises out in the form of fine needles having the composition $(C_5H_7O_3)_2Ba+2H_2O$. It is a colourless salt readily soluble in water. The strontium compound may be obtained in a similar manner. It forms brilliant prismatic crystals, which are readily soluble in water. Attempts to obtain a crystallisable magnesium salt have hitherto been unsuccessful.—D. B.

Erythrol. A. Colson. Compt. Rend. **104**, 113.

IF erythrol has the constitution $CH_2(OH).CH(OH).CH(OH).CH_2(OH)$ it should yield erythric and tartaric acids by oxidation. Hitherto it has not been possible to obtain satisfactory results in this direction:—When erythrol is treated with phosphorus bromide, a bromide $C_4H_6Br_4$ is obtained which melts at 112° and is identical with the crotonylene tetrabromide prepared by Henninger. If heated with bromine in sealed tubes at 175° a mixture of a solid and a liquid product is obtained. Both are isomeric, and have the composition $C_4H_4Br_6$. The solid crystallises in needles, which melt at 167°—169° and dissolve readily in chloroform, but are only sparingly soluble in alcohol and ether. The liquid forms an oil, which dissolves readily in ether and chloroform, but is only slightly soluble in alcohol. On heating the liquid product with dilute potash in sealed tubes it yields a potassium salt, which is free from bromine, only slightly soluble in water and in some respects resembles potassium hydrogen tartrate. It does not, however, give precipitates with salts of silver or calcium, has no action on polarised light, but yields an insoluble lead salt. This compound is in all probability the potassium salt of erythric acid. It would seem, therefore, that the liquid is the unsymmetrical $CBr_3.CHBr.CHBr.CH_2Br.$, whilst the solid bromide has the constitution represented by the formula $CHBr_2.CHBr.CHBr.CHBr_2$. The investigation is still being pursued.—D. B.

A Process for Revivifying Spent Charcoal. M. P. W. Boulton, B. E. R. Newlands and Edward Perrett, London. Eng. Pat. 15,897, Dec. 24, 1885. 3d.

FOR the purpose of revivifying spent charcoal which has been used for the purification of sugar or other liquors, the inventors use two vessels, the one containing refractory materials previously heated by fire, the other the charcoal which is to be operated upon. Gas, steam or some other elastic fluid is caused to pass first through the hot vessel and then through the charcoal, which is made to descend gradually through the second vessel in a direction opposite to that taken by the steam. The apparatus is fully described and illustrated in the specification, and details of the method of working are also given.
—A. J. K.

A New or Improved Diastasic Saccharine Substance, and Method of Manufacturing the Same. L. Cuisinier, Brussels. Eng. Pat. 1820, Feb. 8, 1886. 6d.

THE author claims the discovery of a new diastasic substance, which he calls "Cerealose." It has a more sugary flavour than the solid maltose of Dubrunfaut, and is more easily manufactured. If maize be simply steeped in cold water for two or three days a special kind of diastase is developed, which the author calls "Glucase." By the action of this substance upon starch "Cerealose" is obtained. Cerealose is a mixture of varying and uncertain composition containing from 48 to 72 per cent. dextrose, from 5 to 24 per cent. maltose, and from 1 to 12 per cent. of dextrin.—A. J. K.

Improvements in Filtering and Decolourising Sugar, Syrups, and Other Liquids and in Preparing a Material therefor. M. F. Heddle, D. C. Glen, and Duncan Stewart, Glasgow. Eng. Pat. 3116, March 5, 1886. 6d.

THE material used is an earthy compound of a class known by various names—diatomite, desmid earth, white peat, kieselguhr or bergmehl. A special quality found at Black Moss and Kinmordie in the county of Aberdeen, is said to be most suitable for the purpose. After being heated in a kiln, to remove volatile constituents and to carbonise it, the prepared material is known as hedylglin, and may be used instead of animal charcoal for purifying sugar syrups and other liquors. It can be revivified by the usual method of washing, exposure to air or ignition.—A. J. K.

Improvements in the Process of Purifying Saccharine Juices. R. Englert and Dr. F. Becker (Prague). Eng. Pat. 3196, March 6, 1886. 6d.

THE saccharine juices obtained either from beetroots or sugar canes by the diffusion process are first defecated as usual with lime and carbonic acid, and then further purified by the use of sulphite of alumina or iron, hydrosulphurous acid or of a sulphite of some other base than alumina or iron. By a judicious use of one or other, or of several of these substances in combination with the lime and carbonic acid treatment, it is claimed that the juices are so thoroughly defecated as to render unnecessary the use of animal charcoal.—A. J. K.

Improved Process for the Insaccharification of Molasses and Sugar-Syrups, and the Simultaneous Production of Oxalates from the Salts contained therein. C. D. Abel, London. From Messrs P. Schwengers Söhne, Uerdingen, Germany. Eng. Pat. 4801, April 6, 1886. 6d.

MOLASSES and sugar-syrups are perfectly soluble in concentrated methyl alcohol, and on treating this solution with alcohol and oxalic acid the salts contained in the molasses are separated therefrom, together with the sugar, in the form of oxalates leaving the organic acids and nitrogenous constituents in solution. On these two facts the following process depends. The molasses or sugar syrups are dissolved in methyl alcohol or a mixture of methyl and ethyl alcohols; 110lb. molasses polarising 50 per cent. would require 7 pints of methyl alcohol. The dissolved molasses is now further mixed with oxalic acid and excess of ethyl alcohol, in which latter the oxalic acid is previously dissolved. The sugar and oxalates separate out as a precipitate. This is separated by pressure from the liquid and dissolved in water. By further addition of alcohol the oxalates separate out from the sugar solution. Any trace of oxalic acid remaining in the sugar solution is removable by lime, and the solution has then a purity co-efficient of 99 per cent. About 80 per cent. of the sugar originally in the molasses is recoverable by this process.
—A. J. K.

Compound for use in Preparing Starch or Flour Size for Yarn, Textile or other Fabrics. C. N. Waite, Medford, Middlesex, Mass., U.S.A. Eng. Pat. 14,117, Nov. 2, 1886. 4d.

FOR the purpose of neutralising, dissolving and softening starch or flour size to be used on yarn or textile or other fabrics, the author uses the following mixture:—1lb. of crystallised sodium sulphate, ¼lb. of zinc oxide, 5oz. to 6oz. of zinc chloride and 100lb. of starch are boiled together with 150gals. to 300gals. of water, according to the thickness of the starch required. These portions may be varied to suit different circumstances. Zinc oxide neutralises any free acids which may be present, and prevents the conversion of starch into dextrin, which is an economy, since starch has a greater thickening power than dextrin. Sodium sulphate is used partially to dissolve the zinc oxide, and may be replaced by equivalent quantities of sodium chloride, ammonium chloride or ammonium sulphate. The zinc chloride renders the size soft and pliable when dry, and instead of it may be used glycerin, sulphate of soda, or any other softener. The chief novelty which is claimed is the perfect neutralisation and solution of starch or flour with zinc oxide, which at the same time has no alkaline reaction.
—A. J. K.

Improvements in Apparatus for Extracting the Saccharine or other Soluble Matters from Sugar-Cane and other Substances. M. A. Perret, Paris. Eng. Pat. 1931, Feb. 7, 1887. 1s. 3d.

THIS patent is not capable of abstraction without reference to the diagrams in the specification, which are numerous and detailed.—A. J. K.

Improvements in the Treatment of Grain for the Manufacture of Starch or Glucose. H. L. Sulman and E. E. Berry, London. Eng. Pat. 2138, Feb. 11, 1887. 4d.

THE usual method of macerating rice, wheat or other cereal preparatory to its conversion into starch or glucose is by means of caustic soda at the ordinary atmospheric temperature. The use of lime water has also been patented. The authors use lime water and an excess of slaked lime, and work at temperatures as high as is possible without causing the starch granules to burst. The advantages claimed are (1) shorter time taken in the macerating process; (2) no danger of the lime being completely neutralised, as is the case when lime water only is used; (3) larger amount of albuminoid matter extracted. It is preferred to use a tank with a false bottom, the lime being placed below and the grain above the false bottom, so that they do not actually come into contact.—A. J. K.

XVI.—BREWING, WINES, SPIRITS, Etc.

New Filtering Apparatus for Beer, Wine, etc. Dingl. Polyt. J. **263**, 34—35.

Figs. 1 and 2 illustrate a form of apparatus used for this purpose by Fr. Vanieck. It consists of a number of frames of wire gauze (Fig. 1) placed one above the other, with sheets of filter-paper between each. Each piece of wire "gauze" contains two holes, each bordered by a rim, one rim being perforated and the other not. The filter-papers contain corresponding holes. The frames are placed one above the other in such a way that the perforated and unperforated rims occur alternately, thus forming channels for the inflowing and exit liquor O, O (Fig. 2). A fall of five metres or half an atmosphere pressure is required. By means of such an apparatus containing 40 frames, each 320sq.dm. area, 1750 litres of wort can be filtered in an hour. Instead of filter paper, chemically pure woody fibre may be employed, which can be washed after use. The form of filter-press used is shown in Fig. 3.—A. G. G.

Fig. 1

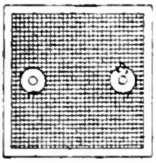


Fig 2

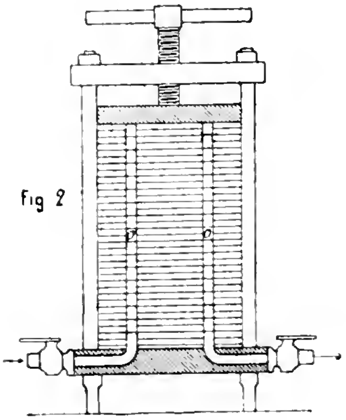
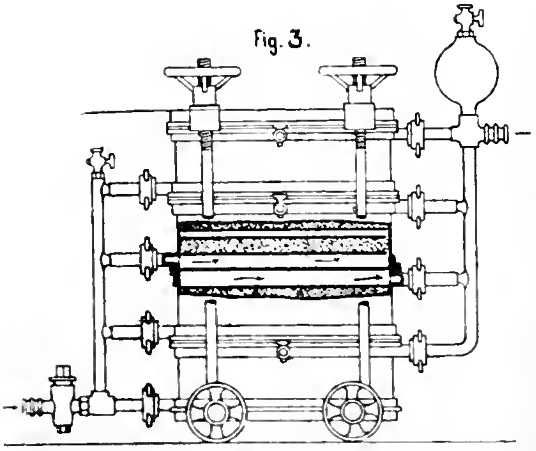


Fig. 3.



The Limit of Fusel Oil in Spirits. G. Bodländer and J. Traube. Rep. Anal. Chem. **7**, 167—169.

A point of considerable importance is the limit of fusel oil which should occur in brandies and liqueurs. Beer has proposed a standard of 0·3 per cent., but from experiments already published by one of the authors with Traube's capillarimeter (this Journal, 1886, 393, 497, and 547), the authors consider this number too high. From a series of determinations which they have made with the cheapest and most inferior brandies (costing from 30—40pf. per litre), they now fix the maximum limit of fusel oil in spirits at 0·1—0·15 per cent. Only one of the samples examined exceeded Beer's limit, and this was the dearest of all those examined. The determinations were made with the above-named apparatus.

—G. H. M.

Improvements in the Treatment of Brewers' Worts. W. Spencer and J. Jones, West Derby, Lancashire. Eng. Pat. 4168, March 25, 1886. 6d.

The object of this patent is the aëration of worts after they leave the copper. For this purpose the worts are passed through a cage having fine slits over its entire surface, and, at intervals, rims with serrated edges in order to spread the worts over as large a surface as possible. When the worts have drained away the hops remaining in the cage are sparged with boiling water by means of a revolving sparger.—G. H. M.

Improvements in Treating Brewers' Worts. F. Faulkner, Oldbury, and W. Adlam, Bristol. Eng. Pat. 5772, April 28, 1886. 8d.

This patent covers the use of a blast of heated air to the brewers' mash tun (compare Eng. Pat. 4071, 1886; this Journal, 1887, 221) in order to effect the oxidation of the more deleterious nitrogenous substances in the wort. The temperature of the blast of air must not be sufficiently high to injuriously affect the active diastatic substances of the malt extract. The plant required is fully described and illustrated.—G. H. M.

An Apparatus for Pasteurising Beer, Wine, and other Suitable Fluids. H. Schaarwächter, Barmen, Germany. Eng. Pat. 6401, May 12, 1886. 8d.

The inventor claims the use of an apparatus for pasteurising liquids, a description of which would be unintelligible without the details and drawings given in the specification.—G. H. M.

The Application of an Improved Antiseptic Salt in Brewing. A. Boake and F. G. A. Roberts, Stratford, Essex. Eng. Pat. 8420, June 26, 1886. 4d.

This consists of the use of sodium metasulphite, $Na_2SO_3.SO_2$, as an antiseptic in brewing. The salt is used in the proportion of three to six ounces per quarter of malt, or its equivalent.—G. H. M.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(A) CHEMISTRY OF FOODS.

American Barley. C. Richardson. Amer. Chem. J. **9**, 16—22.

The author has examined a large number of Canadian and American barleys and compared the results with those given by Maercker, who considers that the characteristics of a good barley are fine colour, mealy consistency, and small amount of albuminoids. The best Canadian barley is grown in the counties north of the north-western part of Lake Ontario, and, as this forms the greater part of the Amercian supply, the United States samples are compared with it. Maercker found that the finest grain contained not more than 8 per cent. of albuminoids, and consisted of at least 80 per cent. of mealy corns. Of the twelve typical specimens of the Canadian crop, none were below 9 per cent. of albuminoids, the average being 9·83, and only six contained 60 per cent. of corns which were mealy or half-mealy in structure. They cannot be said, therefore, to be equal to what is considered extremely fine barley in Germany. They are, however, better than the average production of European countries. In weight per bushel they are about the same or slightly heavier than the average found by Maercker—52 pounds—and in moisture, much dryer than the product of damper climates. Of the different districts, that north of Lake Erie produces the specimens richest in nitrogen, but, on the other hand, the percentage of mealy corns is much higher.

The average of the United States barley is about as mealy as the Canadian average, but out of 64 samples only 2 contained 80 per cent. or over of mealy or half-mealy corns. In weight per bushel there is no variation from Canadian and foreign grain, but in size the barleys of the United States, as a whole, are larger than those of Canada. The average percentage of albuminoids is greater in the United States barley than in Canadian, and much above Maercker's number; the Californian is 1 per cent. lower than the average for the rest of the country, which is 11·5 per cent. In brightness, the samples from those portions of the country having a dry climate at harvest time, especially the Pacific slope and the North-west, were far superior.

It was noticed that winter-sown barley contained less albuminoids than the spring-sown grain; the former gave 10·5 per cent., the latter 11·42. In a few samples the outer covering of the grain was detached and weighed. The extreme amounts were 16·94 and 12·55 per cent., much less than in oats.—G. H. M.

An Improved Baking Powder. H. Watkins, Hereford. Eng. Pat. 5162, April 14, 1886. 4d.

THE special feature of this invention is the substitution of malt flour for the starch or farina ordinarily employed in admixture with other substances for use as a baking powder.—C. C. H.

Improvements in Preserving Milk, and in Vessels or Containers therefor. P. Jensen, London. From K. G. Dahlz, Drammen, Norway. Eng. Pat. 10,903, August 26, 1886. 8d.

THE milk is first strained and cooled down to 10° C. or 15° C. It is then put into cubical vessels having two sides flat and the other two dished; the vessels are previously sterilised by being heated to 150° C., and after being filled with milk are hermetically sealed. The temperature is then raised and kept to 70° C. for 1$\frac{3}{4}$ hours, cooled down to 40° C. for 1$\frac{3}{4}$ hours, and again raised to 70° C.; this is repeated two or three times. Finally the temperature is raised to and kept at 100° C. for half-an-hour, after which it is cooled down to 15° C. By this means it is believed all the organisms, as well as the germs, are quite destroyed; hence whilst not destroying or impairing the fresh taste, the milk so treated will keep fresh for an indefinite period.—C. C. H.

An Improvement in the Preparation of Food Products. C. S. Boynton and W. J. Van Patten, Burlington, Vermont, U.S.A. Eng. Pat. 17,075, Dec. 30, 1886. 4d.

ANY of the cereal grains—*e.g.*, wheat, oats, barley, maize, rice, etc., are decorticated, crushed, and dried at 180° F. To the granulated meal so obtained a solution containing diastase, prepared in the usual way from malted barley, is added, and the whole dried at a temperature from 160° F. to 175° F. Care must be taken to avoid the formation of grape sugar.—C. C. H.

Improvements in the Manufacture of Extract of Coffee. H. F. Von Konitz, Berlin; and J. Tuntz, Bonn. Eng. Pat. 122, Jan. 4, 1887. 4d.

AN infusion of coffee berries is evaporated to a syrupy consistency; the vapour passing off is condensed and subsequently distilled in vacuo after the addition of a sufficient quantity of a non-volatile acid to render it slightly acid. The first part of the distillate, amounting to about one-fourth of the whole, contains the aromatic flavouring of the coffee berries: when this is added to the syrup first prepared a substance is obtained which on mixture with water gives an admirable imitation of freshly prepared coffee.—C. C. H.

Improvements in the Process of and Apparatus for Manufacturing Powdered Milk. John Carnick, New York, U.S.A. Eng. Pat. 1996, Feb. 8, 1887. 8d.

THE author has succeeded in preparing on a commercial scale a cream-white, dry, powdered or granulated milk, free from stickiness or lumps, of a pleasant sweet milky flavour, and of good keeping qualities. Fresh cows' milk, from which about $\frac{1}{4}$ to $\frac{1}{3}$ of the cream has been previously removed, is evaporated in a vacuum pan at a temperature of 140° F. to 160° F. to the consistency of a thick syrup. At this stage granulated cane sugar is added in a continuous stream, the whole being kept constantly agitated and the temperature reduced to from 120—130° F. At this temperature no caramel is formed, nor discolouration takes place, and the produce of the sugar causes the whole mass to remain granular and finally to dry up to a friable white mass, which is easily removed and ground to a fine powder, in which form it is usually sold and will keep for a long time. The evaporation is conducted in a horizontal cylindrical copper vacuum pan provided with pumps and condenser, and suitable agitating apparatus, and covered with a jacket into which can be turned hot or cold water or steam, so that any desired temperature may be regularly maintained. The finished product may be sold in various forms, either pure or in combination with coffee, chocolate, cocoa, etc. The sugar used is in the proportion of from 30 to 50 per cent. of the batch of milk treated.—A. J. K.

(*B*) SANITARY CHEMISTRY.

Subterranean Motion of Coal-Gas in the Direction of Heated Dwellings. A. Wagner. Rep. Anal. Chem. **7**, 131—138.

IN 1884 the author published an investigation into the question of poisoning by coal-gas, in which it was asserted that with gas escaping from broken pipes the aspiratory action of heated dwellings is only brought to bear for a comparatively short distance, and that in the case of hermetical coverings—as, for instance, asphalt paving—the gas takes the course which offers the least resistance to its passage. This assertion has been subjected to a severe criticism by Pettenkofer and Sudakoff in the *Archiv für Hygiene*, 1886, 166. Against the strictures of the latter the author enters a strong protest.—D. B.

Improvements in the Formation of Organic Oxides, and in the Oxidation of Matter Suspended and Dissolved in Liquids. J. G. Lorrain, London. Eng. Pat. 3826, March 18, 1886. 6d.

THE patentee proceeds by one of two methods: (1) by placing "a quantity of catalytic material" in the liquid, and forcing air through so as to effect chemical combination between the oxygen of the air and the oxidisable matter of the liquid; (2) by similarly suspending or immersing "a quantity of catalytic material" in the liquid, and then decomposing the water of the liquid electrically, either by a dynamo or other means.—C. C. H.

Improvements in the Preparation of Materials for Use in the Treatment of Sewage and Foul Water. J. W. Slater, London, S. K. Page, Aylesbury, W. Stevens and The Native Guano Company, Ltd., London. Eng. Pat. 3973, March 20, 1886. 6d.

This specification relates to the preparation of sulphate or chloride of manganese, alone or mixed with the sulphate or chloride of alumina for the purpose described. In the preparation of the sulphate the patentees take 36 parts of sulphur, 100 parts of manganese dioxide, and place them in a covered crucible, the sulphur at the bottom; the whole is then maintained at a dull red heat for three to four hours; a crude sulphate of manganese suitable for the purpose specified is the result. The chloride is similarly prepared by heating together in a crucible 36 parts sulphur, 300 parts common salt, 100 parts di-oxide of manganese. When it is desired to prepare the mixed sulphates and chlorides of manganese and alumina, bauxite, ground blast-furnace slag or alum clay, 40 parts of either to 10 of the di-oxide of manganese is introduced into the mixture prior to the application of heat.—C. C. H.

Improvements in the Purification and Utilisation of Sewage, and Apparatus therefor. L. G. G. Daudenart, Brussels. Eng. Pat. 4203, March 25, 1886. 11d.

The patentee describes a system of sewage treatment by means of defecation by lime, succeeded by the addition of salts of alumina and chloride of zinc. Settlement is effected in tanks shaped in section like those usual in this country; the sludge is continuously withdrawn by an endless screw and run on to land. The effluent is conducted away in large carriers to land, upon which it is pumped for purposes of irrigation.
—C. C. H.

Improvements in or connected with Filter-presses, and in the Drying of Sewage Sludge and other Moist Matters. W. F. B. Massey-Mainwaring, London. Eng. Pat. 4878, April 7, 1886. 11d.

The filtering faces of the chambers of the filter-press are made flat, and covered with a perforated cast-iron plate resting thereon and bearing upon the chamber by bosses or projections so as to afford a good drainage. The bosses or projections are sometimes replaced by grooves or furrows. The outlets from the chambers are fitted with a three-way cock, so that when the chambers are full a current of air, sometimes heated, may be drawn or forced through to facilitate the removal of moisture from the pressed cake.—C. C. H.

Improvements connected with the Deposition of Finely-divided Solid Matter floating or suspended in Air or Gases. J. G. Lorrain, London. Eng. Pat. 6495, May 14, 1886. 6d.

Guitard and Lodge have both shown that fine particles of solid matter suspended in the atmosphere can be precipitated by the passage there through of an electric discharge from an electrostatic machine. In the present instance, the patentee makes use of a dynamo-electric discharge, generated as a secondary current in an induction coil by means of a current from a dynamo or a primary or secondary battery. The air or gas is passed through a closed receptacle containing discharging surfaces of netting gauze or plates placed close together, and in connection with the secondary coil of the induction arrangement.—C. C. H.

Improvements in the Treatment of Sewage Sludge and the Preparation of a Manure therefrom. T. H. Cobley, Dunstable. Eng. Pat. 6732, May 19, 1886. 6d.

The pressed cake resulting from the treatment of sewage sludge in filter presses is incinerated; native salts of magnesium, potassium, and sodium are added during the process of incineration to "retain" the ammoniacal fumes given off. The ash resulting from such incineration is used instead of caustic lime for the purpose of rendering a fresh quantity of sludge pressable. The resulting ash is richer as a manure than an ash resulting from the addition of caustic lime to the sludge. Peat, shoddy, or wool dust are also sometimes used to retain the ammoniacal fumes during the process of incineration.
—C. C. H.

An Improved Deodorant and Disinfectant. H. M. Caldwell, Sydney, New South Wales. Eng. Pat. 6966, May 24, 1886. 4d.

The improved compound is prepared by first mixing 7cwt. of ferrous sulphate with 40lb. peroxide of manganese; 400 gallons of water are added, and the whole boiled for three hours, adding whilst hot 6lbs. oil of eucalyptus; this preparation acts as a deodorant. Four tons of caustic soda are heated to a dull red with one ton peroxide of manganese for a period of 48 hours; water is subsequently added and re-evaporated. This second preparation is added to one half that first described, the mixture forming a powerful deodorant and disinfectant.—C. C. H.

Improved Manufacture of Disinfecting Powder. J. W. Knights and W. D. Gall, Cambridge. Eng. Pat. 11,011, August 28, 1886. 4d.

Ground and dried peat is mixed with an antiseptic such as sanitas, creosote, or carbolic acid.—C. C. H.

Improvements in the Manufacture of Materials for Use in the Treatment of Sewage, etc., etc. F. Candy, Bexley. Eng. Pat. 13,829, Oct. 28, 1886. 6d.

Any iron ore containing alumina, lime, and magnesia is mixed with carbonaceous material and carbonised in closed retorts in the usual manner. The resulting product is treated with sulphuric or hydrochloric acid. The quantity of acid used is such that the mixture when cool becomes a cake or semi-dry mass. The patentee terms the product "magnetic precipitant," and uses it for the purification of sewage or other polluted waters.
—C. C. H.

Improvements relating to the Purification of Sewage. J. Wohanka and K. Kocian, Prague. Eng. Pat. 278, Jan. 8, 1887. 4d.

The sewage is first treated with ferrous sulphate prepared by treating rich ochre-brown iron ore with sulphuric acid; fresh milk of lime is then added, and finally, an aqueous solution of water-glass. The sludge from such a process of treatment is separated by subsidence in the usual manner. The effluent is run into a separate set of tanks, and further purified by the injection of smoke or gases from chimney shafts or flues. The patentees state this destroys the organism causing putrefactive fermentation. The effluent from this treatment is finally filtered through a bed of gravel, coke, ashes, etc., or other porous material.—C. C. H.

(C.) DISINFECTANTS.

The Manufacture of Bromine Preparations for Sanitary and other Purposes. W. D. Borland, London. Eng. Pat. 6191, May 7, 1886. 6d.

A mixture is made of a soluble bromide with a soluble bromate, preferably of sodium or potassium, and this is mixed intimately with an alkaline bisulphate, such as sodium hydrogen sulphate. For a less concentrated form, nitre-cake is used instead of pure bisulphate. For sanitary purposes it is sometimes convenient to add other substances, such as cupric sulphate, alum, etc. The addition of a small amount of a terpene, essential oil, camphor or hydrocarbon, increases the keeping power of the preparations.—B. T.

XVIII.—ELECTRO-CHEMISTRY.

On the Distillation and Electrolytic Treatment of Zinc Scum. B. Rosing. Zeits für Berg. Hütten. u. Salinenwesen. Dingl. Polyt. J. **263**, 87—94.

SEE page 370.

Improvements in, or connected with, Electrical Batteries and Appliances therefor. A. W. Armstrong, Lewisham. Eng. Pat. 5971, May 3, 1886. 8d.

THE porous cells of this battery are made either of clay or carbon, or a mixture of both, and are packed with granulated carbon. Three tubes pass into each cell, which is then covered with an air-tight seal. By a special arrangement, a measured quantity of the excitant passes from a tank into the porous cells by one of the tubes before mentioned. A supply of water, the amount of which can be regulated according to the work the battery has to do, passes from an ordinary water-cistern into an outer vessel containing the soluble electrode; this water can be made to pass through a vessel containing any suitable soluble substance for promoting greater activity in the battery. When the battery is working, gas is generated in the porous cell and forces some of the partially spent liquid into a reviving tank, from which tank fresh liquid passes back by the third tube. The zinc plate in the outer cell dips into mercury, which serves as an electrical connection, and also to keep the plate amalgamated. A brush is fitted, and can be raised or lowered in order to remove any insoluble salts from the surface of the zinc.—B. T.

Improvements in the Manufacture of Carbon Electrodes. R. Applegarth, London. Eng. Pat. 9518, July 22, 1886. 8d.

THESE electrodes are moulded from suitable carbon paste, which may contain a proportionate amount of manganese rich in oxygen, into the form of vessels with the inner surface corrugated, so as to present a large extent of surface to the exciting medium. The upper part of the cell has a metal band secured to it.—B. T.

Improvements in the Preparation of Carbon Filaments for Electric Lighting. H. J. Haddan, London. From C. Seel, Charlottenburg, Germany. Eng. Pat. 6203, May 7, 1886. 8d.

VEGETABLE FIBRE is steeped in a solution of mineral salts and a gum consisting of a silicate, gum senegal, and caustic soda; it is then rolled into the shape of angle iron and carbonised in any well-known way. The charcoal thread is placed in a box, and melted paraffin wax poured round it, the two ends of the thread projecting through the cover. When the wax is solid, a current of electricity is sent through the carbon until it attains the required resistance. It is then cleaned from paraffin and is ready for use in the lamp.—B. T.

Improvements in the Process of, and Apparatus for, Manufacturing Carbons for Electric Lamps. J. T. Lister, Cleveland, Ohio, U.S.A. Eng. Pat. 10,800, Aug. 24, 1886. 1s. 1d.

THIS patent has for its object the substitution of special machinery for the manual processes now generally adopted in the making of carbons. The mould is made in two parts, the lower of which is placed horizontally on a car which is run on rails underneath the filler. This consists of a vessel in which a cylindrical screen is kept revolving. The mixed dust of which the carbons are to be made is thrown into the middle of this, and eventually all passes through it on to a worm, also kept revolving, which conveys it to the delivery spout. This is provided with as many partitions as there are grooves for carbons in the mould. The dust, now thoroughly mixed by the processes it has lately gone through, passes from the delivery spout into the mould as soon as the latter is placed in position; this delivery is automatically performed by the upward movement of a ram to be described hereafter. The mould is now rolled from the filler, and the top having been put on, is passed into a furnace. Having been baked sufficiently, it passes on to a turntable, and is brought in its turn under the action of a hydraulic press. The ram, in rising, compresses strongly the carbons, and at the same time operates the filler. In falling, the turntable is revolved, and the same series of operations repeated automatically on another mould. The carbons are now removed in such a way that they cannot possibly be bent, and the webs joining them separated by revolving cutters, leaving the carbons quite round and smooth. The car is wheeled on till the ends, which have been made to project, come in contact with revolving knives, and are thus pointed. These carbons can be made cheaper, straighter, and of more uniform density than those produced by manual processes.—E. T.

Improvements in Primary Batteries. M. Bailey and J. Warner, London. Eng. Pat. 13,592, Oct. 23, 1886. 8d.

FINELY-GROUND plumbago is incorporated with nitric or "oxacid," and packed with a suitable carbon electrode in either the outer or porous cell of a battery. Zinc is used for the other electrode. The carbon is sometimes of a tubular form, and when embedded in the paste, has its interior filled with the acid. To re-charge, fresh acid is poured into the tube, or the spent paste replaced by new. —E. T.

An Improved Method of Preventing the Escape of Noxious Fumes from Batteries used for Electrical Purposes. M. Bailey and J. Warner, London. Eng. Pat. 14,937, Nov. 17, 1886. 8d.

THE internal pot of the battery, containing the fuming acid, is closed by a suitable stopper, through which passes vertically a thin glass tube. The part of this outside the cell is sealed into the bottom of a much wider glass tube, in such a way that, passing up the inside of the latter, it ends a little below the top of the wider tube. A third tube, with sealed top, fits loosely inside the large one. Water or other suitable liquid being poured in, the whole forms a small gasometer. In some cases the upper part of the porous pot is narrowed as in an ordinary bottle, and this upper portion glazed.—E. T.

Improvements in an Electrolyte, and Depolarising Solution for Voltaic Batteries. W. C. Quinby, San Francisco, Cal., U.S.A. Eng. Pat. 111, Jan. 4, 1887. 6d.

THE electrolyte which the inventor employs consists o the anhydrous sulphate of the sesquioxide of iron, dissolved in water or other equivalent liquid. This sulphate is found as a natural formation known as "coquimbite." This natural salt is used as the new electrolyte in either a one-fluid or a two-fluid cell, in the latter case the insoluble electrode being in contact with coquimbite. During the working of the cell, sesquioxide of iron is formed and precipitated, and if this precipitate be treated with sulphuric acid, it can again be used as an electrolyte. —B. T.

Improved Apparatus for Preventing the Escape of Noxious Fumes or other Gases from Primary, Secondary, Gas, or other Batteries used for Electrical Purposes. M. Bailey and J. Warner, London. Eng. Pat. 1656, Feb. 2, 1887. 8d.

IN this method the fumes from the cells are collected in a glass bell-jar completely covering the cell, and with its lower edge dipping into some liquid, so as to form a secure seal, or a lip is fitted to the top of existing cells, and the bell-jar dips into this lip. There is an opening fitted with a stop-cock in the top of the glass, by which the contained gases may be liberated.—B. T.

Improvements relating to the Electro Deposition of Aluminium, and to Apparatus therefor. H. H. Lake, London. From Count R. de Montgelas, Philadelphia, U.S.A. Eng. Pat. 1750, Feb. 3, 1887. 6d.

ALUMINA is dissolved in hydrochloric acid, and the solution evaporated to obtain the dry salt, which is then dissolved in hot water. A vessel is made with two compartments, separated by a porous partition. The above solution is poured into one, and common salt into the other. A current is passed from one into the other, entering at the common salt, by suitable electrodes, until the solution of the aluminium salt becomes colourless. The double chloride of aluminium and sodium thus formed is evaporated to dryness and redissolved, to get rid of excess of acetous matter. This solution, kept neutral, is used as the plating liquid with an aluminium anode.—E. T.

Improvements relating to Electric Batteries. H. H. Lake, London. From Count R. de Montgelas, Philadelphia, U.S.A. Eng. Pat. 1752, Feb. 3, 1887. 6d.

A GROOVE is formed along the lower side of a small square bar of wood. In this is placed the upper edge of a perforated plate of aluminium, which forms the negative electrode. A screwed bolt attached to the latter passes through the bar and is held by a binding screw at the top. On each side of the wooden supporting bar are clamped zinc plates by aluminium bolts, connection being made by aluminium terminals. The battery resembles in appearance that of Smee. Any suitable exciting liquid may be used.—E. T.

XIX.—PAPER, Etc.

Improvements in the Manufacture of Water and Fireproof Papers, Millboard, and similar Materials. W. E. Heys, Manchester. From E. G. H. Ladewig, Rathenon, Germany. Eng. Pat. 5563, April 22, 1886. 6d.

THE paper, millboard or similar substance used in carrying out this invention may be used alone or in combination with layers of cork, straw, wire-gauze or any such substances. The pulp is chiefly composed of asbestos, treated with chloride of sodium or glycerine to preserve the flexibility and other peculiar properties of the asbestos. 100 parts of asbestos require about 4 to 6 parts of glycerine diluted with 5 to 10 parts of water. From 4 to 6 parts of isinglass may with advantage be mixed with the water used for diluting the glycerine.

The impregnated asbestos is then pulped in a suitable rag-engine and reduced with water as required. The addition is now made of 2 to 3 parts of dry resin soap dissolved in water, 6 parts of zinc chloride in 15 to 25 parts of water, and 10 parts of graphite with about 50 parts of water. The latter addition increases the resistance of the finished product to the action of fire. If required for pipe joints, it may be provided with wire-gauze on one or both sides. When rolled or formed into sheets, the material is air-dried, immersed in a 1 per cent. solution of zinc chloride, and dried. Finally the sheets are passed through a solution of resin soap and water to which has been added ½ to 1 per cent. of soap, the resin soap having been dissolved in spirit and added to the water. It is claimed that material prepared as described is capable of resisting any ordinary degree of heat, and also that it is suited, owing to its elasticity, etc., for packing steam-joints and for other purposes where the combined action of heat and water have to be resisted.—H. A. R.

An Improved Process for Manufacturing Composition from Cellulose or Ground Wood, which can be given any desired form by employing heat and pressure. R. Eisenhaut, Pyritz, Germany. Eng. Pat. 1443, Jan. 29, 1887. 4d.

THE following is the substance of the claim made by this inventor: a process for manufacturing a composition which can be given any desired form by saturating cellulose or ground wood with a solution of gum in hot water and ammonia, drying the same more or less, and subjecting the said composition to the influence of a mixture of ammonia gas and steam under pressure.

The product so obtained may be shaped as desired by hot plates, dies, or other suitable means. If required, the composition may be tinted by the addition of colours in the state of dry powder, or else, before or during the manufacture, with organic colours.

—H. A. R.

Improvements in Machinery for the Manufacture of Paper Pulp. H. H. Lake, London. From F. J. Marshall, Mass., U.S.A. Eng. Pat. 1808, Feb. 4, 1887. 8d.

THE main features of this invention are as follow: (1.) The combination of fixed and revolving discs in combination with the conical engine commonly in use. (2.) A worm and gear in combination with screw threaded collars for moving the bed-plate to and fro.

—H. A. R.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

Extraction of a New Acid from the Leaves of Gymnema Sylvestre. Nature, **1887**, 565—567.

THIS is an abstract of a paper read before the Nilgiri Natural History Society, Ootacamund, India, by David Hooper, F.C.S., March 7, 1887. It was found that on chewing the leaves of this asclepiadaceous plant, which grows in the Deccan Peninsula, Assam, and Africa, immediately afterwards all appreciation of the sweet taste of sugar is lost. If ginger-bread were eaten, only the taste of the ginger was perceived; if a sweet orange, only the acid flavour of the citric acid, and the orange seemed as sour as a lime. Bitterness is also destroyed, and sulphate of quinine tastes merely like chalk. The effect lasts one to two hours. The principle appears to be soluble in water, alcohol, ether and benzene. The ethereal extract consisted of chlorophyll and two resins, separable by their different solubilities in alcohol. Both resins are of an acrid nature, and left a tingling sensation in the throat. The aqueous solution of the substances soluble in alcohol had a decided acid reaction. This solution was precipitated by sulphuric acid, was collected on a filter, and washed free from sulphuric acid, when a greenish powder was obtained insoluble in water, but soluble in alcohol, ether, benzene, and chloroform. With potash, soda, and ammonia, it afforded a fine red solution with orange coloured froth, precipitated in the case of either of the resins by mineral acids. The substance has the characteristics of an organic acid somewhat similar to chrysophanic acid, but possessed of some very peculiar reactions, and possessing also the anti-saccharine property ascribed to the leaves. It is termed by Hooper *Gymnemic acid*, and this acid constitutes more than 6 per cent. of the constituents of Gymnema leaves in combination with a base not yet isolated. The following analysis was given of the powdered and sun-dried leaves:—Ether extract (chlorophyll and resins) 5·51, alcoholic extract (gymnemic acid, tartaric acid, glucose, neutral bitter principle, resin, &c.) 19·50, aqueous extract (gum 1·45 per cent, glucose, carbohydrate and extractive) 16·87, alkaline extract, by difference (albuminous and colouring matters) 8·15, acid solution (calcium oxalate, 7·64, pararabin 2·74), ash (balance of) 5·69, cellulose 27·86, and moisture 6·04 per cent.; total, 100·00.—W. S.

Arginine. E. Schulze and E. Steiger. Zeit. f. Phys. Chem. **11**, 1.

ON treating the aqueous extract of the germinated seeds of *Lupinus luteus* with phosphor-tungstic acid, having previously removed all albuminous substances, a copious white precipitate is obtained, from which the authors isolated a nitrogenous base called arginine, $C_6H_{14}N_4O_2$. It forms crystalline salts, and is somewhat similar in its properties to creatinine.—D. B.

Crystalline Substances from "Kamala." L. Jawein. Ber. 20, 182—183.

KAMALA is a colouring matter used in the East Indies, and prepared from the seed capsules of *Rottlera tinctoria Roxb.* Anderson (*Jahresber.* 1855, 669) obtained a crystalline substance from kamala which he named Rottlerin. The author has also prepared a substance by extracting the crude kamala powder with carbon bisulphide, which agrees in its reactions with that of Anderson, but does not give analytical numbers corresponding with the formula assigned to it by the latter. (Compare A. G. Perkin and W. H. Perkin, Jun., *Ber.* 19, 3109).—G. H. M.

Action of Hydrogen Peroxide on Albumen. C. Wurster. Ber. 20, 263—267.

WHEN unfiltered white of egg is mixed with an equal volume of hydrogen peroxide, the mixture well shaken, and, for every 100cc. of the former, 1—2cc. commercial lactic acid and 1—2grms. sodium chloride or 20cc. of a 5 per cent. solution of this salt added, the mixture becomes turbid, and after a longer or shorter time, depending upon the temperature, sets to a solid, coagulated, cheese-like mass. Water is added, and the substance quickly filtered off; it always retains, even after prolonged washing, hydrogen peroxide and lactic acid. The filtrate from the precipitated albuminoid evaporated to a syrup gives the reactions for peptone, which however is only present in small quantity. The precipitated albuminoid is quickly peptonised by pepsin and hydrochloric acid. The above results do not agree with those of Chandelon on the action of hydrogen peroxide on albumen (this Journal, 1885, 748). The author ascribes this to the different methods in which the hydrogen peroxide was employed.—G. H. M.

Hydrastine. J. F. Eijkman. Chem. Zeit. Rep. 11, 22.

IN a previous communication (this Journal, 1886, 677) Freund and Will gave analyses of hydrastine confirming the formula $C_{22}H_{23}NO_6$, ascribed to this compound by Mahla. The author's analysis, however, gave numbers agreeing with the formula $C_{21}H_{21}NO_6$.* The statement that hydrastine yields opianic acid and a base on treatment with dilute nitric acid is confirmed by the author, the reaction being represented by the equation :—

$$C_{21}H_{21}NO_6 + H_2O + O = C_{11}H_{13}NO_3 + C_{10}H_{10}O_5.$$

—D. B.

The Alkaloid Tulipin. M. A. Nicot. Les. Nouv. Remèd, 1886, 519.

THE alkaloid obtained by Gerrard from *Tulipa Gesneriana*, and which occurs in considerable quantities in all parts of the plant, appears from the author's researches to exert the action of colchicine, of scillitine, of veratrine and even of strychnine. Its formula is not yet determined. A dose of 0·02grm. is sufficient to kill a frog; 0·1grm. suffices to kill a cat, death ensuing from paralysis of the heart. The alkaloid appears to act very energetically upon the nervous system. Applied medicinally in quantity of ·005—·006grm., in 24 hours it increases the salivary flow, and acts as a diuretic and aperient.—W. D. B.

On Strophanthus. H. Helbing. Pharm. Ztg. 1887, 37.

THE seeds, which amount to 37·4 per cent. of the weight of the drug, contain 24 per cent. of fatty oil, 26·52 per cent. of extract (by the dilute spirit of the Pharmacopœia), and 49·38 per cent. of residue. The oil has a dark green colour with slight red fluorescence, and imparts an emerald green tint to its ethereal solution; it is somewhat thick at the normal temperature, and has a specific gravity of 0·925 at 15° C. Strophanthin may be extracted from the seeds by digestion with alcohol. This extract after dilution with water is freed from fatty matter by agitation with ether, the latter being then removed by a separating funnel. The aqueous solution is treated first with basic lead acetate, then with hydrogen sulphide and filtered, purified by animal charcoal, and carefully evaporated. The residue, which amounts to 8·57 per cent. of the weight of the original seeds, is nearly colourless, but dissolves in sulphuric acid (concentrated or dilute) to a dark green solution, afterwards changing to dark red. Alkaloid reagents give no reaction. It is readily soluble in water and alcohol, but insoluble in ether, petroleum ether, and chloroform.—W. G. M.

On Strophanthus. Wm. Elborne. Pharm. J. March 12, 1887.

THE author, after referring to the pharmacy of the various parts of the fruit or pod, showed that the weight of the seed was 42 per cent.; hairs, 25 per cent.; endocarp, 25 per cent. The seeds on analysis were found to consist of—

(1.) 20·8 per cent. of petroleum ether extract, a yellowish-green fixed oil, not bitter, giving a brown colour when warmed with sulphuric acid and potassium bichromate On standing, crystals separated, which burned like sulphur and left no residue.

(2.) 0·9 per cent. of absolute ether extract, a fatty substance of a green colour.

(3.) 1·5 per cent. of absolute alcohol extract, a bitter residue, resembling the glucosides and giving no alkaloid reactions.

(4.) 2·9 per cent. of aqueous extract containing the same bitter principle found in 3.

(5.) 19·6 per cent. of albuminoid matter; this large proportion rendered the separation of the bitter principle more difficult.

(6.) 54·3 per cent. of insoluble matter. See also preceding abstract.—O. H.

On Vegetable Organisms in Solutions of Alkaloids. L. Soubriran. Journ. Pharm. Chim. 1887, 69.

FOR preventing the formation of the organisms, which render alkaloid solutions turbid, an addition of boric or salicylic acid has been recommended; but Professor E. B. Stuart prefers to use for this purpose camphorated spirit diluted with an equal weight of water, by which equally good effects are produced unattended by any disadvantages. One two-thousandth part of camphor should be used for all alkaloids excepting atropine sulphate, for which saturated camphorated spirit should be employed. The growth of organisms in solutions of neutral citrates, malates, and tartrates may be similarly hindered, but not entirely prevented.—W. G. M.

On Spiritus Aetheris Nitrosi and the Recovery of Oxalic Acid from its Distillation Residue. H. Frickhinger. Arch. Pharm. 1886, 1065.

FOR the preparation of this body the Pharmacopœia Germ. recommends the distillation of 4 parts of alcohol (0·832 sp. gr.) with 1 part of nitric acid (1·185 sp. gr.); the distillate to be then neutralised with calcined magnesia, and rectified on the water-bath. The author recommends the use of alcohol of 0·812 sp. gr., since nearly the whole mixture may then be distilled over, and the distillate will contain less free acid. The preparation is best conducted on a sand bath, in a retort accurately jointed to a well cooled receiver, having at its extremity a glass tube bent twice at right angles, leading into a narrow mouthed bottle, also thoroughly cooled. To test the distillate in the receiver, the cooling is discontinued until, by the increasing pressure in the apparatus, it is driven forward into the test vessel. The liquid will then require rectification. From the residue of the first distillation, oxalic acid can be obtained by pouring it into nitric acid of 1·35

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* In a recent paper (Ber. 20, 80) Freund and Will substituted the formula $C_{21}H_{21}NO_6$ for that previously ascribed to hydrastine.—D. B.

sp. gr. (contained in a large vessel on account of the violent action which may set in), and allowing it to stand for a fortnight; the crystals by that time deposited may be purified by re-crystallisation.—W. G. M.

On the Presence of Arsenic in Chloroform. L. Scholvien. Apoth. Ztg. 1887, 14.

THE author has recently found that with many samples of chloroform, silver nitrate produced, after a short time, a dark-brown turbidity, which could be removed by nitric acid, and which did not form at all if the solution contained a little nitric acid from the first; this has been traced to the presence of arsenic in the chloroform. As a test for this impurity, the chloroform is to be stirred with dilute potash, evaporated, and the residue tested by Marsh's or Bettendorf's methods. When distilled, the arsenic remains in the residue, none passing into the distillate. The presence of the arsenic may originate from the use of an arsenical chloride of lime, which, with the alcohol, might form arsenical organic compounds that would first distil over with the chloroform, yet not be capable of distillation from the chloroform itself. Or it may be due to the use of impure sulphuric acid. It would be interesting to ascertain whether any of the disagreeable effects experienced after inhalation of some samples of the anæsthetic could be traced to the presence of this objectionable impurity.—W. G. M.

An Improved Process for the Complete Purification of Perfumes, in the Manufacture of which Sulphuret of Carbon has been used. E. Edwards, London. From E. A. Viteau, Paris, France. Eng. Pat. 5936, May 1, 1886. 6d.

PERFUME, obtained in the usual way by carbon bisulphide, is evaporated to dryness, and the carbon bisulphide removed by a current of pure hydrogen gas. The product is put into a sealed vessel, and enough pure alcohol added to keep the product in a semi-fluid state. The vessel is then heated sufficiently to make its contents perfectly fluid, and it is agitated until the perfumed product and alcohol are thoroughly mixed. The remaining carbon bisulphide passes off as sulphuretted hydrogen when the vessel is opened, and in order to get rid of all traces of this gas, pure warm hydrogen is passed through the liquid, and very finely-divided silver introduced. The perfume is then separated out by washing with alcohol and submitting to refrigeration at a low temperature.

—B. T.

An Improved Method of Mixing Chloroform with Water. C. E. Landon, Aston; and J. Wilson, Birmingham. Eng. Pat. 6588, May 17, 1886. 4d.

To make chloroform mix with water, it is shaken up with suitable proportions of saponine and water, an emulsion being at once formed, which settles to the bottom. This will mix with water in any proportions.—E. T.

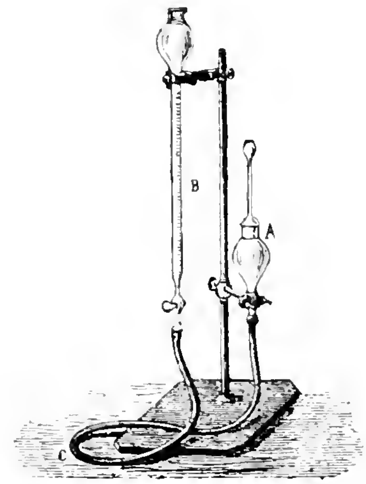
Improvements in the Extraction of Perfume Essences. C. D. Abel, London. From La Société Anonyme des Parfums Naturels de Cannes, Paris, France. Eng. Pat. 6259, May 8, 1887. 8d.

THE vegetable matter to be treated is heated with water in an alembic, and the resulting vapour passed into a condenser of such a sort that any liquid condensed in it will flow back into the alembic. By this means a great deal of the superfluous water is got rid off. In a second condenser the remaining water and essence are all condensed, and flow into a vessel, in which by their different densities they separate. By a pipe attached near the bottom, and bent upwards, the water flows away after a certain level has been reached.—E. T.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

Apparatus for the Estimation of the Specific Gravity of Solids. L. Brasse and E. Vlasto. Génie civil, 1886—1887, 16.

THE funnel A with capillary stopper is connected by an indiarubber tube C, with the small burette B, of about 10cc. capacity. Water or other suitable liquid is poured into the apparatus, so that the surface stands at a low division of the scale in B and at a mark in the capillary part of A. The funnel is now raised and a known weight of the solid is put into it, after which it is lowered until the surface of the liquid again reaches the mark in the stopper. The increase of volume in the burette gives the volume of the substance added, which divided into the weight gives the specific gravity. The method is very expeditious, but greater accuracy than ¼ per cent. is not claimed for it.—A. G. G.



A Delivery Tube for Burettes. W. Leybold. Zeits. Anal. Chem. 26, 230.

MANY chemists prefer to use a glass rod or glass bead for closing burettes, instead of a clip. The glass rod can easily be combined with the delivery tube, as shown in sketch. One end of the glass tube is closed by the blowpipe, and over the other end a piece of indiarubber tubing is slipped. A small flame is directed against the tube at about 1cm. from the closed end; and by blowing through the rubber tubing, a hole is produced at this point; the glass at the edge of the hole is carefully filed off, and the delivery tube is now drawn out to a point. The tube should always be kept in the same position, so as to know on which side the hole is. The author has used such

delivery tubes for some time, and finds that they close tightly, are easy to work with, and retain no air bubbles.
—D. E. J.

Apparatus for the Preparation of Gases for Gasometric Analyses. Alex. Ehrenberg. Zeits. Anal. Chem. **26**, 226—230.

THERE are several objections to Bunsen's well-known apparatus for preparing hydrogen electrolytically; the liquid has to be frequently renewed, on account of the formation of a concentrated solution of zinc sulphate; and zinc is deposited at the negative electrode so rapidly that it sometimes forms a connection between the two electrodes. The apparatus described in this paper, and shown in Figs. 1, 2, and 3, can be used for preparing electrolytic gas, or oxygen or hydrogen separately. It is supported by a heavy foot, and can be raised or lowered as required to suit the level of the mercury in the mercury trough. The vessel *a* is made by cutting off the bottom and part of the neck of a flask, and is tightly closed above and below by ebonite plates. The conducting wires, and also the tube *d*, furnished with a stopcock, pass through the lower plate, the wires being connected with three platinum plates, which serve as electrodes. The wires are covered with guttapercha up to the point where they meet the electrodes, and below the plate they are connected with three spirals of covered copper wire, which lead either to these binding screws or to a commutator. Dilute sulphuric acid (1 : 10) is the fluid used, and in order to fill the vessel, the two tubes, *c* and *c*¹ are removed, and the stopper is taken out of the tube *g*, so as to allow the air to escape; the tubes *b* and *b*¹ are then filled to the required height. The leading tubes, *c* and *c*¹ have the same shape as in Bunsen's apparatus, and the bulbs blown on them are filled with concentrated sulphuric acid. If the binding screw *h* is connected with the positive pole of a battery, and *k* with the negative pole, oxygen gas will collect in *b*, and hydrogen in *b*¹; and these gases can be collected over mercury contained in a trough, into which the tubes *c* and *c*¹ respectively dip. If now, while *k* still remains connected with the negative pole of the battery, the positive pole is connected with the binding screw *i*, *b*¹ will become filled with electrolytic gases (H_2+O), which can be led off by the tube *c*¹; when this is done othe ther tube (*c*) must be closed by means of a glass rod, and a piece of indiarubber tubing *l*. In order to clear or refill the vessel *a*, *b* and *b*¹ must be removed, and the stop-cock *d* opened; the acid can then be run off into a beaker placed beneath. If *b*¹ is graduated into cubic centimetres, the apparatus can be used as a voltameter. The upper part of *b*¹ is then closed by a glass stopper, and after the evolution of the mixed gases, the liquid is allowed to run out through *d*, until it stands at the same level in *b* and *b*¹.—D. E. J.

Fig 1.

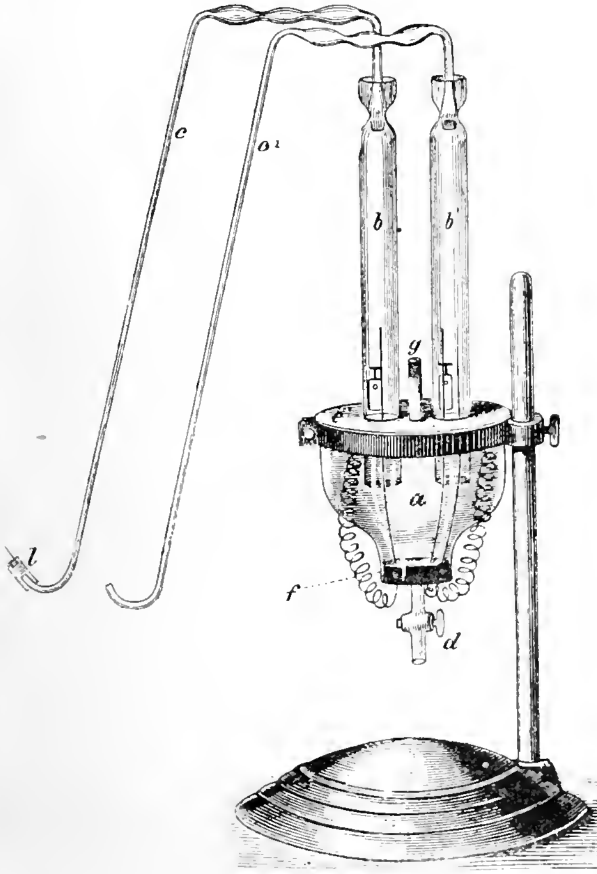


Fig. 2.

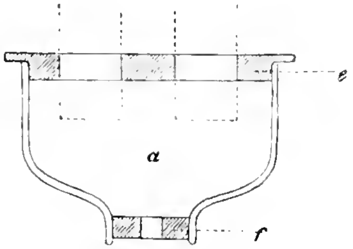
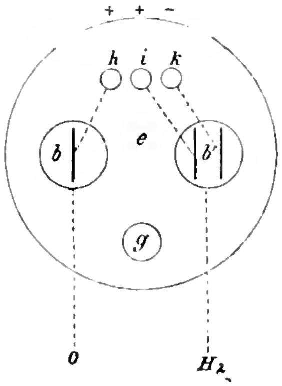


Fig 3.



Certain Improvements in Hydrometers and Saccharometers. T. Derham, Bolton. Eng. Pat. 1938, Feb. 10, 1886. 6d.

THE improved hydrometers are so constructed that each poise possesses a specific gravity bearing a definite relation to the initial specific gravity of the series of specific gravities to be indicated by the instrument.
—C. C. H.

Manganese in Steel and Iron. H. C. Babbitt. Amer. Chem. J. **9**, 58—60.

IT has been objected to the author's method of determining manganese in steel and iron by means of the oxidation of the manganese to permanganic acid by the action of lead peroxide in a nitric acid solution, that the presence of lead nitrate and the time of boiling have a great influence upon the accuracy of the results. The author now employs red lead in place of the peroxide, and he quotes the following experiments to prove that the above-mentioned objections are groundless:—

A sample of steel containing 0·5 per cent. carbon, 0·04 silicon, and 0·09 phosphorus, was selected, and the manganese carefully estimated by the sodium acetate and bromine method, which gave 0·515 per cent. manganese. Estimations by the author's method were made as follows: In each case 0·5grm. of steel was dissolved in about 15cc. nitric acid (1·15 to 1·20 sp. gr.), in a 50cc. beaker. The solutions were boiled till nitrous fumes ceased and red lead added—in A, 1grm.; in B, 2grms. The solutions were then diluted to about 30cc. with hot water. In No. 1, the solution was simply stirred after the addition of water: in No. 2, heated to boiling; No. 3, boiled for one minute: No. 4, for two and a half minutes; No. 5, five minutes; No. 6, fifteen minutes. The solutions were then set aside to allow the residual lead peroxide to settle, the supernatant liquid decanted, and the residue boiled with more hot water containing 20 to 25 per cent. of nitric acid. These decantations are continued as long as they show a decided colour of permanganic acid. When the manganese is below 0·60 per cent., one decantation and subsequent boiling is generally sufficient. The combined decantations are then filtered through asbestos and titrated with a standard reducing agent. The results obtained were:—

No.	A	B	
1	0·516	0·512	per cent. manganese.
2	0·516	0·513	"
3	0·513	0.518	"
4	0·518	0·518	"
5	0·513	0·518	"
6	0·513	0·513	"

These show that the presence of lead nitrate, formed by the action of nitric acid on the red lead, does not influence the accuracy of the results, neither does the difference in the time of boiling appear to exert any influence. The only difference between filtering hot and cold is that occasionally lead peroxide will run through the filter and cause too high results. The author has been unable to obtain uniformly accurate results with steel above 0·50 per cent. manganese by taking an aliquot portion of the first decantation for titration, while companion analyses treated in the usual manner have yielded results which compared favourably with gravimetric methods.—G. H. M.

Application of Nitroso-β-naphthol in Quantitative Analysis. G. v. Knorre. Ber. **20**, 283—290.

In furtherance of the methods of separating cobalt and nickel, and iron and aluminium, by means of nitroso-β-naphthol (compare Ilinski and v. Knorre, this Journal, 1885, 370, and 1886, 41), the author has investigated the action of this compound on other metals. Copper can be separated from lead, cadmium, magnesium, manganese, mercury, zinc, &c., by precipitation as copper nitroso-β-naphthol $(C_{10}H_6O.NO)_2.Cu$. The separation is effected by neutralising the solution with ammonia, which must contain the metals as sulphates or chlorides, acidifying with a few drops of hydrochloric acid, heating almost to boiling, and adding excess of nitroso-β-naphthol, dissolved in hot 50 per cent. acetic acid. After remaining for some hours in the cold the mixture is filtered, the precipitate washed, dried, ignited in a porcelain crucible, and weighed as cupric oxide. The separation of iron from chromium, manganese, nickel, zinc and other metals can be effected by the method previously described for its separation from aluminium. The methods are given in detail in the original, together with the results of check analyses. The author is continuing his investigations, and intends to study the behaviour of other nitroso compounds with metals.—D. B.

New Reaction of Thiosulphates. L. L. de Koninck. Zeits. Anal. Chem. **26**, 26.

On treating the alkaline thiosulphates, in presence of potassium or sodium hydrate, with aluminium, alkaline sulphides are produced which are easily recognised by their characteristic reactions. This decomposition would appear to take place in accordance with the equation $M_2S_2O_3 + 2NaOH + 2H = M_2SO_3 + Na_2S + 2H_2O$, the hydrogen resulting from the action of the aluminium upon the sodium hydrate. The author intends to extend his observations upon the behaviour of aluminium with the salts of the thio-acids.—W. D. B.

On the Detection of Ammonia, Nitric or Nitrous Acid, and Thiosulphuric Acid in a Mixture of their Alkaline Salts. L. L. de Koninck. Zeits. Anal. Chem. **26**, 26.

The substance in aqueous solution is distilled with soda lye in a small fractionation flask, the side tube of which dips into a U-tube containing Nessler's test solution. Any ammonia present is at once apparent, and is carefully removed by prolonged distillation. A little aluminium added to the contents of the flask and fresh Nessler solution placed in the U-tube. Nitric and nitrous acids if present are reduced, and the ammonia passes over into the Nessler solution. The contents of the flask are tested for sulphides, the presence of which indicate the occurrence of a thiosulphate in the original sample. (See preceding abstract.)—W. D. B.

Titration of Zinc and Cadmium Sulphides with Iodine. P. v. Berg. Zeits. Anal. Chem. **26**, 23—25.

The washed sulphide of zinc or cadmium is allowed to drain upon the filter, and then transferred together with the filter to a stoppered flask containing 800cc. of water deprived of air by boiling and the passage of carbonic acid gas. The whole is well shaken to break up the precipitate and bring it into the most finely divided condition possible, so that the sulphide may not be protected from the action of the iodine by separated sulphur. A moderate quantity of hydrochloric acid is added, there being no necessity to entirely dissolve the sulphide, and then an excess of iodine solution of known strength. The residual free iodine is then titrated with thiosulphate without loss of time. The whole operation, from the transference of the sulphide to the flask to the final titration, occupies about five minutes, and gives results varying between 98·8 and 100·2 per cent. The reaction proceeds according to the equation, $ZnS + 2HCl + 2I = ZnCl_2 + 2HI + S$. Owing to the ready oxidation of sulphide of manganese, this method is not applicable to the titration of that body, neither can it be employed for the titration of cobalt and nickel sulphides, as these are not attacked by the solution of iodine in hydrochloric acid.—W. D. B.

Process for the Rapid Separation of Gold, Platinum, Antimony, Arsenic, and Tin. P. J. Dirvell. Bull Soc. Chem **46**, 806.

This is a combination of Silva's method for the separation of gold and platinum from antimony, arsenic and tin by reducing the two first by means of chloral hydrate, and Carnot's method. The sulphides of the five metals precipitated by HCl from their solution are dissolved in aqua regia. A small quantity of a saturated solution of neutral sodium oxalate is added, together with a solution of oxalic acid (in quantity according to the amount of antimony present), and lastly, a marked excess of alcoholic soda. No account is taken of any sodium oxalate which may separate. The solution is heated to nearly 100°C., and an excess of chloral hydrate solution added drop by drop; heating is continued for a few moments more, and the hot solution filtered off from the precipitated gold and platinum. The filtrate is diluted, freed from chloral by boiling, acidified with hydrochloric acid, treated with an excess of sulphurous acid, and the metals separated according to Carnot's method. (*Chem. Zeit. Rep.* **10**, 198.) The whole process is rapid, and yields very accurate results.—W. D. B.

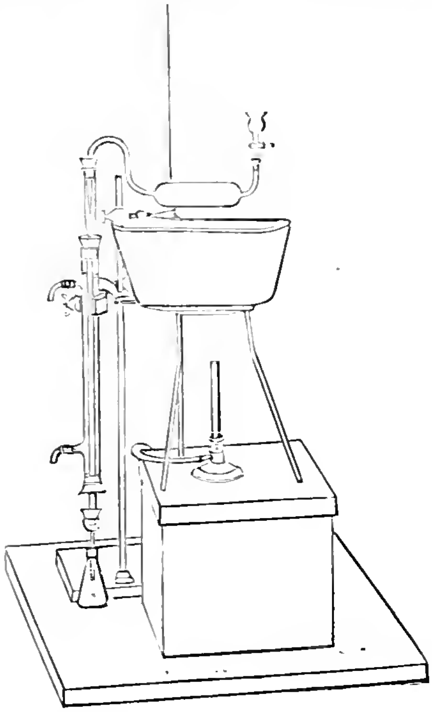
Quantitative Estimation of Boric Acid. T. Rosenbladt. Zeits. Anal. Chem. **26**, 18—23.

Advantage is taken of the ready formation of methyl borate by distilling methyl alcohol with sulphuric acid and a borate, and of the volatility of the methyl borate, in the author's method for the separation of boric acid from bases and silicic acid, and estimation the same. The following are the details of the process:—A quite dry Erlenmeyer flask, with wide mouth and of about 100cc. capacity, is provided with a doubly perforated cork through which passes a funnel with stop-cock and the end of a condenser tube. The other end of the condenser tube is carried into a similar Erlenmeyer flask through a doubly perforated cork, and a tube bent in two right angles leads from this second Erlenmeyer flask to the bottom of a little flask containing a solution of ammonium carbonate. The upper part of that limb of the tube which dips into the carbonate of ammonia is expanded into a bulb. The whole apparatus must be air-tight. The substance under examination in a fine state of division is weighed off into the first flask, moistened with methyl alcohol, the cork inserted, and concentrated sulphuric acid added from the funnel. The contents of the flask are carefully cooled during the addition of the acid, and then 10cc. of methyl alcohol are added gradually by the same funnel. The methyl alcohol and methyl borate are distilled off on a water bath, methyl alcohol being added from time to time in quantities of about 5cc. until 40—50cc. have passed through the apparatus for each 0·3grm. of boric acid. Distillation being ended, the contents of the small flask are added to the distillate, the bulb rinsed out, and 10cc. of a 10 per cent. solution of ammonium carbonate added to the united distillate and washings. During the distillation sufficient magnesia to absorb three times as much boric acid as is present is brought into a platinum basin of 40—60cc. capacity, strongly ignited, and the whole weighed as rapidly as possible. The magnesia is then moistened with solution of carbonate of ammonia, the distillate transferred to the magnesia, evaporated carefully, and the residue ignited and weighed. The increase represents the boric acid. Compounds insoluble in acids—such as silicates—are fused with sodium and potassium carbonate previous to distillation, care being taken in every instance that the substance is in a very fine state of subdivision. Results of test analyses with boric acid and several of its salts are given, and the amounts of boric acid found vary from 99·77 to 99·99 of the quantity taken or calculated. The author lays stress upon the importance of employing methyl alcohol which neither turns black nor evolves sulphurous acid when mixed with sulphuric acid and warmed on the water bath.—W. D. B.

A Method for the Separation and Estimation of Boric Acid. F. A. Gooch. Amer. Chem. J. **9**, 23—33; also Chem. News, 1887, 7—10.

In this method the author takes advantage of the volatility of free boric acid with alcohol in order to secure its removal from fixed substances, and estimates it in the distillate. Methyl alcohol answered best for this purpose. The presence of water retards the action of methyl alcohol very considerably. The author made a series of experiments, using calcium oxide in place of magnesium oxide, and found that when the solution of boric acid in methyl alcohol is allowed to stand with calcium oxide for about fifteen minutes before distilling, there is no volatilisation of boric acid. It appears, therefore, that free boric acid being easily volatilised by means of methyl alcohol, and fixed completely by calcium hydrate, the separation of the acid from almost anything with which it ordinarily occurs, and its subsequent estimation depend only upon the practicability of distilling it from its compounds in such company that it may be retained by lime, and its amount determined by the increase in the weight of the latter. Nitric and acetic acids are suitable agents, therefore, for the liberation of boric acid previous to distillation.

The author employs, for the distillation, the apparatus which is shown in the accompanying figure. It consists of a retort, condenser, and bath for heating. The latter is a paraffin bath, which has been found most convenient. The condenser is preferably set vertically. The retort is made of a pipette by bending the tube at one end to a right angle, and at the other to a goose-neck, as shown. To the former end is fitted, by a rubber stopper or piece of tubing, a glass funnel tube provided with a stop-cock; the end of the goose-neck passes tightly through a rubber stopper in the upper end of the condensing tube. The distillate is received in a small Erlenmeyer flask, which is attached to the condenser by means of a thistle-tube and a rubber stopper grooved to permit the free passage of air. A 200cc. pipette makes the most convenient sized retort. In the experiments given below, 1 to 4 were performed with nitric acid, and 5 to 8 with acetic acid to liberate the boric acid. The results obtained were:—



	B_2O_3 taken. Grm.	CaO taken. Grm.	B_2O_3 + CaO found Grm.	B_2O_3 found. Grm.	Error. Grm.
1	0·1738	0·9647	1·1392	0·1745	0·0007 +
2	0·1806	0·9639	1·1456	0·1817	0·0011 +
3	0·1776	0·9665	1·1450	0·1785	0·0006 +
4	0·1821	0·9739	1·1587	0·1848	0·0027 +
5	0·1806	1·4559	1·6371	0·1812	0·0006 +
6	0·1812	0·9720	1·1543	0·1823	0·0011 +
7	0·1788	0·9986	1·1781	0·1795	0·0007 +
8	0·1813	0·9527	1·1358	0·1831	0·0018 +

In the presence of chlorides, nitric acid cannot be employed to liberate the boric acid, and the author recommends the removal of the chlorine by means of silver nitrate, care being taken to add slight excess of nitric acid after the separation of the silver salt. Chlorides do not appear to interfere with the liberation with acetic acid; but it was found that the presence of any considerable amount of potassium acetate is disadvantageous.

This method can be applied to almost any class of substances containing boric acid.

The distillation apparatus is also capable of extensive application, and may be advantageously used for the determination of free and albuminoid ammonia in water.

—G. H. M.

On the Use of "Solid Bromine" for Decomposing Minerals, etc. A. Brand. Zeits. Anal. Chem. **26**, 222—230.

THIS "solid bromine" consists of thin rods of kieselguhr, mixed with somewhat less than 1 per cent. of lime or alkali, which are soaked in liquid bromine: the thin rods (7mm. in diameter) contain about 1grm. of bromine per cm. length, and the thick rods (15mm. diameter) about 3grms. per cm. length. On heating they give off bromine, and they can also be used for introducing any required quantity of bromine into a solution, since the kieselguhr is not acted upon.

The author has analysed fahl-ore, as well as ores of lead and nickel (containing Fe, Ag, Cu, Pb, Ni, Co, S, Sb, and As), by heating in a current of bromine, and he finds that the volatile bromides contain all the sulphur, antimony, and arsenic (as well as mercury in the case of fahl-ore); while the silver, copper, lead, nickel, and cobalt remain as non-volatile bromides. Iron was found in both, but mainly in the residue. This decomposition, by means of bromine, into volatile and non-volatile bromides is carried out in much the same way as the analysis of fahl-ores in a current of chlorine: the separation proceeds quite smoothly, and the method is cheaper and more convenient than the chlorine process. The decomposition is carried on in a tube, the front part being bent downwards and connected with two U-tubes which act as receivers. The finely-divided mineral is placed in a boat and pushed into the front part of the tube. A number of bromine-sticks are introduced behind the boat, and then the tube is closed air-tight: this is best done by pushing in a stiff paste of plaster-of-Paris, so as to form a plug 2cm. long, and closing the tube with a well-fitting cork. The two receivers are filled with HCl containing a little chlorine or bromine-water: if all the bromine-vapours are not absorbed, the operation must be carried out under a hood, or else the vapours may be led into a vessel containing shavings soaked in alcohol. The tube is now gradually heated from the plug end forwards towards the boat, so that the bromine-vapours expel the air before the decomposition commences. The reaction proceeds vigorously as soon as the boat is heated; the volatile bromides are then driven forward into the receiver, and the tube is cut off between the boat and the bromine-sticks. The decomposition of 1grm. of substance takes about half-an-hour, and before proceeding with the analysis the solution containing the volatile bromides should be poured into a porcelain dish and heated on a water-bath in a fume-closet, so as to drive off the bromine.—D. E. J.

Analyses of Chrome Iron Ore. W. Venator and E. Etienne. Chem. Zeit. **11**, 53.

THE authors give the following complete analyses of two samples of chrome iron ore from the Urals:—

	I.		II	
Chromium oxide......	51·62	51·39	55·75	55·92
Ferrous oxide	17·91	18·13	21·56	21·42
Alumina	11·52	11·63	3·37	3·45
Magnesia	13·15	13·29	13·85	13·67
Lime	0·73	0·75	0·60	0·65
Silicic acid	1·71	1·71	5·37	5·37

—W. D. B.

Successive Separation of Copper, Cadmium, Zinc and Nickel or Cobalt (Iron or Manganese). Carnot. Bull. Soc. Chim. **46**, 812.

Copper and Cadmium.—The solution containing these metals is acidified with 10—15cc. of hydrochloric acid, diluted to 200—300cc., heated to boiling, and a solution of sodium or ammonium hyposulphite (thiosulphate) added in small portions until the precipitation of cupric sulphide is complete, and the supernatant liquid remains milky from presence of free sulphur. The precipitate is ignited with sulphur in a current of hydrogen, and weighed as Cu_2S. The cadmium is precipitated from the solution by H_2S or ammonium sulphide.

Cadmium and Zinc.—The solution should contain no other free acid than oxalic. By boiling with thiosulphate, an orange-yellow cadmium sulphide is precipitated, and is easily washed, but no zinc. Care must be taken that no zinc oxalate be thrown down. The sulphuric or hydrochloric acid present is neutralised with ammonia, an excess of ammonium chloride added, then about 2grms. of oxalic acid in solution, and the whole heated to boiling. If much zinc be present, or the solution not sufficiently diluted, a separation of crystalline zinc oxalate takes place, and by filtering this off, and washing with warm ammonium chloride solution, a portion of the zinc is separated, which can be weighed as oxide or sulphide. But this precipitation of zinc oxalate may be entirely avoided by the use of a sufficient quantity of potassium oxalate, which forms with the zinc oxalate an easily-soluble double salt. The solution of zinc and cadmium, prepared as above, to avoid premature precipitation of zinc, is diluted to 200—250cc., heated to 100° C., treated in separate portions with sufficient thiosulphate, and the boiling continued. The further addition of thiosulphate, or of oxalic acid, will cause no orange precipitate, when the reaction is complete. The precipitated cadmium sulphide is washed, dissolved in nitric acid, converted into sulphate by the addition of a few drops of H_2SO_4, and weighed as sulphate after ignition at a dull-red heat. The zinc is precipitated as sulphide by H_2S, and may be weighed either as oxide or sulphide.

Zinc and Nickel (or Cobalt).—Nickel and cobalt are not precipitated in the foregoing processes, and are present in the sulphuretted hydrogen solution. Sodium or ammonium acetate is added, and the solution again saturated with H_2S. The precipitate is converted into protosulphide by ignition in a current of hydrogen. In absence of cadmium, the copper is precipitated by hyposulphite (thiosulphate) from the solution containing free sulphuric or hydrochloric acid, ammonia added to approximate neutrality, and the majority of the zinc precipitated by H_2S. Ammonium oxalate is next added, and the zinc completely precipitated with a large excess of H_2S. In the filtrate, the nickel or cobalt is precipitated by H_2S after the addition of sufficient ammonium acetate.

In the Presence of Iron and Manganese.—The employment of potassium oxalate in place of ammonium oxalate is essential to prevent their precipitation by H_2S or thiosulphate in the acid solution. This is due to the formation of easily-soluble double oxalates of potassium with iron and manganese.

Zinc and Iron.—The hydrochloric acid solution is nearly neutralised with ammonia and saturated with a rapid current of H_2S, whereby the zinc is partially precipitated and the ferric salt reduced. Potassium oxalate is then added, and the precipitation of the zinc completed by means of H_2S. The iron is subsequently thrown down by ammonium sulphide. This new method for the separation of zinc and iron is in many cases to be preferred before all others.

Zinc and Manganese.—The process is the same as in the case of zinc and iron.

Zinc, Nickel (or Cobalt), Manganese.—The three sulphides are precipitated successively and respectively in the oxalic acid, acetic acid, and neutral or ammoniacal solution.

Nickel, Iron, and Manganese.—The solution in which the iron must exist as a ferric salt, is saturated with ammonia and ammonium carbonate until it has assumed a brown colour, a neutral acetate added, and an excess of H_2S passed in. Iron, nickel, and cobalt are completely precipitated, and the manganese which remains in solution is thrown down by means of ammonium sulphide.

The above-described new methods of separation are rapid, and give accurate results.—W. D. B.

*Colour Reactions for **Arsenic**, Vanadic, Molybdic, and Arsenious Acids, also for the Oxides of Antimony and Arsenic.* L. Levy. Compt. Rend. 1886, **11**, 1195.

In continuation of his researches as to the behaviour of titanic, niobic, tantalic and stannic acids, the author has investigated the colour reactions yielded by the above-named acids and oxides with the following bodies:—Morphine, codeine, phenol, thymol, α-naphthol, β-naphthol, quinol, pyrogallol, salicylic acid, *m*-oxybenzoic acid and gallic acid. These reactions in many cases suffice to indicate the presence of one of the above acids or oxides in admixture with the others.—W. D. B.

A Basic Aluminium Sulphate. K. J. Bayer. Chem. Zeit. **11**, 38.

In the manufacture of sulphate of alumina, the author has observed the formation of a basic sulphate possessing characteristic properties, in which it differs from similar compounds hitherto prepared. By dissolving aluminium hydrate, prepared by precipitation with carbonic acid, in sulphuric acid, and boiling the solution obtained with an excess of hydrate, it is found impossible to bring this excess into solution by a further addition of sulphuric acid, even though the latter be concentrated. The solution also remains acid in spite of the aluminium hydrate apparently present. The hydrate has taken up sulphuric acid without, however, being converted into a soluble compound. On isolating this insoluble residue, it is found to be insoluble in acid, and only a portion is dissolved out by prolonged boiling with sulphuric acid of 1·3—1·4 sp.gr. Hydrochloric acid appears to have no action. Two residues obtained at different times were washed and subjected to analysis, solution for this purpose being effected by means of digestion in caustic soda. The results of analysis, making allowance for the small percentage of SiO_2 present, lead to the formula $3Al_2O_3.2SO_3+9H_2O$, as appears from the following figures:—

	Theoretical.		By Analysis. I.	By Analysis. II.
Al_2O_3	48·74	....	47·76	48·72
SO_3	25·33	....	24·44	25·80
H_2O	25·73	....	27·78	25·47

In (I.) the percentage of water is too high, having been estimated by difference; moreover, the sample contained some soda, which was not estimated. The direct estimation of water by heating the sample at 200—250° C. gave 16·83 per cent., corresponding to 6mols. On further heating the sample to faint redness, further 9·20 per cent. of water were given off, and it was only when the sample was heated to bright redness that any sulphurous acid could be observed. This basic sulphate does not lose water at 100° C., nor over sulphuric acid. On heating the sulphate which has been ignited at a faint red heat, with water, a basic aluminium sulphate passes into solution, from which, on heating, a voluminous precipitate separates. This would appear to correspond to aluminite, which contains equal molecules of alumina and sulphuric acid. Attempts were made to prepare the basic sulphate by boiling an excess of aluminium hydrate soluble in acetic acid, with a concentrated solution of aluminium sulphate,—but without success.—W. D. B.

Testing Aluminium Sulphate for Free Sulphuric Acid and Aluminium Hydrate. K. J. Bayer. Chem. Zeit. **11**, 53.

The presence of free acid is most certainly and conveniently detected by the use of Tropaeolin OO, and its amount estimated by titration with normal soda, using the tropaeolin as indicator. The solution for this purpose should not contain more than 10 per cent. of aluminium sulphate. If the sample contains aluminium hydrate in solution as basic salt, this may be estimated by titration with normal sulphuric acid, tropaeolin being the indicator. The insoluble portion left on dissolving aluminium sulphate in twice its weight of water, which appears as a white turbidity, and may be present even when the solution is distinctly acid, may consist either of hydrated silicic acid or of the insoluble basic sulphate $3Al_2O_3.2SO_3+9H_2O$ already described by the author (see preceding abstract).—W. D. B.

On the Estimation of Phosphorus in Steel and Iron. P. Vorwerk. Chem. Zeit. **11**, 98—99.

The Author, having tested for three months Meineke's[*] and Wood's modifications of the Molybdenum method for the determination of phosphorus, finds that for accuracy and rapidity they are alike suitable for iron-works laboratories. The combined method he specially recommends is as follows:—Enough of the sample (0·3 to 8grms.) to give about 1grm. of the ignited phospho-molybdic precipitate, should be dissolved in nitric acid of 1·2 sp. gr., 60cc. of 1·4 sp. gr. nitric acid, and 5cc. of chromic acid solution (2grms. CrO_3) are added, and the mixture boiled for 15 to 20 minutes. The organic bodies having thus been oxidised, the solution is cooled to 50—55° C. by the addition of 50—60cc. of water. The addition now of 100cc. of 0·96 sp. gr. ammonia will raise the temperature to 75°—80°, so that the precipitation of the phosphorus with 75cc. of the usual molybdate solution may at once be proceeded with, the liquid meanwhile being well stirred. After two hours, the clear liquor may be siphoned off, and the precipitate filtered, washed as usual with acid ammonium nitrate, introduced moist into a weighed porcelain crucible, dried carefully, the filter paper incinerated, and the yellow precipitate heated to 400° C. preferably over a Berzelius lamp for 10 to 15 minutes. The blue-grey residue consists of (empirically) $P_2O_5.4(Mo_6O_{17})$, and contains 1·754 per cent. of phosphorus. If more than 3 per cent. of combined carbon be present, as in some spiegels, the chromic acid treatment will not suffice for the removal of organic impurities; but the solution is evaporated, and the residue, after careful ignition, dissolved in hydrochloric acid and filtered from silica. The filtrate is freed from excess of hydrochloric acid by evaporation, rendered slightly alkaline by ammonia, the precipitate redissolved in nitric acid, and the whole heated to 75—80° C. with 30cc. of concentrated ammonium nitrate solution (750grms. *per* litre) and precipitated as usual. Silica dissolved in the nitric-acid may generally be neglected with safety. Should, however, this body or graphite separate from the solution, the latter after oxidation of the organic substances should be made up to a given volume and filtered through a dry filter into a dry beaker, from which any convenient fraction of the solution may be taken. By keeping the weight of the ignited precipitate lower than 1grm., the ignition may be conducted in a porcelain crucible instead of in a platinum dish. A skilled analyst may thus conveniently make 20 determinations in a day of eight hours. Finally, the author criticises Huss's modification of Sonnenschein's method; Huss, under the impression that phosphorus is not completely precipitated from a nitric acid solution of steel, converts the ferric nitrate into chloride by an exact addition of ammonium chloride. This incomplete precipitation is due to organic matter and not to ferric nitrate, and is therefore equally incomplete after the addition of the chloride.—W. G. M.

Detection of Albumen in Urine. L. Blum. Chem. Zeit. Rep. **11**, 24.

The reaction with metaphosphoric acid is made use of. Owing to the fact that this acid does not keep when in solution, the following reagent is employed as a substitute:—0·03 to 0·05grm. manganic chloride is dissolved in a small amount of water, acidified with a few cc. of dilute hydrochloric acid and treated with 100cc. of a 10 per cent. solution of sodium metaphosphate. Lead dioxide is then added in small quantities at a time with constant agitation, after which the mixture is allowed to settle and filtered. The resulting pink solution of manganic metaphosphate is then used as indicator for the presence

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[*] This Journal, 1886, 509.

of metaphosphoric acid. This solution keeps well, and is not acted on by other ingredients of urine.—D. B.

Assay of Quinine Sulphate. O. Schlickum. Pharm. Zeit. **32**, 23.

[*]To determine the presence of alkaloids other than quinine in commercial quinine sulphate, the author makes use of an observation by De Vrij, who found that quinine chromate is almost insoluble in water. It is shown that both quinine and cinchonine form chromates requiring 2000 parts of water for complete solution. The chromates of quinidine and cinchonidine are, however, more readily soluble. It was also found that a cold saturated solution of quinine chromate is not precipitated by caustic alkalis, owing to the fact that quinine hydrate is no more insoluble in water than the chromate. If, therefore, a solution of quinine is precipitated with potassium chromate, filtered after four hours' rest, and sodium hydroxide is added to the filtrate, no change should take place with pure quinine, the appearance of a flocculent or opaque turbidity being indicative of the presence of cinchonine, cinchonidine, or quinidine. Cinchonine dissolves in about 4000 parts of water, so that sodium hydroxide precipitates a cold saturated solution of its chromate (1 : 2000). The chromates of quinidine and cinchonidine dissolve in about 400 parts of water. The author has based on these ratios of solubility a method suitable for the detection of 0·5 per cent. of cinchonine sulphate or 1 per cent. of quinidine or cinchonidine sulphate in quinine sulphate.—D. B.

Estimation of Colchicine. A. Kremel. Pharm. Post. **20**, 38.

20GRMS. of colchicine seeds are exhausted in an extraction apparatus with alcohol of 90 per cent. The liquid is diluted with 25cc. of water, and the alcohol removed by evaporation. The residue is filtered and washed, and the filtrate agitated three or four times with 10 or 15cc. of chloroform. The mixed extracts are then evaporated, the residue is dissolved in water, again agitated with chloroform, and treated as before. The final residue is dissolved in a few cc. of water, evaporated, dried over sulphuric acid, and weighed.—D. B.

Reaction for Levulose. Ber. **20**, 181—182.

WHEN a cold aqueous solution of two parts of cane sugar and one part of resorcinol is mixed with concentrated hydrochloric acid and quickly warmed, a red colouration takes place, and on cooling a considerable dark precipitate is deposited, which is soluble in alcohol with a beautiful red colour. Levulose and raffinose also give this reaction with resorcinol, but dextrose, galactose, maltose, milk sugar, and inosite do not give any colouration. It appears that this reaction is only given by carbohydrates which contain or which yield levulose on inversion. The precipitate is analogous to those obtained by Michael (this Journal, 1884, 253), by the condensation of aldehydes with resorcinol. The author found that levulose acid gives Baeyer's aldehyde reaction with phenol. When dissolved in alcohol the condensation product gives a fine red colour, which on addition of alkali is first turned blue, then green, and finally dirty yellowish-grey. When water is added to an alcoholic solution of one part levulinic acid and one part resorcinol, to which fuming hydrochloric acid has been added, a white resinous precipitate is thrown down analogous to that described by Michael (*loc. cit.*). This turns red in the air. Quinones and pyroracemic acid give the same reaction.—G. H. M.

Detection of Minute Quantities of Aldehyde in Alcohol. W. Windisch. Ztschr. f. Spirit-Ind. **9**, 519.

ON treating aldehyde in aqueous or alcoholic solution with a freshly-prepared aqueous solution of metaphenylenediamine hydrochloride, a yellow colouration is obtained which is sufficiently sensitive to admit of the detection of one of aldehyde in 200,000 parts of the solution.—D. B.

New Process for the Determination of Tannin. M. Villon. Bull. Soc. Chim. **47**, 97.

THE determination of tannin is a matter of difficulty. On the one hand, the same process gives different results with extracts of different origin containing the same amount of tannin, and on the other, different processes applied to the same extract also give different results. Substances, also allied to tannin, but which do not form leather, such as gallic, ellagic, glauco-melonic and gallamic acids, occur in extracts along with tannin, and are estimated with it by certain methods. The author states that of the 32 methods for determining tannin, that of Hammer, that of Muntz, which is a modification of Hammer's, and that of Löwenthal are the only ones which give satisfactory results. The author precipitates the tannin with a solution of lead acetate, and states that gallic acid is not precipitated. Liebig and Strecker first remarked that tannin gave a yellow precipitate with lead acetate. Stein, in 1857, determined tannin by precipitating with a boiling solution of lead acetate in excess, filtering, drying, and igniting the precipitate, and from the weight of the lead oxide obtained, calculating the tannin. The precipitate of lead tannate varies in composition according to the temperature and concentration of the solution, but the author finds that in a liquid containing a weight of lead acetate equal to three to five times that of the tannin, the precipitate formed has a constant composition and is not dissociated by water. The addition of sodium acetate promotes the precipitation. Upon these facts he founds the following process:—The tannin solution is made of a strength of about 2grms. of tannin per 100cc. The lead solution contains 100grms. of neutral lead acetate and 20grms. of sodium acetate per litre. 100cc. of the tannin solution are mixed with 100cc. of the lead solution left for five minutes, and then filtered. The sp. gr. D of the lead solution, the sp. gr. D′ of the tannin solution and the sp. gr. d of the filtered mixture are taken, all at the same temperature. The calculation of the amount of tannin is as follows:—If the two liquids mixed without precipitation or alteration in volume, the sp. gr. of the mixture would be $\frac{D+D'}{2}$; but as the lead tannate disappears from the liquid the sp. gr. is diminished thus:—$\frac{D+D'}{2}-d$.

Let E be the difference of sp. gr. produced in 100cc. of an aqueous solution by the disappearance of the same weight of tannin as that precipitated as lead tannate; probably $\frac{D+D'}{2}-d$ will be proportional to E, whence

$$\left(\frac{D+D'}{2}-d\right)A=E.$$

This equation permits us to calculate E, if A is determined once for all, and from E to deduce p, the weight in grammes contained in 100cc. of the solution in question, by means of Hammer's table. This table may be summed up in the following formula:—$p=\frac{E}{0{\cdot}00405}$. The constant A is not the same for all the tannins; for gallotannic acid it is 50 per cent.; for quercitannic acid, 45·3; castaneotannic, 44·8; aspidospertannic, 42·5; abietannic, 40; and catechutannic acid, 52 per cent.
—B. H.

Butter Analysis. F. W. A. Wolt. Zeits. Anal. Chem. **26**, 28—33.

THE author has made a series of test analyses of mixtures of genuine butter and "oleo-oil" containing 20, 40, 50, 60, and 80 per cent. of the former, by Köttstorfer's and Reichert's methods respectively, with a view of determining the degree of accuracy of which the two methods are capable. By Köttstorfer's method the mean error was 6·5 per cent., the maximum error 16·1 per cent., the percentage of genuine butter indicated being

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[*] See this Journal, 1887, p. 306.

too low on account of the low percentage of alkali (222·2 to 223·2mgrms. per grain) actually required by the genuine butter; whilst in calculating the results Kottstorfer's mean value, 227, was employed. By Reichert's method closer results were obtained, the maximum error being +4·5, the mean error only +2·3 per cent. The results of examination of thirty-seven samples of butter, butterine, and butterine materials are given, and these confirm the value of the indication which specific gravity affords as to the genuineness of a sample. With the exception of sesame and cocoa-nut oils the specific gravity of all the commonly-used butterine materials falls below 0·90536, whilst that of genuine butter falls between 0·911 and 0·914. The minimum specific gravity of genuine butter is usually placed at 0·912, but in seven samples examined the figures were below this, the lowest specific gravity obtained being 0·91107.—W. D. B.

Modification of Otto's Acetometer. W. Fresenius. Zeits. Anal. Chem. **26**, 59—60.

This modification consists of a glass cylinder 12mm. in diameter, 17—18cm. high, closed at the lower end and graduated into fifths or tenths of a cc. The first graduation mark is at 5cc. from the bottom, and the divisions into fifths or tenths proceed from this to the 12cc. mark. In the performance of the test the apparatus is filled to the 5cc. mark by means of a pipette to avoid soiling the upper part with the vinegar under examination, a few drops of phenolphthalein solution added, and the standard soda run in and carefully mixed until a red tint is acquired. The volume in cc. of the soda solution is then read off, and this gives without calculations the number of grms. of anhydrous acetic acid in 100cc. of vinegar, if the soda solution is of the strength recommended by Fresenius for vinegar testing—namely, the litre corresponding to 50grms. of anhydrous acetic acid.
—W. D. B.

Reactions of Duboisine, Hyoscyamine, and Atropine. Chem. Zeit. **11**, 52.

Although the researches of Ladenburg would indicate the identity of duboisine with hyoscyamine, these two alkaloids exert very different physiological actions. According to Harnack, duboisine acts with about five times the power of purest recrystallised hyoscyamine, and two or three times more powerfully than atropine. The physiological differences between the alkaloids in question being so marked, it is very desirable to have a means for their chemical discrimination, and for this advantage is taken of their behaviour with alcoholic solutions of mercuric chloride. The action of this reagent with atropine was first pointed out by Gerrard, and Schweissinger has extended observations with the following results:—By dissolving about 1mg. of atropine in 1—2 drops of water in a test glass—which to hasten solution may be immersed in hot water—and adding 2cc. of a 5 per cent. mercuric chloride solution in alcohol of 50 per cent., a reddish-brown precipitate is obtained. Pure crystallised hyoscyamine tested in the same way gives a clear solution, which after continued warming on the water bath shows a faint opalescence. Pure crystallised duboisine under the same conditions gives a white turbidity immediately, and on warming a white precipitate. The amorphous base hyoscine, isomeric with atropine and hyoscyamine gives a clear solution when tested as above, and no change takes place on prolonged warming.—W. D. B.

Analysis of Platinum. C. Reinhardt. Chem. Zeit. **11**, 52.

In the examination of metallic platinum to be used for making crucibles it is frequently found a matter of great difficulty to effect solution in aqua regia or hydrochloric acid and potassium chlorate. To obviate this difficulty the author takes advantage of the fact that platinum may be readily alloyed with several metals of common occurrence, and that the alloys are easily brought into solution by acids. Experiments were made with various metals, but it was found that zinc was in every respect the most convenient. The weighed sample of platinum is mixed in a well glazed porcelain crucible with pure metallic zinc and the mixture exposed to the heat of a muffle furnace. When cold, the contents of the crucible are treated with cold hydrochloric acid of 1·124 sp. gr., which dissolves the zinc, leaving untouched a residue of grey metallic needles. These latter are washed, and dissolved in aqua regia. Solution now takes place rapidly, and the analysis is proceeded with in the usual manner.—W. D. B.

Detection of Salicylic Acid in Food. H. Taffe. Bull. Soc. Chim. **46**, 808.

To avoid the extraction of tannin substances when the drink under examination is shaken up with ether, the author advises the employment of a mixture of ether and petroleum ether in equal volumes, as this neither contains water nor takes up water when shaken therewith. By using this mixture, foreign substances are not extracted, and it is possible to obtain the colour reaction with ferric chloride with great certainty, and without it being necessary to purify the ether and petroleum ether extract, even when the quantity of salicylic acid is very minute. According to the author, this plan is to be preferred before all others for the rapid and certain detections of salicylic acid. Since beer gives with the mixed ethers an emulsion which separates very slowly, the author advises that after the mixing, agitation, and standing, a second quantity of the ether mixture be added and carefully stirred with the upper layer or the emulsion, from which it abstracts a portion of the salicylic acid.—W. D. B.

Estimation of Fatty Acids in Soap. B. Schulze. Zeits. Anal. Chem. **26**, 27.

The weighed sample is brought into solution in an Erlenmeyer flask, decomposed with dilute sulphuric acid, and the separated fatty acids dissolved out in ether. The aqueous solution is removed as completely as possible by means of a pipette, and the ether washed three or four times with fresh water, care being taken to remove the aqueous layer as completely as possibly. After the last washing and drawing off of the water, a few drops of barium chloride solution are added, and any free sulphuric acid thus precipitated. The amount of water being so small, the ethereal solution may be at once passed through a filter, and thereafter treated in the usual manner. The fatty acids obtained in this way are completely free from sulphuric and hydrochloric acids, and do not darken at 100° C.—W. D. B.

New Books.

Lauber's Handbuch des Zeugdrucks. Herausgegeben von Dr. Ed. Lauber, unter mitwirkung von Albert Steinheil, Dr. W. Haussmann, and Moritz Kohn. I. Band. Dritte Auflage. Leipzig, 1886. Commissionsverlag von Gustav Weigel.

8vo volume in paper cover. Price 6s. Contains 122 pages of subject matter, Table of Contents and Alphabetical Index. The work is illustrated by three woodcuts, and the subjects of which it treats more particularly in this first volume, are: Chapter I. Singeing the Goods. Bleaching and Shearing. Chap. II. Preparation of the Printing-colours. Chap. III. Preparation of the Rollers. Chap. IV. Fixing the Colours with Steam, etc. Chap. V. Turkey-red Oil; Blocking the Goods. Chap. VI. Continuous Soap and Washing Machine. Chap. VII. Soap in Dyeing; Investigation and Preparation of the Soap. Chap. VIII. Water in Dyeing; Investigation and Purification of Water. Chap. IX. Chlorination of the Perpared Goods; Dry and Damp Chlorine. CHAP. X. Albumen Colours; Testing the same on the Fibre; Testing Albumen; Ultramarine, Chrome Green, etc. CHAP. XI. Reserve with Albumen Colours. CHAP. XII. Steam Colours by decomposition of Metallic Salts, etc. CHAP. XIII. Colours Developed either by Mutual Decomposition or by Volatilisation of Acids, etc.

THE PRINTING OF COTTON FABRICS, comprising Calico Printing, Printing and Dyeing. By ANTONIO SANSONE. Manchester: Abel Heywood & Son, 56 and 58, Oldham Street. London: Simpkin, Marshall & Co., Stationers' Hall Court. Hamilton, Adams & Co., 32, Paternoster Row. 1887.

THIS important work consists of an 8vo volume bound in cloth; contains Preface, 375 pages of subject matter, illustrated by 32 well-executed engravings of plant and apparatus used by Calico Printers, a selection of 12 printed and dyed Patterns, a Table of Contents and Alphabetical Index, followed by one serving as an Index to Practical Recipes. The Table of Contents contains the key to the plan of the work as a whole:—History of Calico Printing; Bleaching. RAW MATERIALS, including Mineral Colours, Natural Organic Colouring Matters, Coal-tar Colours, Mordants, etc.; Thickening or Sizing Materials, Water. PRINTING PROCESSES: Preparing Thickenings and Mordants, Printed Colours (direct), Steam, Oxidation and Reduction Colours (Printing Colours or Processes of recent introduction). DYED COLOURS, including Alizarin Colours (Madder styles), Resists, Discharges, Turkey Reds, Alizarin Reds, Indigo Prints, Manganese Bronze Colours, Benzopurpurin and allied Dyestuffs. THE PRINCIPAL STYLES IN CALICO PRINTING, MACHINERY AND APPARATUS, FINISHING PRINTED GOODS, ELECTRICITY IN PRINTING, PRINTING WOOLLEN FABRICS, COMPARATIVE TABLE OF BAUME AND TWADDELL DEGREES.

CHEMISTRY FOR BEGINNERS. Adapted for the Elementary Stage of the Science and Art Department's Examination in Inorganic Chemistry. By R. L. TAYLOR, F.I.C., F.C.S., Teacher in Chemistry and Physics in the Central Higher Grade Board School, Manchester. London: Sampson Low, Marston, Searle and Rivington, Crown Buildings, 188, Fleet Street.

SMALL 8vo volume bound in cloth. Price 1s. 6d. Containing Preface, Table of Contents, 94 pages of subject matter, Appendix giving an account of the Metric System of Weights and Measures, nine select Groups of Questions on each Chapter of the work, and an Alphabetical Index. With the text are interspersed 21 wood engravings. As regards the extent of the subjects treated of, this is confined to the non-metallic elements.

AUSFÜHRLICHES LEHRBUCH DER CHEMIE. Von H. E. ROSCOE und C. SCHORLEMMER. Vierter Band: Die Kohlenwasserstoffe und Ihre Derivate, oder Organische Chemie. Zweiter Theil, Zweite Abtheilung. Braunschweig: Druck und Verlag von Friedrich Vieweg & Sohn. 1887. London: H. Grevel & Co., 33, King Street, Covent Garden.

8VO VOLUME in paper cover, forming the second part of the fourth volume of the German version of this well-known work. It contains matter from page 337 to 672, with which are interspersed one or two wood engravings. Essentially, it contains the description of the aromatic compounds with seven atoms of carbon, and covers consequently, like the preceding part, a complete field. The first section concerns Toluene and the derivatives corresponding to those treated of under Benzene. Then follows the Benzyl group, which joins itself to the Benzoyl group, and the volume is concluded with the treatment of the Hydroxy-benzyl- and Hydroxy-benzoyl-compounds.

NEW COMMERCIAL PLANTS AND DRUGS. No. 10. By T. CHRISTY, F.L.S., M.S.C.I., etc. London: Christy & Co., 25, Lime Street, E.C. 1887.

8VO VOLUME bound in paper. Price 3s. 6d. Contains a Preface, Table of Contents, 120 pages of subject matter, with which are interspersed numerous excellent wood engravings, and an Alphabetical Index. The following subjects are treated of:—Strophanthus, its Botany, Chemistry, Pharmacy, Physiology, and Therapeutics; the Colonial and Indian Exhibition; Hints on the Cultivation of Dry-yielding Plants in Great Britain; Notes from actual Practice in the Treatment of Disease with Jambul, Salix Nigra, Kava-Kava, Siegesbeckia, Papaw, Hydrocotyle, etc.; Gogo Plant, Chlorocodon Whitei; Huamawripa; Kola Chocolate; Ditana Digitifolia, and particulars of many other new and rare drugs; Reports and Produce received and examined.

Trade Report.

(From the Board of Trade Journal.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

RUSSIA.

Classification of Articles in Customs Tariff.

(*Note.*—Poud = 36lb. avoirdupois. Gold rouble = 3s. 2d.)

Carbonic Strontium.—Section 137, part 2, duty 1 rouble, 20 copecks per poud.

SWITZERLAND.

Classification of Articles in Customs' Tariff.

(*Note.*—Quintal = 220·4lb. avoirdupois.)

Soda, unprepared, crystallised, and calcined. Category 16, duty 30 centimes per quintal.

Sulphate of barytes, purified, in paste. Category 30, duty 60 centimes per quintal.

Plates of glass for photography, ready for use, dried. Category 17, duty 30 francs per quintal.

ITALY.

Alterations in Customs' Tariff.

Mr. J. G. Kennedy, Her Majesty's Chargé d'Affaires at Rome, writing under date of the 23rd April last, says that a law approving the temporary application for a period of three months of certain amended customs duties which passed the Chamber on the 20th April came into force on the 22nd of that month. The following is a statement of some of the amended Customs duties in question:—

Tariff No.	Tariff Classification.	Amended Rates of Duly.
		Lire c.
8	Mineral and resinous oils:—	
	(a) Raw - - Per qointal.	38·00
	(b) Refined - - - „	17·00
	Mineral oils, whether raw or refined, imported in demijohns, or other similar vessels, shall pay 41 lire per 100kilos., if raw, and 51 lire, if refined, with a deduction from each quintal, gross weight, of the general tare of 15 per cent.	
	Mineral oils, whether raw or refined, imported in casks, cases, or tins, shall pay duty according to their net legal weight, *i.e.*, with deduction from the gross weight of the following special tares for each quintal of gross weight:—	
	Barrels and kegs with iron hoops, 15kilos.	
	Wooden cases containing two canisters of tin apiece 14kilos.	
	Tin canisters, 5kilos.	
	If, however, they are imported in vessels other than those referred to above, they shall pay according to gross weight.	
	Mineral oils, whether raw, or refined, if imported in cistern-trucks or reservoir ships, shall be charged by actual net weight.	
	(c) Heavy:—	
	1. If containing 20 per cent., or less, of light oil at the temperature of 310 degrees - „	6·00
	2. If containing more than 20 per cent., and not more than 30 per cent., of light distilled oil at the temperature of 310 degrees - - „	12·00
	Heavy oils, imported in their original receptacles, pay according to gross weight.	
	If imported in cistern-trucks or vessels, they pay upon the net actual weight, with an increase of 20 per cent.	

Classification of Articles in Customs' Tariff.

Mixture of fish-oil and fatty substances. Category 1, No. 7*b*, duty 6 lire per quintal.

Linseed oil containing essence of turpentine, and not used as a varnish. Category 1, No. 7*b*, duty 6 lire per quintal.

Fish-oil mixed with lubricating mineral substances. Category 1, No. 7*b*, duty 6 lire per quintal.

Acetic acid, concentrated and artificially coloured. Category 3, No. 29*h*, duty 10 lire per quintal.

Dissolved iron and iron held in solution by glucose or molasses. Category 3, No. 56, duty 130 lire per quintal.

Iron, pulverised, for medical use. Category 3, No. 56, duty 120 lire per quintal.

"Terpina." Category 3, No 55, duty 10 lire per quintal.

Artificial black containing aluminium, flint, chalk, etc., but without phosphoric acid. Category 1, No. 70*e*, duty 5 lire per quintal.

Varnish for shoes, composed of anilin colour dissolved in spirits of wine. Category 1, No. 67*a*, duty 30 lire per quintal.

Red colouring matter, containing a very large proportion of aluminium. Category 13, No. 217, duty 4 lire per quintal.

Mixture of clay, hair, and other organic substances and water, forming a mortar intended as a covering for tubes in order to prevent condensation of steam. Category 13, No. 218*a*, duty free.

Tannic acid mixed with dextrin. Category 11, No. 246, duty 3 lire per quintal.

Refrigerating apparatus. Category 16, No. 297*a*, duty 60 lire per quintal.

AUSTRIA-HUNGARY.

Customs Decision.

Camphor oil, made from raw camphor, is in future to be included in Category 107*a* of the tariff. Duty, 6 florins per 100kilos.

UNITED STATES.

Customs Decision.

An importation found upon chemical analysis to consist of magnesium-chloride, a chemical salt, is dutiable under the provision for "all chemical compounds and salts," under section 92, and is not entitled to free entry as a substance "expressly used for manure," under paragraph 505 of the free list.

MISCELLANEOUS TRADE NOTICES.

BEER ADULTERATION IN THE ARGENTINE REPUBLIC.

Mr. R. Bridgett, Her Majesty's Consul-General at Buenos Ayres, in a report dated March 4 last, states that, by a recent ordnance of the Municipality of Buenos Ayres, the sale of beer containing salicylic acid is forbidden after March 31, 1888, under a penalty of twenty dollars for each case or cask, and forfeiture of the same. Until then the seller must show on the ticket or wrapper, or must otherwise certify the amount of salicylic acid contained in the liquid up to a maximum of fifty centigrammes per litre, or if it does not contain any acid it must be similarly made known.

TRADE OF JAPAN DURING 1886.

A despatch, dated March 16 last, has been received from Sir F. R. Plunkett, Her Majesty's Minister at Tokio, enclosing copies of the annual report of the Yokohama Chamber of Commerce for the year 1886. From this report it appears that the import and export trade of the whole of Japan for the year 1886 show an increase of £591,000 and £2,423,000 respectively over the preceding year. The total combined value of imports and exports for 1886 is given at £16,221,585, as compared with £13,201,083 in 1885, the total increase, therefore, amounting to above three millions sterling.

RUSSIAN TRADE IN 1886.

The *Journal de St. Pètèrsbourg* for April 2 last, contains an article on the foreign trade of Russia for 1886, founded upon the report of the Russian *Administration des Douanes*. The receipts, it is stated, show an increase of about 10 per cent. upon those for 1885, but this is exclusively the result of the increased duties charged upon foreign goods imported into Russia. The revenue from exports has diminished, and the commercial crisis appears to be as severe as ever. The bad harvest of 1885 exercised an unfavourable result on the export of cereals in 1886, and the general diminution of exports in this class is no less than 21 per cent., the total amount exported being less than in any year since 1881. The general stagnation of trade is, according to the *Journal*, as marked in the ports of the Black Sea and the Sea of Azov as in the Baltic.

COMMERCIAL MUSEUMS AT FRANKFORT AND AMSTERDAM.

The Belgian *Bulletin du Musèe Commercial* for April 9 last states that the Commercial Museum established by the Chamber of Commerce at Frankfort-on-the-Main is now opened to the public. It also announces that the Association for Exportation from the Kingdom of Saxony is about to open a Commercial Museum in Amsterdam.

CAMPHOR MONOPOLY IN FORMOSA.

The following information, respecting the camphor monopoly in Formosa, is extracted from a recent report by the United States Consul at Amoy:—

"The reports of the customs authorities in Formosa indicate a constant diminution in the production of crude camphor during the past two years, and the early extinction of that industry from among the industrial pursuits of that island.

"Since the termination of the Franco-Chinese war, Formosa has been made a separate province and placed under the jurisdiction of a Governor-General, who has instituted many new taxes, formerly quite unknown in Formosa; and among these, on the lingering remains of the camphor industry, he has erected a Government monopoly of that business, which, from all the information I can gather, seems likely to hasten its speedy extinction. This camphor monopoly, so created, is comparatively of little moment, except as it seems to be a revival of the old *co-hong* system, and a restriction upon the foreign trade of Formosa, so far as the article of camphor is concerned.

"Some very intelligent foreigners regard this as but the first step, a feeling of the way, by the native authorities of Formosa, to similar Government monopolies in other and more important articles of industry and trade that might cause irreparable injury to foreign commercial interests connected with the trade of Formosa, such, for instance, as the tea and sugar trade."

TRADE STATISTICS FOR APRIL.

The Board of Trade Returns for April show the following figures:—

Exports.

	April, 1886.		April, 1887.
British and Irish Produce	£16,117,801	....	£16,441,662
Foreign and Colonial Produce (partly estimated)	5,168,697	....	5,716,339

Imports.

	April, 1886.		April, 1887.
Total value....................	£26,066,751	....	£31,149,925

Below are the details affecting drugs and chemicals:—

Exports.

		Apr. 1885.	Apr. 1886.	Apr. 1887.
British and Irish produce:—				
Alkali	cwt.	611,179	518,108	526,983
,, ...	value £	176,024	142,260	150,316
Bleaching materials	cwt.	127,002	130,105	122,425
,, ,,	value £	42,150	37,616	46,231
Chemical manure ..	value £	131,591	132,156	100,459
Drugs and medicinal preparations (unenumerated)	,,	63,981	59,780	62,784
Other chemicals and medicinal preparations	value £	153,211	154,366	162,826
Oil (seed)............	tons	4,471	7,225	6,799
,, ...	value £	105,063	150,907	141,477
Soap	cwt.	33,731	38,695	35,502
,, ...	value £	39,921	40,462	35,311
Painters' colours and materials (unenumerated)	value £	102,738	101,078	106,534
Foreign and Colonial merchandise:—				
Bark, Cinchona	cwt.	3,635	9,929	14,950
,, ,, ...	value £	18,982	46,611	58,084
Chemicals (unenumerated)	,,	20,023	7,513	24,391
Cochineal	cwt.	769	1,069	714
,, ...	value £	5,159	6,972	4,627
Cutch and gambier	tons	676	859	854
,, ,,	value £	14,780	21,296	22,076
Gum Arabic	cwt.	5,777	2,852	2,801
,, ...	value £	22,061	10,690	9,918
Indigo	cwt.	13,012	5,199	7,437
,, ...	value £	301,656	101,906	164,541
Lac, various kinds..	cwt.	7,293	7,006	5,021
,, ,, ,, ..	value £	24,525	21,110	13,657
Lard	cwt.	2,280	3,456	507
,, ...	value £	5,153	6,528	925
Oils, cocoanut	cwt.	6,123	10,670	10,060
,, ,, ...	value £	9,632	15,007	14,570
,, olive	tuns	385	232	312
,, ,, ...	value £	13,751	10,018	12,282
,, palm	cwt.	20,195	50,598	39,871
,, ,, ...	value £	28,661	51,033	38,350
,, petroleum	gals.	490,676	45,806	29,201
,, ,, ...	value £	11,049	2,150	1,197
Quicksilver	lb.	223,739	662,834	476,783
,, ...	value £	17,580	50,513	43,590
Nitre (nitrate of potash)	cwt.	1,723	2,158	6,228
Nitre (nitrate of potash)	value £	1,432	2,202	5,101
Tallow and stearine	cwt.	21,911	20,644	17,879
,, ,, ,, ..	value £	21,592	22,401	20,808

Imports.

		Apr 1885.	Apr. 1886.	Apr. 1887.
Drugs, unenumerated	value £	68,706	60,595	52,629
Chemical manufactures—				
Products unenumerated	value £	126,317	124,407	107,614
Alkali	cwt.	3,501	5,878	5,680
..	value £	3,721	4,082	3 519
Brimstone	cwt.	55,400	58,899	60,220
.. ..	value £	15,686	14,755	15,967
Nitre (nitrate of soda)	cwt.	242,314	202,613	142,800
.. ..	value £	118,419	110,815	25,000
.. (nitrate of potash)	cwt.	29,069	26,105	30,947
.. ..	value £	25,048	22,301	27,080
Quicksilver	lb.	24,675	452,700	881,400
..	value £	1,850	36,221	88 300
Bark (Cinchona)	cwt.	11,043	16,748	13,375
..	value £	70,337	95,032	69,213
Gum Arabic	cwt.	8,212	3,871	2,394
..	value £	26,899	11,242	11,837
Lac, seed, shell, stick, and dye	cwt.	13,548	11,396	11,192
Lac, seed, shell, stick, and dye	value £	45,712	34,394	28,570
Dyes and tanning materials—				
Bark (for tanners' or dyers' use)	cwt.	20,489	31,319	38,645
Bark (for tanners' or dyers' use)	valoe £	9 278	15,149	17,191
Anilin dyes	value £	20,160	22,127	18,269
Alizarin	value £	16,759	24,935	20,188
Other coal-tar dyes	value £	961	360	585
Cochineal	cwt.	949	1,021	701
..	value £	5,760	6,745	4,253
Cutch and gambier	tons	3,552	1,486	1,661
..	value £	75,540	37,367	11,160
Indigo	cwt.	10,869	4,831	5,101
..	value £	216,363	55,026	97,192
Madder, madder root, garancine, and munjeet	cwt.	1,493	1,417	553
Madder, madder root, garancine, and munjeet	value £	2,450	1 848	727
Valonia	tons	2,734	4,624	3,882
..	value £	43,314	63,802	54 133
Oils—				
Cocoa-nut	cwt.	16,412	16,822	13,745
..	value £	21,598	23,627	20,036
Olive	tuns	2,629	1,487	1,855
..	value £	109 669	60,234	67,484
Palm	cwt.	48,217	69,716	62,816
..	value £	70,112	69,613	60,916
Petroleum	gals.	4,519,891	3,178,015	4,695 104
..	valoe £	144,293	215,023	190,777
Seed, of all kinds	tuns	935	970	977
..	value £	27,319	21,672	22,013
Train, blubber, and sperm	tuns	609	766	797
Train, blubber, and sperm	value £	19,640	13,038	19,818
Turpentine	cwt.	2,885	5,697	11,435
..	value £	2,977	7,195	12,246
Rosin	cwt.	131,660	62 825	117,021
..	value £	28,343	10,418	25,237
Tallow and Stearine	cwt.	105,437	33,258	88,211
..	value £	170,520	44,319	103,770

TRADE BETWEEN SPAIN AND THE UNITED KINGDOM.

Imports into the United Kingdom from Spain.

Principal Articles.		March 1886.	March 1887.
Chemical Products unenumerated	Value	£7,274	£6,590
Copper Ore and Regulus	Tons	2,302	3,615
	Value	£60,921	£70,628
Manganese Ore	Tons		1,600
	Value		£2,400
Pyrites of Iron or Copper	Tons	51,567	48,351
	Value	£103,543	£92,545
Quicksilver	lb.	149,925	300,000
	Value	£35,194	£29,500
Total Value for March		£815,407	£906,072
,, ,, April		£781,457	£799,058

Exports of British and Irish Produce from the United Kingdom into Spain.

Principal Articles.		March 1886.	March 1887
Alkali	Cwt.	33,482	30,865
	Value	£12,257	£10,492
Caoutchouc Man'f'ctures	Value	£1,951	£1,250
Cement	Tons	245	158
	Value	£505	£354
Chemical Products, including Dye-stuffs	Value	£2,931	£3,660
Products of Coal, including Naphtha, etc.	Value	£1,979	£1,623
Manure	Value	£5,913	£10,464
Soap	Cwt.	664	281
	Value	£555	£252
Total Value for March		£286,698	£327,115
,, ,, April		£273,145	£246,897

CONSULAR REPORTS.

(From the Chemist and Druggist.)

Argentine Republic.

Pharmaceutical Imports.—The imports of articles of pharmaceutical interest into the Argentine Republic during the year 1885 are officially stated to have amounted to 2,497,349 dols., which is probably rather below the real value, considering the heavy import duties prevailing. This total is made up of the following items:—

Alcohol (duty 50 per cent.) 245,390 litres, value 162,081dols., principally from Germany; prepared colours, value 195,579dols., principally from England; sheep medicines (duty free), value 234,736dols., from England, Germany, and Italy; prepared medicines (duty 25 per cent.), value 576,443dols., from France and England; perfumery (duty 50 per cent.), value 202.353dols., from France; pharmaceutical substances and products (duty 25 per cent.), value 98.679dols., from Germany and England; chemical substances and products (duty 25 per cent.), value 180,554dols., from Germany and England; soda ash (duty 25 per cent.), 1803 tons, value 104,101dols., nearly all from England.

The United Kingdom furnished about one-third of the total value of these imports, the precise figures being—

	Dollars.
Linseed oil	60,860
Prepared colours	163,557
Sheep medicines	62,246
Prepared medicines	127,651
Soda ash	94,231
Other chemical products	410.571
Total of chemical and pharmaceutical imports	819,116

Chile.

Foreign Trade.—The foreign Trade of Chile is not, apparently, in a flourishing condition. The customs duties in 1885 yielded about 10 per cent. less than in 1881, while both imports and exports have been falling steadily since 1883.

Iodine.—There is a heavy export duty on this article, from which, in 1881, a revenue of £54,755 was derived, and of £21,436 in 1885.

Japan.

Export Statistics.—Among the articles exported from Hiogo and Osaka the following are named:—

—	—	1886.	1885.
Antimony	Piculs	31,009	36,130
Aniseed	,,	983	1,360
Camphor	,,	36,632	21,199
,, oil	,,	5,808	3,380
Cuttlefish, dried	,,	18,922	12,271
Fish oil	,,	702	1,317
Gallnuts	,,	1,847	2,064
Ginseng	,,	266	545
Isinglass	,,	7.237	7,595
Medicine	Dollars	39,300	50,000
Rapeseed	Piculs	1,600	2.549
Seaweed	,,	20,296	26.952
Soap	Cases	85,734	142.453
Sulphuric acid	,,	6,270	6.193
Tallow	Piculs	838	2,821
Wax, bees'	,,	35	51
,, fish	,,	120	141
,, vegetable	,,	12,899	13,707

COSTA RICA.

In San José, the capital of this Republic, a city of 30,000 inhabitants, there is not, our consul states, a single British house of business, although all other principal civilised nations are represented. The resources of the country are being steadily developed, and the imports for 1886, although the customs duties at the beginning of that year were increased by about 10 per cent., show no decline upon preceding years.

Exhibition of Produce.—A very successful exhibition of Costa Rican products was held at San Jose last year, as a preliminary to the Paris International Exhibition of 1889, where the Republic will, it is thought, make a considerable show. Among the articles exhibited were a large selection of medicinal plants and dyeing materials, natural mineral waters, anise, linseed, sarsaparilla, vanilla, quince seed, castor oil, essential oils, etc.

ECUADOR.

Business prospering.—In reviewing the trade and commerce of the Republic for 1886, our consul observes that the country has been in a more settled state than was the case during the preceding years. In 1886 there have only, our representative dryly remarks, been "several alarms of political disturbances, and continuous revolts of an insignificant nature, on the part of some disaffected citizens known as the Montoneros." This, for Ecuador, is no doubt the very acme of tranquillity, and under these propitious conditions the development of the country's resources is progressing with great rapidity. The staple products of the Republic are cocoa, indiarubber, coffee, and hides, show a large increase in production, and the purchasing power of the country has correspondingly increased. Public works are being extended in all directions.

Cinchona.—Of Peruvian bark, 2987 quintals (value £8961) were exported in 1885, and only 613 quintals (value £2452) in 1886. This is the only article showing a decrease during the past year, and it may be noted that the collection of cinchona has now been almost abandoned, owing to the difficulty of its transport through the forests of the interior, and the fact that its value has so declined as to render the product insufficient to cover expenses and freight. The abolition of export dues and reduction in freight, have not been found sufficient to overcome this drawback.

RUSSIA.

Russian Petroleum.—Our Odessa correspondent writes that the demand for Russian petroleum, both in Russia and foreign countries, is so rapidly increasing that the Transcaucasian Railway will shortly be unable to maintain the necessary traffic for its transport. It is, therefore, essential that pipes be put down from Baku to Poti and Batoum. Negotiations in this direction are now being carried on at the capital, and it is said that the laying down of the pipes will shortly be commenced, and that the railway company is to obtain the concession. During the past year large reservoirs were constructed in London, Antwerp, Trieste, and Tunis for the reception of Russian petroleum direct from tank steamers, and these are already in use. It is rumoured that an excise duty on petroleum in its present state is to be imposed, but the general opinion is that this step would be detrimental to all, excepting the large exporters, and that until the pipe referred to above is laid down and the trade properly developed and extended, the imposition of the excise should be deferred, for then the tax would influence the price of petroleum only to a small degree, and the fear of seeing the industry monopolised by a few of the larger and more powerful exporters would not be realised.

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

5665 A. Thomson, Sheffield. An improved steam, water, or gas cock or tap. April 19

5676 J. Platt, Sheffield. Apparatus for obtaining more perfect combustion of fuel in the furnaces of steam generators. April 19

5705 E. Edwards—From E. C. Sonnett and A. A. Leredde, France. Apparatus for generation of steam and formation of a vacuum, to be used for preserving food, forcing water, and other purposes. April 19

5730 J. Metcalfe and E. Davies, London. Injectors or apparatus for feeding steam boilers or generators, and for other purposes. April 20

5731 E. Davies and J. Metcalfe, London. Apparatus for feeding steam boilers or generators, and for raising and forcing liquids. April 20

5793 J. King, Liverpool. Apparatus for use in the roasting, drying, carbonising, or torrefying of farina, dextrin, manures, feeding stuffs and other materials; for the heating, concentrating, evaporating and distilling of liquid and other bodies; for heating disinfectors for hospitals, and water for baths and other purposes. Complete specification. April 21

5890 T. Firth, London. An improved high pressure tap. April 22

5927 J. K. Broadbent and A. Budenberg, Manchester. Improvements in and relating to apparatus for preventing smoke and regulating the supply of air to furnaces. April 23

5982 L. A. Enzinger, London. Improvements in filter presses. April 25

5990 H. Cotton and R. Moon, Liverpool. Improvements in and applicable to furnaces to promote combustion.

5993 J. Ruscoe, Hyde. Self-sealing retort lids, cross bar, and fastening. April 25

6007 J. Weir and G. Weir, Glasgow. Apparatus for condensing steam, or for heating or evaporating by means of steam. April 25

6054 E. Schorah, Halifax. An improved machine for carbonising fabrics and fibres. April 26

6061 J. Balbirnie, Sheffield. Apparatus for burning substitutes for coal, coke, or other combustibles; the result, a cheap self-feeding fire or furnace. April 26

6218 J. W. Holden, London. Improvements in forced draught and smoke-consuming apparatus for steam boiler and other furnaces. April 28

6261 J. Buchanan, jun. See Class XV.

6372 W. J. Cooke, Manchester. Improvements in injectors for raising and forcing water or other liquids. May 2

6424 J. C. Aitken, Glasgow. Steam condensers. May 3

6441 J. D. Noble, London. Means for opening and closing valves, cocks, taps and the like, and controlling the flow of gas, steam, water, and the like. May 3

6612 C. Burnett, London. Improved apparatus for raising water and other liquids. May 5

6686 J. Y. Johnson—From P. Guillaumin, France. Improvements in weigh bridges, weighing machines, dynamometers, and similar instruments or apparatus for measuring weight or force. May 6

6705 R. Fergusson, Liverpool. Economical production of steam. May 7

6727 A. Beldam, Liverpool. Improvements in "non-return valves" employed in apparatus for raising and forcing fluids in water service systems, and for analogous purposes. May 7

6776 E. Korting, London. Improvements in injectors. May 9

6781 H. Appleby and J. G. Robinson, London. Blast pipes, and means for regulating the draught created thereby. May 9

6807 J. W. Hyatt, London. Water purifier and filter for steam boilers. Complete Specification. May 10

6838 R. Chambers, Handsworth. A steam boiler composition injecter. May 10

6860 P. Sedlak, London. Apparatus for filtering water and other liquids. May 10

6907 W. P. Thompson—From A. E. Lebret, France. Improvements in barometers, hygrometers, and the like. May 11

6908 A. Horne, Liverpool. Automatic apparatus for stopping injecting or pumping apparatus, when the level of the liquid pumped in the hot well or reservoir falls to a given point, and starting the apparatus when the liquid rises to a given height. May 11

6985 A. Pottier, London. Apparatus for separating solid impurities from the water of steam boilers. May 12

7034 O. W. Bennett and S. O. Hemenway, London. Carburetting apparatus. Complete specification. May 13

7078 P. Williams and W. Powles, London. Electrical water level apparatus for indicating by direct reading the capacities and rise and fall of gasholders, water in reservoirs, etc., and for other purposes. May 14

7111 H. H. Lake—From Zonca and Bella, Italy. Grinding mills. Complete specification. May 16

COMPLETE SPECIFICATIONS ACCEPTED.*

1886.

7755 J. Holden. Injector for feeding furnaces with liquid fuel. May 11

8481 H. H. Salomons. Retort covers, lids or doors. April 30

8523 A. Myall—From J. McIntyre. Surface condensers. April 30

8583 A. J. Boult—From S. Bond. Apparatus for consuming smoke and saving fuel. May 4

8787 G. Yellott. Centrifugal pumps. May 4

8905 S. Vickess. Apparatus for separating impurities or objectionable matter from solids. May 14

9038 A. Myall—From J. McIntyre. Surface condensers. May 11

9181 J. G. Galley. Apparatus for preventing the formation of incrustation on the surface of boiler flues, and for removing such incrustation if formed. May 18

9198 A. Harrison. Apparatus for charging and drawing heating, smelting and other furnaces. May 18

10370 S. Vickess. Apparatus for filtering liquids. May 11

12867 J. W. Lovibond. Apparatus for standardising intensity of colour in transparent bodies. April 27

15186 J. Henderson. Improved furnace or grate bars. May 7

1887.

3118 E. Luck. Distilling apparatus. April 27

3647 C. H. Roeckner, F. L. Roeckner, and E. L. Roeckner. Apparatus for separating solids from liquids, and for filtering liquids. May 4

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* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

4425 H. E. Newton—From W. Bauer. Filter presses. May 18

4587 J. Waters. Steam generators and furnaces therefor. April 30

4588 J. Waters. Steam generators. April 30

4600 C. F. Dahl. Furnace for recovering, in an inodorous manner, the salts contained in the lyes used in the manufacture of wood fibre. April 30

4626 C. A. Koellner. Filter pumps. May 18

4976 J. V. Wilson. Pans for heating oil or other liquids, and apparatus for passing air or gases through liquids, and agitating liquids in pans and similar vessels. May 7

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

5986 G. Beal, Liverpool. Lime coal fuel. Converting coal dust into blocks at small cost, producing great heat, and almost smokeless. April 25

6018 A. J. Boult—From D. Macdougald Kennedy, Canada. Improvements in the purifying of hydrocarbon oils. Complete specification. April 25

6039 R. Haddan—From M. Vaillant-Dubus, France. Improvements in or relating to the heating of air by boiler furnaces, and other means of heating. Complete specification. April 25

6061 J. Balbirnie. See Class I.

6064 W. Hanson, Middlesbrough. Improvements in coke ovens. April 26

6239 O. Imray—From C. A. von Welsbach, Austria. Treatment of incandescence bodies formed of metallic oxides for increasing the luminosity and resisting properties thereof, and apparatus for that purpose. April 28

6274 W. Wakefield, London. An improved method of and apparatus for generating vapour or gas from oil, together with burners for burning the same in lighthouse and other lamps. Complete specification. April 29

6342 G. Downing—From T. Baur, Germany. Improvements in coke ovens. April 30

6348 B. Pitfard, London. Improvements in the manufacture of appliances to be rendered incandescent by heat. April 30

6421 H. Hall, London. Improvements in machinery for the manufacture of artificial or patent fuel May 2

6475 S. Willoughby, London. Improvements in candles. May 3

6520 J. Hargreaves, Liverpool. Improvements in and apparatus for promoting the combustion of liquid fuel. May 4

6596 G. Johnstone, Glasgow. Improvements in apparatus for lighting railway trains with gas. May 5

6598 J. C. Bent, Birmingham. Improvements in incandescent gas fires, or gas heating apparatus for domestic purposes. May 5

6635 R. N. Clifford, Birmingham. A new perforated block fire-lighter. May 6

6650 J. Pointon, Liverpool. The better securing the perfect combustion of gas or vapour of petroleum, and the utilisation (1) of the evolved heat in the generation of steam; (2) of the products of combustion. May 6

6652 B. H. Thwaite, Liverpool. Improvements in methods of combustion of oil spray or gas from liquid hydrocarbons for illuminating purposes, and in apparatus therefor. May 6

6701 E. Zohrab, London. An improved method of and apparatus for the treatment of peat. May 7

6771 J. Lyle, Glasgow. Improvements in and connected with the burning of oils or other hydrocarbon fluids as fuel in furnaces. May 9

6818 H. Williams, Stockport. Improvements in the method of generating inflammable gaseous vapour applicable for heating, lighting, and actuating power, and apparatus therefor. May 10

6915 G. K. Cooke, London. A method of superheating and burning illuminating gas, and apparatus in connection therewith. May 11

6979 D. W. Sugg, London. Improvements in apparatus for lighting by gas. May 12

7067 W. H. Beck—From A. Kreiger, France. New or improved automatic apparatus for the production of carburetted air gas. May 14

7071 J. Birchall, Liverpool. Improvements in or connected with steam generators heated by gas, partly applicable to other heating purposes. May 14

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

7317 T. Christy. Regulating the heat of hot air chambers. May 18

8312 P. Farinaux. Apparatus for manufacture of carbonic acid and other gases. May 11

8319 A. M. Clark—From G. E. Wery. Consuming smoke and economising fuel in furnaces and fireplaces. April 27

8184 G. Symes. Purification of gas, and impregnation of same with hydrocarbon or other vapour, and apparatus therefor. April 30

8709 A. Paget. Manufacture and application of "mantles" in incandescent gas lighting, and packing such mantles. May 7

8761 W. C. Haigh and A. A. Haigh. Artificial fuel. April 27

1887.

281 J. Parkes and J. Parkes. Carburetting apparatus. April 27

927 S. Levy—From G. H. Kohn. Manufacture of water gas and other gases for lighting and heating, and apparatus therefor. May 4

4687 A. A. Harwood and M. D. Van Tassel. Apparatus for generating gas. May 7

4784 H. B. Sheridan and E. Rawlings. Apparatus for the manufacture of gas. May 4

4888 F. Friedlander and J. Quaglio. Obtaining hydrocarbons from gases. May 11

5313 H. Cockey and F. C. Cockey. Gas washers. May 11

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATIONS.

5785 A. A. Yale—From The Chemische Fabriks Actien Gesellschaft, Hamburg. Process for the purification of crude anthracene. Complete specification. April 20

5824 J. W. Knights and W. D. Gall, London. Improvements in the manufacture of carbolic acid and other tar acids. April 21

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

5729 W. R. Hodgkinson—From M. Conrad and L. Limpach Bavaria. An improved process for the preparation of γ-oxychineldine and its derivatives for use in the preparation of dyestuffs and for other uses. April 20

5896 A. Kern, London. Improvements relating to the manufacture of sulpho-nitrosulpho, nitrosulpho, and amidosulpho acids, and to their application for the production of new colouring matters. April 22

5953 A Kern. Improvements relating to the preparation of the methylic ether of gallic acid, and to the manufacture of purple colouring matters therefrom. April 23

6687 C. D. Abel—From The Actiengesellschaft für Anilin-Fabrikation, Germany. Processes for the production of azo-colours that dye cotton direct from a soap bath. May 6

6688 C. D. Abel—From The Actiengesellschaft für Anilin-Fabrikation. Processes for the production of yellow, orange, and red colours by the action of phenanthrene-chinone, isatine, or methyle-isatine upon the sulpho-acids of aromatic hydracines. May 6

7116 A. Ewer and P. Pick, London. Process of obtaining products of condensation from aldehydes and the sulphuric acids of the aromatic amines, and also compounds of the same with tetrazo-compounds. May 16

COMPLETE SPECIFICATION ACCEPTED.

1886.

8992 C. D. Abel—From The Farbwerke Vormals Meister Lucius and Bruning. Production of green colouring matters. May 7

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

5685 A. J. Boult—From E. H. M. Caston, Canada. Manufacture of merchantable material from thistledown. April 19

6121 E. M. Serrell, jun., Paris. Process and machinery for the mechanical "debavage" or cleansing of cocoons after brushing. Complete specification. April 27

6208 J. D. Sutcliffe and B. T. O'Brien, Manchester. Improvements in apparatus applicable for drying cotton and other fibrous or granular material. April 28

6433 J. Elce, Manchester. Improvements in machines for opening and cleaning cotton and other fibre, parts of said improvements being applicable for other purposes. May 3

6461 C. C. Kauffman, London. Improvements in the process of and apparatus for treating ramie, jute, and other fibres. May 3

6480 W. H. Stead, Liverpool. Improvements in the treatment of cotton seed for the removal of fibrous matter therefrom, and in apparatus therefor. May 3

6726 P. Bairstow and J. Bairstow, London. Improvements in the method of and apparatus for distributing oil or other liquids upon wool and other fibres whilst being fed to drawing-frames, combing and other machines. May 7

COMPLETE SPECIFICATION ACCEPTED.

1886.

W. R. Lake—From C. Orlay. Rendering textile fabrics, etc., impermeable, and protecting them from injury by moisture. May 18

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

6131 A. C. Lewis, Bradford. A new method of dyeing warps. April 27

6565 O. Delhaye, London. A new or improved process of dyeing vegetable or animal fibres. May 4

6721 T. A. Crook, London. Improvements in machines employed in bleaching, dyeing, printing, and finishing woven fabrics, or analogous operations. May 7

6737 C. Collin and L. Benoist, London. A new process for fixation of colouring matter by oxidation at high temperature of the textile fibres. Complete specification. May 7

7021 C. H. Behnisch, Luckenwalde, Germany. Improvements in the method of and apparatus for producing patterns or designs on cloth and other fabrics. Complete specification. May 13

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

9286 F. A. Gatty. Dyeing wool or other animal fibres in the raw or manufactured state. May 18

16780 J. H. Lorimer. Treatment of wool, cotton, paper, etc., for bleaching, colouring, disinfecting and drying the same, and apparatus therefor. May 4

1887.

113 G. Jagenburg. Process and apparatus for dyeing unspun textile fibres. May 11

4365 E. Booth—From W. A. Fourness. Apparatus for dyeing loose or spun fibres. April 27

4761 G. Jagenburg. Method and apparatus for mordanting, dyeing, and bleaching raw cotton. May 1

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

5711 W. S. Squire, London. Improvements in the manufacture of sulphuric anhydride. April 19

5753 T. T. Mathieson and J. Hawliczek, Liverpool. Improvements in the manufacture of carbonate of soda or soda ash, and in apparatus therefor; partly applicable for other purposes. April 20

5757 T. T. Mathieson and J. Hawliczek. Improvements in the manufacture of caustic ash. April 20

5853 E. W. Parnell and J. Simpson, Liverpool. Improvements in the utilisation of sulphate of lime and sulphate of baryta in the manufacture of alkalis and sulphuretted hydrogen. April 22

5854 E. W. Parnell and J. Simpson. Improvements in the production of sulphide of ammonium, and in apparatus therefor. April 22

6029 W. N. Hartley and W. E. B. Blenkinsop, London. Improvements in the manufacture of metallic sulphates. April 25

6107 H. Gardner—From R. J. Henderson, United States. Separation of carbonic oxide from nitrogen, carbonic acid, hydrogen, and other gases contained in the gaseous mixture resulting from the incomplete combustion of coal and of coke by the use of the chlorides of copper and of iron. April 26

6209 R. L. Hickes, London. Combining disinfectants with soda crystals. April 28

6417 J. Marx, London. Improvements in the manufacture of alkalies. May 2

6718 H. Grimshaw and H. Kenyon, Manchester. Improvements in the manufacture or production of zinc and other sulphides; in the utilisation of residual or waste products therein, and in apparatus therefor. May 7

6909 C. F. Claus, Wimbledon. Improvements in processes for obtaining sulphur from iron pyrites, copper pyrites, zinc blende, and other metallic sulphides. May 11

7011 J. Fleischer and C. Muhlich, Paris. Improved valve for liquid carbonic acid. Complete specification. May 13

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

872 P. Thomas. Apparatus for producing sulphurous acid in solution. April 23

6573 R. Weiss. Production of alumina compounds applicable for bleaching. May 18

8018 M. von Neucki and C. Kolbe. Manufacture of salicylic acid "esters." April 23

8217 J. H. Dennis and N. Glendinning. Obtaining sulphide of zinc from solutions. April 23

8308 L. Mond. Obtaining chlorine. May 7

8312 P. Farinaux. See Class II.

8723 E. Solvay. Process for the simultaneous manufacture of assimilable phosphates and of sulphate of ammonia. May 11

9366 O. Imray—From La Société Anonyme pour l'Etude de la Création de Soudières. Apparatus employed in the ammonia soda process. May 7

1887.

329 O. von Gruber. A process for manufacturing the double sulphate and phosphate of ammonium or potassium. April 30

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

5698 S. H. Rowley, London. An improved mode of preparing articles of pottery or glass to receive metal pipes or other metal connections. Complete specification. April 19

5701 J. Armstrong, London. Manufacturing rolled glass, and machinery therefor. April 19

5723 S. Pitt—From G. Falconnier, Switzerland. Improvements in the manufacture of building materials from glass, and in the application of the same. Complete specification. April 19

5769 B. Hartland, London. Firebricks made of an improved combination or mixture of earthy materials. April 20

5866 J. Blair, London. Improvements in china and crockery ware. Complete specification. April 22

5901 J. D. Doulton, London. Improvements in earthenware blocks and tiles, and in the manufacture of the same. April 22

6283 A. Murray, London. An improvement in the manufacture of bricks, mouldings, ridges, and other articles of clay used in building. Complete specification. April 29

6398 H. J. Burton, London. A machine for coating surfaces of glass, paper, metal, or other suitable materials, with solutions of gelatine or emulsions of chemical salts or finely-divided pigments. May 2

6412 J. B. Germeual-Bonnaud, London. Improvements in decorating glass, porcelain, or other ceramic ware with impressed designs. May 2

6477 W. P. Thompson—From M. C. Stone, United States. Improvements in the ornamentation of glazed earthenware articles. Complete specification. May 3

6502 R. N. Langton, London. Improvements in the manufacture of cups, saucers, and other articles for domestic and other purposes. Complete specification. May 3

6513 A. W. Itter, London. Improvements in the method of facing bricks, tiles, and other analogous articles. May 3

6616 L. C. A. Marguerie, London. A novel vitro-metallic material suitable for glazing, and for other purposes in place of glass. May 5

6634 F. Mitchell and C. Mitchell, Guildford. Improvements in cutting-off table whereby the punching of holes and cutting-off in the making of tiles, and other clay goods, is effected in one operation. May 6

6691 T. Sutcliffe, London. Improvements in tools for shaping the mouths of earthenware or stoneware bottles, jars, and the like. May 7

6758 W. R. Renshaw, Kidsgrove. Improvements in printing as applied to earthenware, china, and glass. May 9

6769 T. Stanway, Hanley. A new or improved means of decorating or ornamenting china, earthenware, glass or other suitable surfaces. May 9

6779 W. Lutwyche—From J. Valère, Paris. Ornamenting glass and other vitrifiable substances by means of translucid and opaque enamels in relief—Valère's translucid enamel in relief on glass, etc. May 9

7038 L. Boissonnet, London. Improvements in furnaces for burning pottery. May 13

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

3803 F. J. Frenzel, jun. Encaustic tiles. May 11

4821 E. Moore. Manufacture of opaque glass of a certain new colour. May 18

4822 E. Moore. Manufacture of opaque glues of a new colour. May 4

5129 F. Wallbrecht. Manufacture of bricks, tiles, and all kinds of earthenware. May 18

7338 E. Picard. Manufacture of glass. May 1

7438 E. Kerry and E. C. Kerry. Improvements in bricks. May 1

8067 P. J. Milligan. Manufacture of bricks. May 7

8339 R. Steinau. Improvements in facing bricks and manner of setting same. May 1

8477 W. Kent and C. Cope. Apparatus for working or mixing plastic materials, such as potters' clay. May 4

9226 H. H. Lake—From M. P. H. Bécoulet and L. J. O. Bellet. Manufacture of sheets or plates of glass, and other articles. May 4

10574 A. Drummond. Manufacture of glass, and application of same to roof lights, etc. May 11

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS

APPLICATIONS.

5814 T. H. Lodge, London. Improvements in the method of and means or apparatus employed for drying "slip" or "slurry," from which Portland cement is produced. April 21

5815 T. H. Lodge. Improvements relating to the manufacture of Portland cement, and in apparatus employed in connection therewith. April 21

5816 T. H. Lodge. Improved method of and means or appliances connected with the utilisation of the hot waste gases from cement and other kilns for the production of steam power. April 21

6038 G. H. Sharpe, F. W. Turner, and E. Mesnard, London. Improved manufacture of cement suitable as plaster, and for moulding purposes. April 25

6110 G. F. Redfern—From F. Martin, France. Improvements in limekilns. May 2

6701 B. H. Thwaite, D. L. Collins, and D. Wilson, Liverpool. Improved method of manufacturing Portland cement, and apparatus therefor. May 7

6802 J. Hoyle, London. Improvements in burning cement and lime, and in kilns for the same. May 9

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

2573 P. Jochum. Apparatus for mixing and preparing pulverulent argillaceous and other materials. May 11

6212 E. Edwards—From C. Hubert and H. Gennari. Apparatus for forming compressed blocks for building and other purposes. May 7

7511 M. M. Brophy and J. A. Archer. Manufacture of transparent material for roofing, etc., and apparatus therefor. May 11

7888 F. W. S. Stokes. Manufacture of cement in a powdered state, and apparatus therefor. May 11

8177 W. Kent and C. Cope. See Class VIII.

10167 P. Feserich. A new or improved artificial asphalt and process for manufacturing the same. May 4

13205 J. D. Denny. Terra cotta building blocks, and appliances for making same. May 18

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

5697 J. Abbott, London. Improvements in "pots" for tinning plates, and in apparatus connected therewith. April 19

5727 A. Wilson, London. Improvements in apparatus for manufacturing compound plates of iron and steel. April 19

5781 Viscount d'Hauterive, London. A process for producing an unoxidisable coating on iron and steel. April 20

5811 G. Elias, London. Improvements in the production of terne and tin plates, and in machinery or apparatus therefor. April 21

5951 R. Low, London. An improved process or method of hardening or tempering steel projectiles. April 23

6028 A. Schanschieff, Norwood. Improvements in miners' safety lamps, to enable them to indicate the presence of fire-damp. April 25

6635 C. Morris and G. Birkbeck, London. Improvements in the manufacture of terne plates. April 25

6058 B. H. Thwaite, Liverpool. Improved methods of casting steel and other metals, especially applicable to the casting of projectiles, heavy ordnance, and like material. April 21

6086 S. P. Thompson, London. Improved processes in electro-deposition. April 26

6087 E. D. Wassell, London. Method and means for reducing the point in carbon in steel, and forming a homogeneous weld. Complete specification. April 26

6109 A. J. Mashrey and P. S. Phillips, London. Apparatus for the manufacture of tin and terne plates. April 26

6117 G. B. Williamson—From H. F. Logan, New Zealand. Improvements in smelting crude antimony. April 27

6120 W. Patterson, Durham. Improvements in miners' safety lamps. April 27

6157 T. Hussey, Northwold. Armour-plating for vessels of war and other purposes. April 27

6165 R. S. Casson, London. Improvements in the manufacture of steel or ingot iron and phosphate of lime. April 27

6173 R. A. Hadfield, London. Improvements in the treatment of steel. April 27

6286 J. Colley, London. Improvements in moulds adapted for use in the casting of metals. April 29

6287 W. Bevitt, Romford. Radiating gold amalgamator. April 29

6367 C. Burnett, Hartlepool. An improved system of boring long holes in coal mines. May 2

6368 A. Reaney, Sheffield. Improvements in the manufacture of projectiles for piercing armour-plates, etc. May 2

6370 S. Toussaint, Paris. Process and apparatus for extracting the tin from tinned iron cuttings or scrap, and from metal covered with tin. Complete specification. May 2

6487 R. L. Short, J. Short, and J. B. Short, London. A safety lamp for use of miners and others. Complete specification. May 3

6536 R. Chapman, sen., and R. Chapman, jun., London. Improvements in glasses for miners' safety lamps. May 4.

6569 J. E. East, London. Improved means or appliances for employment in close annealing iron and steel sheets, and other parts or articles of metal. May 4.

6633 W. H. Osborn, Birmingham. Producing by electro-deposition ornamental designs and lettering on plates of metal. May 6

6703 E. Zobrab, London. An improved method of case-hardening, or converting into steel the surfaces of iron plates and other objects made of iron. May 7

6719 E. Morewood, London. Improvements in coating plates or pieces of iron, steel, or other metal with tin, terne, zinc, or other metals. May 7

6757 C. Kaberry and L. Hope, Liverpool. Improvements in safety lamps. May 9

6768 C. Bramall, Oughtibridge. An improved portable combined smelting and converting furnace, and apparatus employed therein. May 9

6900 J. Willis, Sheffield. Improvements in the manufacture of armour-plates, shot, and shell. May 11

6916 W. Baker and J. Barton, London. Improvements in miners' safety lamps. May 11

6913 M. Settle, Manchester. Improvements in magneto-electric machines employed for firing explosive charges for mining and other purposes. May 12

6991 H. Trautmann, London. Improvements relating to the plating or coating of wood, leather, and other articles or materials with metal by electro-deposition. May 12

7013 D. Appleton and F. A. Binney, Manchester. Improvements in electro-plating rollers and other articles. May 13

7017 A. P. Vivian, London. Improved manufacture of metallic alloys. May 13

7068 J. Marsh, H. P. Marsh, and J. P. Marsh, Sheffield. Improvements in the manufacture of self-hardening steel, and in making tools of same. May 14

7139 D. Edwards, R. Lewis, and P. Jones, London. Improvements in apparatus for coating metal plates with tin or other metal. May 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

6790 C. Burnett. Machines for drilling, boring, etc. May 18

8367 T. Nicholson. Machinery for crushing minerals. May 18

8387 G. Francis. Tamping blast holes in mines and other places. April 27

8390 R. Heathfield. Apparatus for coating sheet-iron with zinc, or alloys of zinc, or other coating metal or alloy. April 27

8531 F. J. R. Seaver—From E. C. Kleiner-Fiertz. Manufacture of aluminium and other light metals. May 4

8885 H. Boyns. Improvements in, and apparatus for, dressing minerals. May 11

9113 C. R. Whittaker. Safety lamp for use in mines. May 11

9382 B. C. Tilghman. Straightening, stiffening, drawing, and rolling metal bars. May 18

10127 E. Schroder and H. Perner. Preparing a metallic covering for giving a non-oxidising or only slightly oxidising covering to wood, etc. May 11

10477 W. A. Thoms. See Class XVIII.

10823 J. Y. Johnson—From La Compagnie Anonyme des Forges de Chatillon et Commentry. Tempering or hardening metal. May 11

14265 R. Stewart and J. F. Waldie. Washing coal, etc., and apparatus therefor. May 7

15322 E. C. Kleiner-Fiertz. Manufacture of aluminium and other light metals. April 27

16286 J. Craven and W. Chapman. Foundry ladles for pouring molten metal. May 4

1887.

921 C. D. Abel—From E. Fischer and M. W. Weber. Extracting gold and other precious metals from their ores, and apparatus therefor. April 23

4576 D. G. Reillon, S. T. Montagne, and O. L. B. L. Bourgerel. Extracting aluminium from alumina. April 30

4609 J. C. Newbery and C. T. J. Vautin. Wet or hydrometallurgical method of extracting gold from crushed or other finely-divided ore. May 4

4664 W. P. Thompson—From E. H. Cowles and A. H. Cowles. See Class XVIII.

1562 E. Dunkley and A. Dunkley. Method of making leather waterproof or flexible. May 18

XI.—FATS, OILS, AND SOAP MANUFACTURE

APPLICATIONS.

5960 S. Schofield, Bradford. A process for extracting oil or other lubricants from greasy waste or cleaning cloths, and for making the extracted grease into soap. Complete specification. April 23

6756 T. Turner, Preston. An improved method for filtering spent or other oils. May 9

6986 W. Sanzenbacher and S. Tanatar, London. Method and apparatus for distilling fatty acids by means of superheated steam. Complete specification. May 12.

7117 J. Thomson, London. Improvements in the composition of mercurial soaps. May 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

6736 J. S. Edwards. Treatment of fish, etc., to extract oil or fat therefrom, and apparatus therefor. May 11

8756 R. Tervet and F. Alison. Treating and purifying paraffin wax, and apparatus therefor. May 7

XII.—PAINTS, VARNISHES, AND RESINS.

APPLICATIONS.

5791 F. Crane—From J. Hale, United States. An improved compound or varnish for coating metal, wood, and other materials. April 20

6291 J. H. Jackson, London. The universal liquid and metallic enamel bronzes. April 29

6323 W. L. Wise—From R. Lehmann, Germany. Improvements in apparatus for the manufacture of oil-lac Complete specification. April 30

6582 P. Molyneux, London. An improved paint or coating. May 4

6619 J. C. Martin, London. Improvements in treating or imparting body or opacity to sulphate of baryta and other sulphates and substances, and the manufacture from materials so treated of white and tinted or coloured pigments. May 5.

6671 S. Banner, Liverpool. Improvements in treating resins, oleo-resins, gums, pitches, varnishes, bitumens, tars, oils, fats, and other hydro-carbonaceous matters, and in products obtained therefrom (in combination with other substances). May 6

6697 J. Wilson, Leith. Making sulphide of zinc paint. May 7

6755 H. A. Harvey, Liverpool. Improvements in compositions for coating the bottoms of navigable vessels, and the submerged portions of floating and other structures. May 9

6870 H. H. Lake—From E. N. Todd, United States. Improvements in compositions for the manufacture of articles by moulding, carving, or turning, or of varnish and lacquer, and for similar purposes. Complete specification. May 10

6937 R. Ripley, Liverpool. Improvements in paint or colouring for metal-work, stone-work, stucco, and other surfaces. May 12

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

9581 J. B. Hannay and E. J. Pape. Making white paint May 18

1887.

4334 T. Kenyon. Preparation of pigments, and treatment of bye-products therefrom. April 27

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

5741 H. House, Leeds. Improvements in the manufacture of artificial leather from leather waste and scraps, and in the utilisation of the same, and in machinery employed therefor. April 20

6116 J. Palmer, London. A new and improved process for softening and unhairing, or unwooling hides or skins. April 27

6412 G. Delfos, London. A method of treating goat skins. May 3

6914 J. S. Hooper, London—From J. W. Darrow, United States. An improved method for treating hides and skins for leather and other purposes. May 11

6958 J. Campbell, Glasgow. Improvements in making glue. May 12

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

5619 J. Hall and A. Hall. Machinery employed in the manufacture of leather for setting, scouring, striking, printing, rolling, slicking, fleshing, unhairing, whiting, shaving, and brushing. May 14

8582 A. J. Boult—From Count V. de Nydprüek. Improvements in tanning. April 30

11683 J. W. Abom and J. Landin. Tanning hides and skins. May 14

XIV.—AGRICULTURE, MANURES, Etc.

APPLICATIONS.

6632 W. L. Wise—From E. Solvay, Belgium. New or improved processes for converting natural and other phosphates into products assimilable by vegetables, and into valuable sub-products. May 5

6813 F. Knauer, London. Improved method for enriching seed plants with alimentary substances. May 10

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

8723 E. Solvay. See Class VII.

9636 L. A. Chevalet. Process for manufacturing neutral phospho-guano. April 23

XV.—SUGAR, GUMS, STARCHES, Etc.

APPLICATIONS.

5660 J. Thomson and J. Black, Glasgow. Improvements in or connected with sugar cane mills. April 19

6100 G. Epstein, London. Improvements in the treatment of diastase and other material or products. April 26

6261 J. Buchanan, jun., Liverpool. Improvements in apparatus for drying and granulating sugar, salt, and like substances. April 29

6431 S. Vickess, Liverpool. Improvements in apparatus for cutting or dividing sugar or like friable substances into blocks or cubes. May 3

6875 A. M. Wood, London. Improvements in the treatment of indiarubber, caoutchouc, gutta-percha, and analogous gums. May 10

6936 P. J. E. Heffter, Germany. Improvements in the method of clarifying and saturating sugar solutions, especially beet-root rob, by means of tannic acid or tannin. May 12

7087 W. R. Watson—From A. Young, Hawaiian Islands. Improvements in the manufacture of sugar, and in the apparatus used in connection therewith. May 14

7119 C. Steffen, London. An improved process for systematically lixivating raw sugar by means of aqueous alcoholic or other saccharine solutions. Complete specification. May 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

9216 C. Lyle and J. Lyle. Manufacture of lump sugar. May 7

10911 P. Labèrie. Apparatus for evaporating the juice of beet-root, sugar cane, etc. May 11

1887.

602 R. A. Robertson and J. G. Hudson. Sugar cane mills. May 4

XVI.—BREWING, WINES AND SPIRITS.

APPLICATIONS.

5759 C. Last, London. Improvements in malting houses and kilns. April 20

7008 W. Smith and W. Bagshaw, Dudley. Apparatus for skimming or removing barm or yeast from ale, beer, or other fermented or fermentable liquors. May 13

COMPLETE SPECIFICATION ACCEPTED.

1886.

9090 A. W. Gillman and S. Spencer. Apparatus for the preparation of finings for the use of brewers. May 7

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

APPLICATIONS.

A.—Chemistry of Foods.

5708 J. F. O. Qvistgaard, London. Apparatus for heating milk prior to separating the cream therefrom, also applicable for destroying germs therein, and for heating other liquids. April 19

6003 R. Jones, London. An improved method of preserving animal and vegetable substances for the good of man. April 25

6025 W. H. Gilruth, London. An improvement in, or connected with, the process of withering, firing, or curing tea. April 25

6073 R. E. Phillips, London—From C. P. N. Martin, Ceylon. Improvements in drying ovens for drying tea, and for analogous uses. April 26

6096 A. G. Wass, London. An improved food for animals. April 26

6285 A. Leerbeek and J. Holm, London. An improved process for producing albumen-maltose dietary malt powder for food. Complete specification. April 29

6401 H. B. Thornton, London. An improved method of preparing and preserving a mixture of tea, coffee, or other substance used for the making of beverages in combination with milk and sugar. May 2

7112 D. Ker, London. Improvement in manufacturing cocoa in any form, from the nib cocoa to the prepared cocoa, a paste, a powder, and the flaked cocoa; all soluble in warm water. May 16

B.—Sanitary Chemistry.

5655 G. E. Davis, Manchester. Softening and purifying water for domestic and trade purposes. April 19

5661 G. E. Davis and J. B. Aitken, Manchester. Treating or purifying sewage, waste liquors from manufactories, and other foul liquids, and producing valuable substances therefrom. April 19

6068 R. Nicholls, London. Improved means applicable for the purification of sink water and for like purposes. April 26

6665 B. C. Badham, London. Certain improvements in, and apparatus for, purifying gases arising from sewers, surface water drains, closets, and other places. May 6

7072 W. J. Lomax and M. Guthrie, London. Extracting gas, oil, fatty and other matters from sewage sludge and similar deposits, and apparatus therefor. May 14

C.—Disinfectants.

6037 A. Dickson Hunter, London. Improvements in compositions for treating matters having an offensive smell. Complete specification. April 25

6085 T. Hallsworth and R. Bailes, London. Improvements in or relating to disinfecting powders or compounds. April 26

6209 R. L. Hicks, London. Combining disinfectants with soda crystals. April 28

6571 J. W. Hamilton, Liverpool. Improvements in or relating to disinfectants. May 4

COMPLETE SPECIFICATION ACCEPTED.

A.—CHEMISTRY OF FOODS.

1886.

9712 E. R. Allen and W. C. Allen. Manufacture of articles of food from the kernels of almonds and other fruits. April 30

XVIII.—ELECTRO-CHEMISTRY.

APPLICATIONS.

5687 W. P. Thompson—From H. W. Spang, United States. Improvements in fusible connections for armatures for electric generators. Complete specification. April 19

5709 A. J. Gravier, London. Improvements in dynamo-electric machines. April 19

5720 C. Coerper. Improvements in dynamo-electric machines. April 19

8867 W. Kingsland, London. Improvements in secondary batteries. April 22

5955 G. E. Dorman, Stafford. Improvements in the manufacture of thermo-electric elements or chains. April 23

5958 A. M. Clark—From L. Maiche, France. Improvements in dynamo-electric and magneto-electric machines. April 23

6273 J. T. Armstrong, London. Improvements in the manufacture of porous plates and cells for electrical batteries. April 29

6294 A Watt, London. Improvements in the electrolytic treatment of zinc and its ores. April 29

6409 R. E. Bell and W. A. Kyle. Improvements in dynamo-electric machines and motors. May 2

6623 W. H. Tasker, London. Improvements in the manufacture of plates or elements for voltaic batteries. May 5

6681 R. E. B. Crompton, Chelmsford, and J. C. Howell, Llanelly. Improvements in secondary batteries or electrical accumulators. May 6

6711 F. von Harotmuth, London. Method and apparatus for the manufacture of carbon rods for electric arc lights. May 7

6754 R. E. B. Crompton and J. Swinburne, Chelmsford. Improvements in and connected with dynamo-electric machines. May 9

6805 G. Philpott and M. C. Stapylton, Brighton. An improvement on the electrical secondary generator. May 10

6828 E. T. Higham and D. Higham, London. Improvements in the regulation of dynamo-electric machines. Complete specification. May 10

6829 P. Jensen—From O. Lugo, United States. Improvements in electric batteries. Complete specification. May 10

6869 H. H. Lake—From W. J. Ludlow, United States. Improvements in and relating to primary and secondary batteries. Complete specification. May 10

7021 G. Scarlett, Liverpool. Improvements in electro-dynamic and dynamo-electric machines. May 13

7030 C. Maltby-Newton, High Wycombe. An improved construction or formation of plates with composition for electric batteries. May 13

7059 R. W. Paul, London. Improvements in electrical accumulators and primary batteries, and means for effecting the same. May 11

7093 W. G. Spurgeon, London. Improvements in the containing jars or cells of primary or secondary batteries. May 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

5817 S. F. Walker. Galvanic batteries. May 4

5855 F. W. Benson. Improved galvanic battery. May 4

7561 J. Gibson and F. M. Gibson. An improved electrode. May 7

7818 C. Smith. Secondary batteries. April 23

7953 W. Geipel. Method of regulating currents generated by dynamo-electric generators. April 27

8003 L. B. Atkinson, T. Goolden, and A. P. Trotter. Dynamo-electric generators. May 4

8226 A. M. Clark—From A. E. Peyrusson. Secondary batteries. April 23

8197 A. T. St. George. Apparatus for generating electricity. April 30

8620 G. E. Dorman. Thermo-electric batteries. May 4

8832 A. Schanschieff. Saline preparation applicable for use in galvanic batteries, and process for manufacturing same. May 11

9056 W. Maxwell. Construction of dynamo-electric machines. May 11

10177 W. A. Thoms. Deposition of platinum by electricity. April 30

1887.

4219 C. Desmazures. Improvements in accumulators of electricity April 23

4527 L. Epstein. Electrodes for primary or secondary batteries. May 14

4571 W. E. Heys—From J. Beattie, jun. Construction of zines for galvanic batteries. April 30

4664 W. P. Thompson—From E. H. Cowles and A. H. Cowles. Electric furnaces applicable for making aluminium, and for other purposes. April 30

4667 W. P. Kookogey. Galvanic battery solutions. April 30

4744 H. J. Harris. Supporting elements in batteries. May 4

4931 M. Bailey and J. Warner. Improved battery and method of regulating same. May 4

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

5805 P. M. Crane and F. Wilkinson, Manchester. Improvements in the manufacture of corrugated paper and analogous materials or fabrics. April 21

6174 F. Voith, London. Improvement in engines or machines for the manufacture of paper pulp. April 27

6897 G. Hibbert, Gateshead. Improvements in apparatus for straining pulp used in the manufacture of paper. May 11

7052 W. O. A. Lowe, Liverpool. Improvements in the manufacture of paper, cardboard, or flexible sheets. May 11

7090 T. Phœnix, Newcastle, and G. Kirk, Uttoxeter. Improvements in the manufacture of pottery tissue paper for transfer printing. May 11

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

5269 G. Pitt—From R. P. Pictet and G. L. Brelaz. Manufacture of paper from wood, and apparatus therefor. May 11

5296 L. Bastet. Manufacture of waterproof and combined water and fire-proof paper. May 11

7633 L. A. Groth—From H. Schnurmann and G. Closs. Manufacturing sulphite cellulose in beton boilers. May 7

7694 W. Hull and W. B. Walker. Beating or pulping machines applicable for paper making. May 11

8593 J. Luke. Treating or preparing paper for the manufacture of floor and wall coverings, etc. April 30

8936 E. Davies and H. F. Harris. Method and apparatus for treating spent hops for use in the production of pulp for paper and mill-board. May 11

9178 A. J. Boult—From A. Ubbelobde. Manufacture of paper pulp from moss peat. May 18

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

COMPLETE SPECIFICATION ACCEPTED.

1886.

8168 W. Merck. Production of peptone from nucleo-proteines. April 23

XXI.—EXPLOSIVES, MATCHES, ETC.

APPLICATIONS.

5803 F. P. Warren, London. An improved mode of attaching explosives to the sides or bottoms of ships. April 21

5877 A. Minter, London. An improved paint or coating for the formation of frictional surfaces for lighting safety and other matches. April 22

5883 F. W. Smith—From Messrs. Klee and Koecher, Germany. Improvements in the construction of exploding charges or cartridges. Complete specification. April 22

5899 P. M. E. Andouin, London. Improvements in explosives, and in the manufacture of the same. Complete specification. April 22

5987 M. A. Whitley, Bradford. Improvements in the manufacture of matches. April 25

6022 J. H. Johnson—From F. Engel, Germany. Manufacture of explosives. April 25

6550 D. Campbell, London. Improvements in match and fusee lights, and in apparatus for the manufacture thereof. May 4

6817 J. H. Burke, Southsea. A centrifugal percussion fuse for igniting the bursting charges of shells. May 10

7085 T. R. Bayliss, London. New or improved movable primers for cartridges or ammunition, and other explosive charges. May 14

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

6222 J. Macnab. Explosive cartridges for blasting purposes, May 11

8127 T. Nordenfelt. Improvements in fuses. April 27

11219 G. Smith. Electrical fuses. May 14

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NOTICES.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those members of Council whose names are placed in italics in the annexed list, will retire from their respective offices at the forthcoming Annual General Meeting.

Professor James Dewar, F.R.S., has been nominated to the office of President, and Mr. David Howard has been nominated Vice-President under Rule 11.

Professor Clowes, Mr. J. Neilson Cuthbertson, Mr. Ivan Levinstein, and Professor W. A. Tilden, F.R.S., have been nominated Vice-Presidents under Rule 8; and Mr. B. S. Proctor has been nominated Ordinary Member of Council under Rule 17, in the place of Mr. Levinstein, nominated Vice-President.

Mr. James Duncan, Mr. F. J. Rowan, Dr. Edward Schunck, F.R.S., Mr. T. W. Stuart and Mr. Frank Wilson have been nominated, under Rule 18, to fill four vacancies among the Ordinary Members of Council.

The Treasurer and Foreign Secretary have been nominated for re-election.

The Annual General Meeting of the Society will be held at 11 a.m. on Wednesday, 13th July next, in the Lecture Theatre of the Owens College, Manchester. Particulars as to visits to works and excursions are issued, together with the Ballot List and Member's Ticket in a separate cover. Members are particularly requested not to place any other communication whatever in the envelope provided for the return of the Ballot List, but to send word of the places they wish to visit to Mr. Carter Bell.

Comment having been made on the delay in reprinting the numbers for January, 1882 and 1883, the Secretary begs to inform those whom it may concern, that the delay is due to the fact that up to the present not more than twenty orders for those numbers have been received. It is hoped that this notification may stimulate those who desire to complete their sets, to make early application with a view to expedite the consideration of the question of reprinting by the Council. Notice is also hereby given that the numbers for January and February, 1886, being exhausted, no orders for those copies, nor for complete sets of Vol. V., can be executed.

Authors of communications read before the Society or any of its Local Sections are requested to take notice that, under Bye-Law 43, they cannot receive the prescribed 50 copies of their communications unless they comply with the condition laid down in that Bye-Law—viz., that they give notice of their desire to receive such copies upon their manuscript before sending it to the Editor. Mention should also be made as to whether the Discussion is to be included in the reprint.

CHANGES OF ADDRESS.

Cornelius Beringer; Journals, etc., to 293, Vauxhall Bridge-road, London, S.E.

H. Buckeridge, l/o Crouch End; Leighton Villa, Cheverton Road, Hornsey Lane, N.

G. Chaloner, l/o Green Lanes; 30, Weston Park, Crouch End, N.

P. de G. Coghill, l/o Kensington; 47, Derby Lane, Old Swan, Liverpool

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C. S. Doggett, l/o Munich; Walpole, Mass., U.S.A.

R. F. Foster, l/o Cape Town; Caledon Dispensary, Uitenhage, South Africa.

Dr. H. H. Fries, l/o Berlin; 92, Reade-street, New York, U.S.A.

Edgar Hall, l/o Queensborough; Alexandria Cottage, Merlin Street, St. Leonard's, New South Wales.

W. F. Jack, l/o Neath; 45, Ludgate Hill, London, E.C.

F. Joynson, l/o Connah's Quay; Witton House, Northwich, Cheshire.

J. Lawrence, l/o Glasgow; Standard Explosives Co., Toms River, New Jersey, U.S.A.

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M. Shimose, l/o Insatsukyoku; Heiki-Seizo-Sho, Akabanè, Tokyo, Japan.

Hugh T. Spencer, l/o St. Helens; 104, Thomas Lane, Broad Green, near Liverpool.

Jas. Towns, l/o Canning Town; 71, White Horse Street, Stepney, E.

G. M. P. Vary, l/o Edinburgh; communications to be retained until further notice.

H. G. Warner, l/o Ash; c/o Wallis and Milestone, Garratt Lane, Wandsworth, S.W.

A. W. Warrington, l/o Clapham; Dinglefield, Dingle Lane, Liverpool.

LIST OF MEMBERS ELECTED, JUNE 23, 1887.

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A. Hoegger, Windsor Villa, Victoria Crescent, Eccles, Manchester.

J. H. James, 131, Hopton Road, Coventry Park, Streatham, S.W., mining engineer.

W. C. Matthews, Kerfeid Place, Albert Park, Melbourne, Australia, manufacturing chemist.

George Merrell, Lock Box 786, Cincinnati, Ohio, U.S.A., manufacturing chemist.

Jas. Oddie, School of Mines, Ballaarat, Australia.

David Perry, Forth and Clyde Chemical Works, Kirkintilloch, N.B., manufacturing chemist.

Dr. Otto Pring, Schwarzenberg, Saxony, editor of the *Chemische-technische Zeitung*.

D. Russell, Silverburn, Leven, Fife, N.B., paper maker.

Herbert B. Stocks, 13, Peet Street, Gladstone Road, Liverpool, chemical assistant.

Archibald Walker, 8, Crown Terrace, Glasgow, distiller.

Herbert W. Weld, 41, Albion-place, Mount Auburn, Cincinnati, Ohio, U.S.A., pharmaceutical chemist.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

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The meetings of the London Section will be held on the first Monday in each month.

SESSION 1886–87.

Prospective Arrangements.

July 13, 14 and 15.—Annual Meeting in Manchester.

The meetings of the Session 1887—88 will be resumed on the 7th November next, and will be continued on the first Monday in each month.

FURTHER COMMUNICATION ON ENGLISH-GROWN TOBACCO.

BY ARTHUR WINGHAM, F.I.C., F.C.S.

In a previous communication the results of a few analyses and experiments in connection with some English tobacco, grown by Lord Harris, were laid before this Society. The present paper is a continuation of that communication, and contains the results of analyses of tobaccos grown elsewhere and under different conditions. The samples are four in number, and are numbered 8, 9, 10, 11. Nos. 8, 9, and 10 were grown by Mr. C. De L. Faunce de Laune, near Sittingbourne, and No. 11 by Mr. W. L. Wigan, near Maidstone. The following table shows the average measurements and weights of the leaves :—

	Length.	Breadth at broadest part.	Weight.
No. 8.	24 inches	10¼ inches	7·0 grammes
„ 9.	31 „	11 „	25·4 „
„ 10a.	24 „	12¼ „	18·0 „
„ 10b.	24 „	9 „	16·0 „
„ 11.	18 „	7 „	6·1 „

No. 8. Pale yellow leaves, very similar to Chinese tobacco. Uniform in colour, but lacked body.

No. 9. Large leaves of brown colour, varying in shade. Considerable body and very large mid-ribs and veins.

No. 10. Dull-brown leaves, varying in shade, shape, and size. Considerable body. This was a mixed sample of leaves that had been bulked for some considerable time. It contained two leaves (10b) which were of very good quality, good body, and uniform dull-brown colour; and seven leaves (10a) which were of a mixed character.

No. 11. Mixed sample—some leaves green, and others partly fermented. The fermented leaves were of a dull-brown uniform colour, with plenty of body. Very thick leaves.

The samples were dried at 100° C., and the moisture determined with the following results :—

No.	8	contained	20·7	per cent.	water.
„	9	„	21·4	„	„
„	10a	„	20·8	„	„
„	10b	„	18·8	„	„
„	11	„	14·0	„	„

Unfortunately there was not sufficient of 10b to examine separately, consequently it was mixed with the other portion of sample 10. The weight per square foot of these samples could not be ascertained with any possibility of certainty, on account of variation in shape in the same sample, and also of excessive corrugation in some cases.

The dried leaves were broken down, and the mid-ribs and thick veins removed. The remainder of the leaf, consisting of the fleshy part and the thin veins, was taken for analysis. The ash was first determined with the following results :—

PERCENTAGE OF ASH.

No. 8	21·35%	No. 10	23·23%
„ 9	17·98	„ 11	17·03

The samples burnt much more readily than the samples of English growth described in my previous paper, although there was still a slight difficulty in oxidising the last traces of carbon in No. 8. On first heating, an oil distilled off and burnt with a very luminous flame, especially in No. 9, which gave off a very large quantity. No. 11 evolved an oil which burnt with a less luminous flame, and also emitted objectionable odours, which were no doubt due to the presence of green unfermented leaves in the sample. Little or no self-supporting combustion was noticed, except in No. 10, which did continue to burn slightly when once ignited. The quantities of ash in Nos. 8 and 10 are high; Nos. 9 and 11 being fairly normal.

A complete analysis of the ash was then made in each case, with the following results :—

PERCENTAGE COMPOSITION OF ASH.

	No. 8.	No. 9.	No. 10.	No. 11.
Potash (K_2O)	9·52	9·30	10·14	11·32
Soda (Na_2O)	3·98	2·86	2·40	0·91
Lime (CaO)	37·59	41·41	39·22	35·83
Magnesia (MgO)	3·48	6·32	3·85	3·49
Iron Oxide and Alumina	0·68	0·58	0·56	0·70
Chlorine	9·15	8·70	8·42	9·68
Carbonic Acid (by diff.)	22·68	18·11	18·18	22·67
Sulphuric Acid (SO_3)	5·61	5·64	8·58	5·82
Phosphoric Acid (P_2O_5)	3·24	4·14	2·14	5·25
Silica	6·13	4·87	8·41	6·51
	102·06	101·96	101·90	102·18
Deduct ox. eq. for Cl	2·06	1·96	1·90	2·18
	100·00	100·00	100·00	100·00

It will be seen from the above figures that these ashes have the great fault which was also so marked in the samples of Lord Harris—viz., a high percentage of lime and a low percentage of potash, and the consequent high ratio of the former to the latter. One great advantage, however, that these ashes have over the Faversham samples, is the comparatively low percentage of chlorine. This lower quantity of chlorine would act favourably in rendering the burning of the leaf more easy. The higher percentage of silica is also favourable, although, at the same time, there is an undesirable increase in the sulphuric acid. Iron is also present in these ashes in small quantity.

Lithium was found spectroscopically in all four samples.

Compared amongst themselves, No. 11 may be taken as the best ash; although even this is not by any means of the composition most desired for tobacco. The lower percentage of lime, the higher potash and the higher phosphoric acid are all favourable items in No. 11 sample. No. 9, which was supposed to have been heavily manured with a certain guano, does not appear to differ materially, except in the phoshoric acid and magnesia, from the other samples, 8 and 10, grown in the same neighbourhood.

The total nitrogen in the leaves was determined as described in my previous paper, care being taken to have a large excess of copper oxide present. The following are the results :—

PERCENTAGE OF NITROGEN.

No. 8	9	10	11
3·23	5·71	5·29	6·54

There is a very decided difference between the samples in these figures.

The fleshy part of the leaf in each case was tested for nitrates. No. 8 contained none, while Nos. 9 and 10 contained considerable quantities. No. 11 contained none in the green leaves, but a considerable quantity in the brown leaves. This supports what was previously supposed to be the case—viz., that the nitrates present in tobacco are produced during the process of drying and fermenting.

The nitrate nitrogen was estimated in Nos. 9 and 10 by Schloesing's method of distillation with ferrous chloride and hydrochloric acid afterwards absorbing the nitric oxide by adding pure oxygen potash and pyrogallic acid. The following are the results :—

PERCENTAGE OF NITROGEN AS NITRATES.

No. 9	0·12 %	No. 10	0·31 %

These figures correspond to the following percentages of

POTASSIUM NITRATE IN THE LEAVES.

No. 9	0·86 %	No. 10	2·21 %

The presence of nitrates, I have found, however, is no indication of a good tobacco. It is true that saltpetre will convert a bad tobacco into a material that will smoulder, but in a good and well-fermented leaf the burning quality does not depend on the presence of nitrates. I have examined some of the best samples of foreign leaves, and have found only minute traces of nitrates present. The remaining nitrogen will be referred to hereafter.

The amount of soluble extract was then ascertained by heating weighed quantities with water at 80° C. for one hour, and weighing the dried residue. The following figures were obtained :

	No. 8	9	10	11
Soluble extract (by diff.)	55·95	58·70	52·15	49·84
Residue	44·05	41·30	47·85	50·16

The soluble matter is high in each case, especially so in No. 9, and slightly so in No. 11.

The ash in the residue was then determined and calculated into percentage on original leaf. In this way the following figures were obtained, showing :—

THE MINERAL CONSTITUENTS IN THE LEAF EXTRACTED BY, AND INSOLUBLE IN, WATER.

	No. 8	9	10	11
Ash extracted (by diff.)	17·26 %	14·29 %	13·04 %	11·42 %
Ash remaining in residue	7·09	3·69	10·19	5·61
	24·35	17·98	23·23	17·03

These figures speak very favourably for samples 10 and 11, and fairly well for No. 8, but they condemn No. 9 as being very immature. The superficial nature of the mineral constituents in this sample is very clearly shown, and the leaves, which are very large, are undoubtedly very artificial.

The nitrogen in the residue was also estimated, and the following results obtained :—

PERCENTAGE OF NITROGEN IN THE LEAF EXTRACTED BY, AND INSOLUBLE IN, WATER.

	No. 8	9	10	11
Nitrogen extracted (by diff.)	2·08 %	3·57 %	4·22 %	3·92 %
Nitrogen remaining in residue	1·15	2·14	1·07	2·62
	3·23	5·71	5·29	6·54

The nitrogen remaining in the residue roughly represents that which exists as albuminoids, as the following determinations of albuminoid nitrogen prove, except in the case of No. 10 :

PERCENTAGE OF ALBUMINOID NITROGEN.

No. 8	9	10
1·28	2·18	1·53

The figures in connection with No. 10 seem to point out the existence of albuminoids, not entirely precipitated by water at 80° C. Further experiments are being carried on to ascertain, if possible, the forms of combination in which the remaining organic nitrogen exists.

I intend also pursuing the subject of the organic constituents of tobacco, with a view to ascertaining the changes which take place during the process of fermentation, about which very little of a scientific nature seems to be known. I regret that in the report of the discussion of my previous paper, I am reported as having said that nicotine and nicotianine were not present in the unfermented leaves, and that they were produced during fermentation. I am sorry that I produced that impression. What I intended to convey was—that nicotine was probably not present in the green leaves as nicotine, but was probably there combined with other organic radicals in the form of a glucoside, or something of that nature, and that it was "released," and not "produced," during fermentation. But even this was only a surmise on my part, consequent upon a few peculiar results which I obtained in the earlier period of my investigation.

I think the above results, combined with those previously recorded, will now justify an expression of opinion as to the possibility of growing the tobacco plant in this country. There is not the slightest doubt about the mere growing; the only questions arising are the commercial ones, of its preparation for, and its value in the market. With the last question I will not trouble this Society, and as regards the preparation, or in other words the fermentation, I believe there is very little to fear. The natural difficulties are not so great as not to be within reasonable scientific reach. At present, one season's crop only has been experimented upon, but very important and promising results have been obtained. With the advanced knowledge and experience, I think another series of experiments will very nearly overcome the difficulty of fermentation. The analytical results obtained have pointed out one or two very great errors in the direction of the mineral constituents, and these certainly should be guarded against in the future. I do not desire to say that the quality of a tobacco can be ascertained from the analysis of its mineral constituents, any more than from the quantity of nicotine present, but I do maintain that the quality of its mineral constituents has a decided influence on the burning, and that a better attention to the supply of the natural requirements of the plant in this respect will most likely aid materially the development of the other good qualities. For that reason I have placed the mineral constituents first as regards importance, and in these samples have neglected to a certain extent the organic. The quantities of the mineral constituents present are on the average high, and with their present composition would tell very much against the tobacco, even if the fermentation were complete. It must be confessed that a calcareous soil is not the best on which to cultivate tobacco, but then, on the other hand, it can be argued that if, under existing circumstances, such good results have been obtained, then, under more favourable conditions, and with further experience, one can certainly expect very much more favourable results in the future.

The leaves which I have brought to your notice, both now and previously, are all somewhat immature, especially those in connection with my last paper. The large leaves grown at Sittingbourne are also of a very forced character, although they are very fine specimens, while the smaller and more compact leaves obtained near Maidstone seem to be of a much more natural growth. Whether the artificial nature of a leaf, as regards its organic constituents, is a disadvantage or not is an open question. The result of future fermentation experiments will, no doubt, decide this point, as also the probability of English tobacco cultivation being a commercial success. But it is, in the meantime, necessary to grow the plant under circumstances as closely allied as possible to those of its natural requirements, and to obtain a home grown leaf having, in the first place, an ash of a quality more nearly resembling the known composition of the ash from more naturally grown tobacco, than has been the case with the home-grown leaves examined up to the present time.

I have again to record my best thanks to Dr. Hodgkinson for enabling me to carry out the experiments.

DISCUSSION.

Mr. **Ruffle** was glad that this subject had been brought forward again, because, owing to the alterations in the Budget arrangements, the question of moisture in tobacco would have to be specially determined. While at work upon moisture in another subject, he had made a few experiments on tobacco also, in expectation of the question cropping up. He had not had an opportunity of dealing with pure leaves, but only with such as could be obtained from the shippers. He had found that by drying over dry calcium chloride the loss was not so great as in drying at 212° F. While fully admitting the importance of the results obtained as to the ash, it seemed to him that the character of the organic constituents must influence the character of the tobacco. That was a point which should be further investigated. He had found the results of drying at 212° F. to be sometimes 5 per cent. higher than in drying over calcium chloride. Might it not be that the cellulose, or whatever was the chief organic constituent, of leaves grown under certain conditions was more readily hydrated than when grown under other conditions? If so, such leaves would burn with more difficulty than those not so highly hydrated. The solution of this question might assist in determining the quality of tobacco leaves.

Mr. **Rideal** would like to know more of the early history of these tobaccos; whether they were of the same species, and also what was the nature of the manure used. Judging from the great variation of the author's results, the question of manure was important, and some further information upon that point would greatly help in forming a judgment upon the figures given. He would be glad to know, too, what Mr. Wingham considered to be a normal, or the best, ash. He had always understood that the presence of nitrates had an important influence on the burning of tobacco, but, judging from Mr. Wingham's remarks, it appeared to be otherwise. Chlorides also should affect the ash; and he would like to hear more on that point.

Mr. P. **Carmody** inquired whether the author could state what were the percentages of soda in the various samples, and whether they agreed with those of the samples previously treated.

Mr. **Wingham** replied that the percentages were slightly less, but very variable, being, in the samples before the meeting, 3·9, 2·8, 2·4, and 0·91 per cent.

Mr. **Carmody** explained that he had put the question, because it was well known that in ordinary ash the percentage of soda was always low—less than 1·2 per cent. It had been stated that these leaves were unfermented; and yet they were brown in colour. He had never yet known a brown leaf unfermented. He thought that the change of colour indicated that a change similar to fermentation had taken place. The sample No. 2 appeared to be different in character from the others. It was soft and flabby, and probably contained a good deal of water, and would yield a small amount of ash. As had been already suggested, much would depend on the character of the manure used. If the same manure had not been used on all the samples it would be difficult to compare them.

Mr. J. W. LEATHER pointed out that as yet there had been no opportunity of proving what English-grown tobacco would be like if fermented, the time not having yet arrived for last year's crop to undergo that process. In America, the crops harvested last summer would have been dried during the autumn, and would be fermented this spring. He had himself tried some English tobacco after drying, and had found it anything but nice; but he had no doubt that later on some smokeable English tobacco would be produced.

Mr. WINGHAM, in reply, said the point raised by Mr. Ruffle was of considerable importance at the present moment. It might interest chemists to know that by the new duty regulations 35 per cent. was the maximum moisture allowed in manufactured tobacco, and the authorised process for determination was drying at 212° F. What the difference might be if the determination was made in a vacuum over calcium chloride, he was not prepared to say. If the nicotine were present as a free base, it would probably be volatilised in the vapour of water by drying, and that might account for a slight increase in the moisture as determined at 212° F. It was possible, too, that the results shown by drying over calcium chloride were not correct; for instance, there might be a certain point at which the tobacco itself rather than the calcium chloride would absorb moisture. He did not think the higher percentage was due to hydrated cellulose. Referring to Dr. Rideal's questions, sample No. 8 was described as Kentucky tobacco, not heavily manured. The next sample was described as Kentucky tobacco also, but heavily manured with bat's guano. Little was known of the next sample, except that it was much mixed and had been stored in bulk for a considerable time. This storage would no doubt explain the percentage of nitrates. He did not think a "normal ash" could be defined, there being considerable variation in all kinds. No doubt the presence of nitrates had a decided influence on the combustibility of tobacco. Still their presence in quantity was not essential to a good tobacco; and if one took a good foreign leaf and examined it for nitrates, the chances were that one would find very small traces present. It might be expedient for manufacturers to introduce nitrates, but the effect was to render the tobacco quick-burning and hot. Chlorides also had a great influence on the burning qualities of the tobaccco. In the leaves grown by Lord Harris, chlorine was found far in excess of the amount required by the potash and soda. Consequently a considerable quantity combined with lime, producing calcium chloride. This fused in the burning of the leaf, clogging the carbonaceous matter, and preventing the oxidation of the last traces. If the chlorine was not in excess of the amount required by the soda and potash, probably little harm would be done. In burning the samples under consideration, the clogging effect had not been noticed, although 9 per cent. of chlorine was present. He had been much struck by the amount of soda found in Lord Harris's samples, but the ground on which they were grown had been manured with common salt. This would doubtless account for both the soda and the chlorine. The samples under notice were not manured with salt, and were grown on a chalky soil. It was erroneous to suppose that the brown colour of tobacco was an indication that fermentation had taken place. On the other hand, he had seen it stated that tobacco leaves could not be dried at all without becoming brown. That also was a mistake, since one of the dried samples under notice was green. The flabbiness of sample No. 9 was due to wear and tear. It had moreover been heavily moistened that day. If it were dry, it would be very crisp. He quite agreed with Dr. Leather's remarks about fermentation. It would be most unfair to compare these leaves with foreign tobaccos kept perhaps for two or three years. These leaves did not pretend to be thoroughly fermented. The process of fermentation involved many operations and much time. No doubt if these leaves were packed away under considerable pressure for a summer, as foreign leaves were, they would be much improved. He had tried some of this tobacco, especially No. 10 sample, which had been stored for some time, and whether in a pipe or as cigarettes, it was by no means the worst he had smoked. He thought, therefore, there was good hope for the future of English tobacco.

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Meeting held May 16, 1887.

MR. B. E. R. NEWLANDS IN THE CHAIR.

DISCUSSION ON MR. JOHN RUFFLE'S PAPER ON "A NEW METHOD OF ESTIMATING MOISTURE IN SUPERPHOSPHATES AND SIMILAR FERTILISERS."

THE CHAIRMAN considered the paper a most important contribution to the proceedings of the Society, and that the author's wide experience of the subject would ensure it respectful attention. The fact that the water in superphosphate was driven off under certain circumstances and not under others, was undoubtedly of importance in considering its mode of estimation. In making superphosphate, the mixture gave rise to a high temperature—considerably above that at which sulphate of lime would hydrate. Therefore, the water could not combine in the mixer or "den;" and before the temperature was sufficiently reduced for combination to occur, the whole mass became solid, and the water was thus locked up. If the superphosphate were pasted, the particles were brought closer together, and the sulphate of lime thus became hydrated, and the mass would set as plaster of Paris. In drying at 212° F., the water was given off at such a temperature that the sulphate could not catch it in its progress. But by Mr. Ruffle's process the water was taken out at a low temperature, and in its struggle to get out it saturated the sulphate to its full extent. Thus the result obtained in the latter case was less than that obtained by drying at 212° F. One of the tables in Mr. Ruffle's paper showed the composition of prepared superphosphates. In this table, "soluble oxide of iron," "soluble alumina," and soda were mentioned as existing as sulphates, and the amount of water of crystallisation assumed to exist in each salt was stated. If this were the case, it was obvious that at a comparatively low temperature efflorescence would occur, and the water of crystallisation would be given off, especially in vacuo. Therefore, the process would of necessity estimate the quantity of water existing in the form of these sulphates, and thus a slight error would arise.

Mr. F. NETTLEFOLD said that in analysing a certain boiler residue he had found $CaSO_4.H_2O$ to be present, and he further found that this body split up on heating it to 212° F. He would be glad to have Mr. Ruffle's opinion as to whether the presence of this hydrate would affect the estimation of water in superphosphate.

Mr. Crowder said the paper was well worthy the serious attention of the members, as coming from one whose work had given him an European fame. He had studied the figures given as far as time had permitted, and he could certainly say of some of the experiments that they confirmed results which had been obtained in his own laboratory. For instance, Mr. Ruffle had found that the soluble P_2O_5, and even the total P_2O_5, was affected by raising the temperature, and that "drying without rise of temperature did not affect the soluble nor the total P_2O_5;" and these results were quite in accordance with his own experience. Mr. Ruffle had said that a drying of from 5 to 7 hours was necessary in order to arrive at constant results. The decision of the percentage of moisture in superphosphates was a matter which had bothered him considerably. He had sometimes had to send out superphosphate, and questions had arisen as to its dampness. He usually reckoned about 15 to 15½ per cent. was the normal quantity in superphosphate, such as was made from Carolina phosphate. Of course the results obtained by drying in vacuo would be much more accurate; still, as the process took 24 hours, he was not certain that it would be much more advantageous than the rough-and-ready determination by means of the water bath, which could be done in two hours. With reference to Mr. Ruffle's difficulty in finding a good air pump, he might mention that he had found the Körting pump thoroughly satisfactory. He quite concurred with Mr. Ruffle's view that the phosphoric acid in these superphosphates was principally in the state of free phosphoric acid and not monocalcic phosphate. That question had in fact been settled some ten or twelve years ago by Professor Way. He did not think the lime was ever present in any quantity as acid-phosphate; it was always in the form of sulphate. He could not understand Mr. Ruffle's difficulty in determining the free sulphuric acid. If superphosphate were treated by absolute alcohol, any free sulphuric acid present would be detected. In conclusion, he would mention a curious and awkward experience which occurred to him some years ago in the manufacture of high-class superphosphates. On one occasion, in boiling the superphosphate down in an overshot pan, he suddenly found that the whole mass had solidified. The fires were immediately drawn and the pan cooled down, when it was found that the whole had solidified into a substance resembling green glass, which was insoluble in water, in acids and in alkalis. It was recovered by fusion into phosphoric acid. It was nearly free from lime, just as Mr. Ruffle had found the filtrate from the washing of the superphosphate. (Mr. Crowder exhibited a piece of this solid material, which resembled flint in appearance.)

Mr. Mumford desired to make a few remarks of a practical rather than a chemical character. Everybody who was concerned in the subject under discussion, would recognise the importance of having, in these days of keen competition, some universally-adopted method for the determination of moisture. He was not vain enough to suppose that people engaged in industrial chemistry would ever be able to dictate to scientific men with respect to their methods of determining the constituents of the articles they turned out; but he did think that in the case of such a constituent as moisture, some universal mode might be arrived at and adopted. In speaking of the advantages of testing for moisture by the rough-and-ready method of the water bath, Mr. Crowder had lost sight of the fact that, to save postage, very small samples were sometimes sent to the analyst, who was frequently required to make a complete analysis therefrom. The chemist might, therefore, be tempted to determine the moisture and the soluble phosphoric acid from the same identical portion of the sample. If he determined the moisture in the water bath at 212° F., he would cause a precipitation of the soluble P_2O_5, and the manufacturer would thus be mulcted not only in the excess of moisture shown by the one test as compared with the other, but also in the deficiency of the soluble phosphoric acid reverted by the method of determination. Mr. Ruffle's method, however, appeared to leave the soluble phosphoric acid as it was before the determination. He had himself some years ago endeavoured to dry on a practical scale a quantity of carefully prepared superphosphate. His first difficulty was to find a place having a constant temperature, and also large enough to permit of a test on a practical scale. At last he found a chamber over a boiler, where there was a constant temperature of 160° F. After carefully weighing, drying and sampling the superphosphate, the loss was determined. He then calculated the cost of producing such a superphosphate, taking into account the extra labour for manipulating it. On a sample being tested, however, he was astonished to find that even at the low temperature employed, a considerable loss of soluble phosphoric acid had occurred. He had of course not calculated on this, and had his estimate been acted on, a contract would have been made at great loss. This experience showed the necessity for great caution in such matters. He had thought that as moisture could be determined at 212° F., he was quite safe with a constant temperature of 160° F.; but the reverse was the case. He hoped that the outcome of this paper and discussion would be the adoption of some universally-recognised method of estimating moisture, and that manufacturers would thus be rid of the great difficulty which existed at present.

Mr. J. W. Leather said the last speaker had anticipated much of what he had intended to say, but from a different point of view. Was it really so important whether one determined the water at 100° C. or at no degrees. Of course the consequence of determining the water at 100° C. and at the atmospheric temperature would be to obtain different results; because, in the first case, one would drive off a proportion of the water of crystallisation of certain salts, and in the second case one would not. He had, however, never heard of an analyst determining the soluble phosphoric acid and the water of a superphosphate from the same portion. He would be glad to know what Mr. Ruffle meant by a vacuum. The term was of itself vague, and might mean any number of millimetres pressure. Would Mr. Ruffle say, too, whether he used a water or a mercury pump; and if the latter, how many millimetres of mercury the pressure in his receiver registered.

Mr. Bernard Dyer could corroborate what Mr. Ruffle and Mr. Crowder had said respecting free acid in superphosphate. He had often been asked to say how much free sulphuric acid was present, and had sometimes irritated manufacturers by saying there was none or only a trace. He had devised the alcohol method mentioned by Mr. Crowder for his own use, and thought he had hit upon something new; but found it had been in use previously. For ordinary purposes, however, good methylated spirit was as suitable as absolute alcohol. It had been known for some time that the text-book statements as to monocalcium phosphate were to some extent chimerical; and that the conventional methods of expressing their analyses were not scientifically accurate. Except as a point of scientific interest, however, that did not much matter, seeing that the soluble phosphoric acid was really the basis of the analyses. Referring to the table showing the moisture determinations of Sombrero and Carolina superphosphates by drying for five hours in the natural and beaten-up states, he would like to ask whether it was to be understood that the weights became constant at four or five hours, or whether Mr. Ruffle simply stopped the experiments then. In the case of the Sombrero sample, there was not a vast difference between the moisture in the natural state and the beaten-up moisture at the end of five hours. Possibly the mechanical difficulty had come in in these tests. When manure was beaten up to a paste, a dry pellicle formed upon it, in the same way as in the analogous case of drying a sample of sugar, so that the water might be mechanically kept from escaping. However, this question was quite apart from the main purpose of the paper. Mr. Ruffle's method and results were most interesting, and it would certainly seem that there might be an advantage in adopting his process; but a general agreement to do so would be necessary among chemists, or the conflicting figures of different analyses would be very annoying to the trade. It was undoubtedly, however, always more satisfactory when chemical analyses could be stated on an exact scientific basis. What was at present meant by "moisture" in most analyses was clearly not actual free water, but water which was driven off at 212° F. He would like to see further experiments, with the purpose of showing how far, for any one class of superphosphate, the difference between the absolute moisture and the conventional loss at 212° might be constant. Probably some analysts would adopt this new method at once, and others only by degrees; and in face of this possibility, misunderstanding might perhaps be avoided by stating on the analyses: "Moisture (loss at 212°)," or "Moisture (loss *in vacuo*)."

In reply, Mr. Ruffle said with respect to the question as to the soluble alkalis shown in Table 5 being sulphates, he thought he had succeeded in showing them to be not sulphates but phosphates. As there was not sufficient sulphuric acid found in the filtrate to combine with the iron, magnesia, etc., as sulphates, they must have been phosphates. He could quite understand Mr. Crowder's and Mr. Dyer's remarks about the constancy at 212°. It was always difficult to get out of an old groove: but he would ask makers to bear in mind that the question "What amount of moisture will you guarantee?" had already come across the water. Competition was now very keen; and if one man would not guarantee the correct moisture, another would. From the chemical point of view the old method would be beaten, and the water bath would have to be abandoned for something else. If chemists were asked to determine moisture they should do so to the full extent of their ability. So long as they knew nothing better than the determination at 212°, they were right in using it. But if they had now another method, and found that the result obtained at 212° F. was not absolute moisture, they should cease to call it so. The question of what was true moisture in superphosphate still remained. Buyers sometimes would refuse to accept a parcel on account of its being "too wet." The seller would then send a sample to a chemist; but how was he to determine whether it was too wet by reason of an excess of water having been put in, or whether the manure was merely out of condition from other causes. The manufacturer had no doubt intended to be correct, and the right proportion of O. V. had been used; but the men had perhaps run in too much water with the O.V. If the analyst wanted to find out whether the manure had been correctly mixed, how could he do so by testing at 212°? If, however, he carefully calculated it out by the calcium method, he probably would be able to tell. With all respect to Mr. Crowder, he could not admit the correctness of the method employed by him for estimating the amount of free sulphuric acid. One had in these manures a more or less concentrated solution of phosphoric acid, lime and sulphuric acid. Some of that lime might be combined with the phosphoric acid—at any rate, one could not prove that it was not. To that solution of water, phosphoric acid, lime and sulphuric acid, alcohol was added. A precipitate of sulphate of lime was thus got. But how could one prove that that sulphate existed before the alcohol was put in? Might it not have been formed by the sulphuric acid combining with the lime after the addition of the alcohol, and thus producing an insoluble sulphate of lime? If so, the really free sulphuric acid would be put too low. He was glad to learn that the results worked out by him as to the effect of temperature had been confirmed practically. As to whether a correct determination of water was necessary or not, he thought it was. Such determinations were more and more appreciated technically, and would, he thought, be in time generally required. In reply to the question as to the vacuum employed, he had taken an ordinary Tate's air pump, and had worked it until he could produce no further vacuum. He had attached a mercury gauge, but had not measured off the exact number of millimetres registered. The difference between the two limbs of the gauge was about half-an-inch, and on leaving the pump for 24 hours he found that the mercury in the higher limb had not gone up $\frac{1}{8}$in. That was practically the utmost limit that could be obtained, and that was what he had adopted. The figures in Table 4, queried by Mr. Dyer, were not constant. They simply showed the loss obtained in so many hours. As stated in the paper, these samples were taken from large heaps, and were dried at 212° F., both in the natural and in the beaten-up state; and these figures had been given in order to show that the results obtained from actual samples of ordinary superphosphates made on a large scale agreed with those which he had got from samples of known composition, and that they might therefore be accepted for guidance practically. It had been suggested that there might be a constant margin between the absolute moisture of a superphosphate and that determined at 212° F. He did not think so. If the phosphate employed was always of the same quality, and if the same quantity and strength of acid was always used, the margin might be constant. But inasmuch as phosphates varied in quality, they would carry different quantities of acid. And, again, whereas one maker would mix with 105 acid, because he could not get a stronger, another would use 120 acid, because he had it, and it was convenient. But the analyst would know nothing of these differences of preparation. Sooner or later one method or the other must be adopted, and he did not doubt that it would be that one which was most correct.

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NOTES OF A RECENT VISIT TO SOME OF THE PETROLEUM PRODUCING TERRITORIES OF THE UNITED STATES AND CANADA.

BY BOVERTON REDWOOD, F.I.C., F.C.S.

A large proportion of the crude petroleum produced in the United States is still obtained in what is known as the Bradford district. This oil territory, lying partly in central and northern McKean County, Pennsylvania, and partly in southern Cattaraugus County, New York, has an area of 133 square miles, 121 square miles of which are included in the Bradford field proper. The development of this territory dates from the year 1874, when the first successful well was drilled, and four years later—viz., in December, 1878—the average daily production of the Bradford district was no less than 23,700 barrels (of 42 American gallons) or about four sevenths of the total daily production of the State of Pennsylvania. Two years later still the Bradford district supplied 63,000 barrels per day, out of a total production of 72,215 barrels per day. During recent years there has been a steady decline in the production of this prolific territory, notwithstanding the efforts made to maintain the output. Up to January, 1885, the Bradford district was estimated to have yielded 109,000,000 barrels, an average of about 820,000 barrels per square mile. The total productions of the oil regions of Pennsylvania and southern New York up to the same date has been given on the authority of Stowell's statistics as 260,990,435 barrels. In December last there were in the Bradford district, according to Stowell, 13,505 old wells with an aggregate daily production of 17,887 barrels (1⅓ barrel per well), and 16 new wells with an aggregate daily production of 100 barrels (6 barrels per well).

During the past year the attention of petroleum producers has been chiefly centred on the Washington field in Washington County, Pa. In December, 1884, a well was drilled on the Gantz farm, in this field, by the Citizens' Fuel Company, with the object of obtaining natural gas for use as fuel. At a depth of 2200 feet, oil, and not gas, was obtained, and this discovery at once led to the drilling of other wells. In August, 1885, a flowing well known as the Gordon well was completed, and in the following year several other exceedingly productive flowing wells were drilled, one of the number, the Thayer well, yielding 2000 barrels per day. The production of the Washington field reached its maximum of 16,000 barrels per day in August last, and had declined to 8000 barrels per day at the end of the year. Stowell gives the aggregate daily production of the Washington field in December last as 7720 barrels from 180 old wells (43 barrels per well), and 2560 barrels from 33 new wells (71 barrels per well).

The daily production of the various oil-fields of Pennsylvania, New York and Ohio (expressed in barrels of 42 American gallons) on the 1st January, 1886, and 1st January, 1887, was as follows :—

	1887. Jan. 1.	1886. Jan. 1.
Allegheny	5,800	6,400
Bradford	24,600	29,000
Kane	1,500	80
Cherry Grove	210	400
Cooper	450	750
Balltown	650	1,200
Grand Valley	2,100	*
Cogley	1,600	5,200
Tarkill	1,750	*
Baldridge and Thorn Creek	2,000	1,400
Red Valley	800	*
Pontins	2,800	*
Oil Creek, Tidioute, Clarion, Armstrong, Warren, etc.	11,500	11,500
Washington	8,500	250
Shonstoun	3,300	60
Macksburg	1,300	1,900
Totals	71,390	63,140

The yearly production of crude petroleum in Pennsylvania and the contiguous States from the beginning of the year 1859 to the end of last year is given in the following table in barrels of 42 American gallons :—

1859	5,000	1873	7,878,629
1860	500,000	1874	10,950,730
1861	2,113,000	1875	8,787,506
1862	3,056,000	1876	9,175,906
1863	2,611,000	1877	13,490,171
1864	2,116,000	1878	15,165,462
1865	2,497,000	1879	19,741,661
1866	3,597,000	1880	26,562,000
1867	3,347,000	1881	28,447,115
1868	3,583,000	1882	31,051,165
1869	4,210,720	1883	24,090,000
1870	5,673,195	1884	23,520,817
1871	5,715,900	1885	21,600,651
1872	6,531,675	1886	25,816,000

During the past year the consumption of United States crude petroleum, produced in the districts referred to, has been as follows :—

	Barrels.	Barrels.
Total deliveries from the oil regions	26,803,400	
Deduct total exports	16,431,300	
Total home consumption		10,372,100
Total exports from the United States	16,431,300	
Add decrease in European Stocks †	150,000	
Total foreign consumption		16,581,300
Average daily home consumption	28,400	
Average daily foreign consumption	45,100	
		73,800

The consumption of crude petroleum for the year 1886 thus exceeded the production by more than 2000 barrels per day, the deficiency being supplied from the stocks. These stocks, held by the storage companies, at the end of the year 1886 amounted to 34,156,605 barrels. The average price of crude petroleum in the United States during 1886 was 70⅝ cents. per barrel.

The wells in the Washington field being several hundred feet deeper than those in the older fields, and being constructed in accordance with the most modern principles of drilling, may be taken as illustrating to the fullest extent the development which has taken place in this important branch of mechanics, and it will therefore be interesting to consider the details of construction of these wells.

The derrick employed does not differ materially from those erected in the older fields, but is of somewhat greater height and strength, the greater depth of the wells necessitating the use of longer and heavier drilling tools. The structure is usually about 80ft. in height by about 20ft. square at the base, and is strongly braced by diagonal stays. The stems of the drilling tools are 4in. in diameter, and the "string of tools," as it is called, consisting as usual of "bit," "auger stem," "jars," "sinker-bar," and "rope-socket," is frequently from 65ft. to 70ft. in length, and weighs from 3000lb. to 3500lb. The well is commenced by inserting a wooden "conductor," or iron "drive pipe," which extends from the surface, through the soft ground, to the top of the first stratum of rock. The drilling is then commenced, and it is usual in the Washington field to use for the upper part of the well a drill 13in. in diameter. As the drilling proceeds the well is "cased" to support the walls, and to exclude water. The casing employed for the upper part of a well drilled with a 13in. bit consists of strong iron tubing, 10in. in internal diameter, carefully screwed together in lengths of 17½ft. to 20ft. When this 10in. casing cannot be lowered any further the drilling is continued with a smaller bit, and casing of a corresponding diameter is inserted. A further reduction of size is usually made before the well is completed. Thus a well which I visited was commenced with from 16ft. to 18ft. of wooden conductor, and contained, on being finished, 682ft. of 10in. casing, 1060ft. of 7⅝in. casing, and 1750ft. of 5⅝in. casing. Each "string" of casing extends downwards from the mouth of the well, and

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* Not specified January 1, 1886.

† The statements of stocks at foreign ports other than European had not been received when this table was compiled.

the upper part of the well is therefore lined with three thicknesses of iron, the casing of such a well thus requiring nearly three-quarters of a mile of iron tubing.

The average depth of the wells in the Washington field is 2400ft., but at the time of my visit there was one well producing which was of the depth of 2595ft.

Only the most experienced drillers are able successfully to cope with the difficulties attendant upon drilling to such a depth as 2400ft., and even workmen of the highest skill occasionally fail, for there are wells in this field which have been abandoned with three sets of tools in the bore, after fruitless exertions in "fishing," as the operation of raising or attempting to raise the lost tools is termed. The chief difficulty arises from the caving of the rock as the drilling proceeds and before the casing is inserted. The average time occupied in the drilling of a well in the Washington field is about four months, and the cost of each well is as much as £1600. In the Bradford field the cost of a well was usually estimated at from £500 to £600. Drilling is paid for in the Washington field at the rate of 7s. to 8s. per foot, as compared with 1s. 10d. to 2s. 5d. in the Bradford field. At this rate of payment, the well-owner furnishes the derrick (which costs about £100), the boiler, of 25 h.p. (costing about £100), the engine, of 20 h.p. (costing about £40), and the connections (costing about £20), while the drilling contractor uses his own cable and tools, and finds coal and labour. Occasionally the contractor provides the engine, boiler, and connections, and then is paid at a higher rate for each foot drilled. The gang consists of two drillers (who receive from the contractor 16s. each per day) and two tool dressers (who are paid 14s. each per day). The drillers and tool dressers work in pairs as a day and a night shift, so that the work proceeds continuously. The well owner is usually the lessee, for oil-producing purposes only, of the land. Oil leases in the Washington field are as a rule for five years, or as much longer as oil or gas is produced in paying quantities, and almost invariably it is provided by covenant that the lessee is to commence development within a year, or in some cases two years, or in lieu thereof is to pay a stipulated rent per acre. The landowner, or farmer, retains the right to use the land for agricultural purposes, the oil-lessee being entitled only to so much of the surface as he may require for the purpose of petroleum production, and for ingress and egress. The terms of such a lease frequently are that the lessor receives a cash payment of £20 per acre (if the district has already produced oil) and one-eighth of the oil produced (in kind).

The wells are invariably torpedoed on the completion of the drilling, with the object of shattering the oil-bearing rock, and increasing the flow of oil. The torpedo employed consists of a shell of tin-plate filled with nitroglycerine. In the Washington field it is a common practice to torpedo a well several times, with increasing quantities of the explosive, the final charge amounting to 80 quarts, or in some cases as much as 100 quarts. The nitroglycerine is manufactured in the neighbourhood in a manner which, it may be confidently asserted, would not receive the approval of Her Majesty's Inspectors of Explosives, and is conveyed to the well in tin cans, holding from six to eight quarts, placed in padded compartments in a spring waggon. The torpedo cases or shells are usually about 10ft. in length by 3½in. in diameter. Such a case holds 20 quarts, and accordingly as many as four are employed when a charge of 80 quarts is to be exploded, the cases being successively lowered into the well as they are filled with nitroglycerine. The torpedo was formerly provided with a percussion firing head, and was exploded by dropping a "go-devil" or cast-iron weight into the well, but owing to the increased size of the bore of the wells this method of causing the explosion has been superseded by the use of a "go-devil squib," which is practically a miniature of the torpedo, provided with a percussion firing head, and suspended in the well in proximity to the torpedo proper by means of a cord on which a perforated leaden weight runs. The weight being dropped is guided by the cord to the head of the squib, and the explosion of the small torpedo being thus effected, that of the large torpedo immediately follows. The torpedo is generally fired under about 50ft. or more of water. The distance from the surface of the ground being so great, little or no sound is heard when the explosion occurs, but a slight tremor of the ground is usually felt, and the water and oil in the well are projected upwards to a great height.

Nearly all the wells in the Washington field are flowing wells, the flow usually being continuous. The maximum regular yield per well is probably from 600 barrels to 700 barrels (20,160 to 23,520 imperial gallons) per diem, but one well in this field is estimated to have given 3600 barrels (121,000 imperial gallons) per 24 hours for about a week after it was completed. In consequence of the great expense of drilling in the Washington field, no well which yields less than 100 barrels (3360 imperial gallons) per day is considered to pay, at the present price of crude oil.

Most of the crude petroleum produced in the Washington field is what is known as amber oil. Prior to the development of this field, such oil had never been found in large quantity, and petroleum experts accordingly predicted that the Washington field would not be found to be very productive, but subsequent experience demonstrated the small value which such predictions in matters relating to petroleum production possess. I have on the table an interesting representative series of samples of crude petroleum from the Washington field. The character of these samples is indicated in the following table :—

No.	Name of Well.	Sp. Gr.	Colour.
1	Mulholland, McKeevor & Co.'s Lead Works Lot	0·790	Yellow
2	Cameron, 1	0·777	,,
3	The Caldwell and Marsh	0·798	Amber
4	Union Oil Co., McGovern	0·798	Yellow
5	The Weaver, No. 1	0·800	Amber
6	The Munhall & Smithman, R. D. Wylie	0·804	,,
7	The Shirls, No. 1 Shirls Company	0·792	Yellow
8	The People's Light and Heat Co., Gordon, No. 1	0·819	Amber
9	Gordon, No. 2	0·775	Yellow
10	Gordon, No. 4	0·820	Amber
11	The People's Light and Heat Co., Hess, 2	0·801	,,
12	Vandergrift, Weirich, No. 1	0·816	Brown
13	Cradle Factory, Miller and Guffey	0·811	,,
14	The Hallam and Co., on the Clark	0·828	,,
15	Coast and Sons, on the Weirich	0·792	Dark brown
16	Vandergrift, No. 1 Barre	0·788	Yellow
17	Vandergrift, No. 2 Barre	0·771	,,
18	Hall and Co.	0·801	Amber
19	The Gabby, Pew and Emerson	0·799	,,
20	The Manifold, Pew and Emerson	0·780	Dark brown
21	Willets, No. 1	0·777	Yellow
22	,, No. 3	0·771	,,
23	,, No. 5	0·786	,,
24	Union Oil Co.'s No. 1 Taylor	0·772	,,
25	Coast and Sons, Hayes	0·772	,,
26	McKinney Brothers' Montgomery, No. 1	0·797	Amber
27	Thayer, No. 1 Clark	0·792	,,
28	,, No. 2 Clark	0·811	,,
29	Belmont Oil Co.'s Smith, No. 1	0·808	,,
30	Citizens' Oil and Gas Co., The Gantz	0·820	Dark brown

The odour of all the samples is moderately strong, but not disagreeable.

The specific gravity and colour of a representative series of samples from the older fields placed on the table for comparison are as under :—

Name of Field.	Sp. Gr.	Colour.
Bradford	0·810	Reddish brown
,,	0·819	,,

Name of Field.	Sp. Gr.	Colour.
Parker (Clarion)	0·797	Reddish brown
,, (Karns City)	0·789	,,
Thorn Creek	0·802	,,
Stoneham	0·802	Dark amber
Macksburg	0·829	Reddish brown

The crude petroleum found in the Washington field contains a considerable quantity of solid hydrocarbons, which to some extent crystallise out in cold weather. A sample of the paraffin which thus separates is exhibited.

I have also on the table a number of specimens of the oil sands from the same field, of which the following is a description:—

1. "Manifold" sand. Small red and grey particles in equal proportions.
2. "Gantz" sand. Black, grey, and white particles in equal proportions.
3. "Fifty foot" sand. Of a pale brown colour.
4. "Stray" sand. For the most part of a greyish colour, but with a few reddish-coloured particles intermixed.
5. "Gordon" sand. Similar to the "Gantz" sand, but of finer grain.

The following is the record of a well on the Israel Weirich farm in the Washington field, showing the depths from the surface and the thicknesses of the oil sands met with:—

	Depth.	Thickness.
Top of "Big" or "Mountain" sand	1,433ft.	240ft.
,, "Gantz" sand	2,080	30
,, "Fifty-foot" sand	2,187	50
,, "Stray" sand	2,379	24
,, "Gordon" sand	2,404	35

The decline in the production of the Bradford field has given rise to some apprehensions of an approaching scarcity in the supply of crude petroleum in the United States, but although there are no indications which warrant the belief that another equally prolific territory will be discovered, it is certain that petroleum exists in very considerable quantities in many States of the Union, besides Pennsylvania and New York. The petroleum of Ohio has already been referred to. The oil found in the Lima field in this State is described by Professor Orton, State Geologist of Ohio, as a "black, sulphuretted and rather heavy" oil. The specific gravity appears to range from 0·818 to 0·843. Considerable difficulty has been experienced in producing from this petroleum an illuminating oil of good quality. Petroleum is also obtainable in large quantities in West Virginia, Kentucky, and Tennessee. It is also found in Alabama, Florida, Michigan, Illinois, Indiana, Missouri, Kansas, Louisiana, Nebraska, Montana, Wyoming, Dakota, Colorado, New Mexico, and California.

The Governor of Wyoming, in a report to the Secretary of the Interior, dated 1885, states that the most extensive oil basins of the territory lie east of the Wind River, and north of the Rattlesnake range of mountains, the principal deposits being apparently located in the Fort Washakie, Lander, Shoshone, Beaver Creek, Big Horn, Rattlesnake, Seminole and Laramie ranges. A trial well drilled in the Shoshone basin to a depth of 72ft., is stated to have yielded at the beginning of the year 1885, 40 barrels (of 42 American gallons) of oil per 24 hours.

I had occasion some time ago to examine a number of samples of crude petroleum from the Shoshone basin in Wyoming, and found them to possess the following characters:—

No of Sample.	Sp. Gr.	Colour.	Odour.
1	0·912	Very dark brown	Strong and disagreeable
2	0.912	,,	,,
3	0.912	,,	,,
4	0·910	,,	,,
5	0·911	Brownish black	Slight and disagreeable
6	0·911	Very dark brown	Strong and disagreeable
7	0·915	Brownish black	Slight and disagreeable

The yield of commercial products from Samples Nos. 6 and 7, portions of which are on the table, I found to be as follows:—

No.	Naphtha.	Kerosene.	Intermediate and Lubricating Oils.	
6	2·5	27·5	52·5	per cent.
7	none	10·0	72·5	,,

Considerable attention has been given to the development of the petroleum resources of California, the local demand being, to some extent, supplied with refined oil, manufactured in the State from native crude petroleum, and I was glad to have an opportunity last autumn of visiting the principal producing territory, situated in Pico Cañon, near the city of Newhall, in Los Angeles County. The existence of oil in this locality was discovered by Andreas Pico prior to 1857, but the development may be said to date from 1869, when the Pico well was drilled. It was not, however, till 1875 that drilling was actively commenced. Petroleum is also obtained in Ventura County, California, near Santa Paula, where drilling was commenced in 1874; from a small group of wells in the Santa Cruz mountains; from Puente, east of Los Angeles, where drilling first took place about 18 months ago; and in still smaller quantities from several other localities in the State of California. I was informed that the oil produced in the Ventura territory, which is from 35 to 40 miles west of Newhall, is conveyed by pipe to the seaboard, and thence in tanks by steamship to San Francisco, where it is refined. I was not able to ascertain the production of this territory, but I presume that it is very small, and I was told in San Francisco that the oil being refined there at the time of my visit all came from Pico Cañon. The quantity of crude oil found in the Santa Cruz mountains is as yet very limited, the production not exceeding from 10 to 15 barrels per day. The oil is stated to have a specific gravity of 40° B. (0·830), and to contain a good deal of paraffin.

In the ravine at Newhall we found a little colony, where Mr. Mentry, the manager at the wells, and the workmen reside. The wells number 16 in all, and are from 700 to 2000ft. in depth. The petroleum is found in the tertiary formation in sandstone, but there do not appear to be any well-defined oil-bearing strata, the oil being found in greater or less quantity at almost all depths. The oil-belt at present defined has a length of about two miles, and is about a quarter of a mile in width. The individual yield of the wells ranges from five to seven barrels up to 40 barrels per day, and the aggregate production is stated to be 500 barrels per day. The oldest of the wells was drilled about 10 years ago, but has been deepened since, and all the wells are still yielding. Only one of the wells is classed as a flowing well, but we were informed that all would flow if the gas pressure were allowed to accumulate. The flowing well was drilled about four or five years ago, and was at first pumped for about five months, but it has since flowed at intervals of about 20 minutes, and now yields 40 barrels per day. We saw this well flowing, and observed that the discharge took place with considerable force for the space of nearly five minutes. Each well is connected with a cylindrical iron vessel, through which the oil passes, and where the gas which escapes with the oil is collected and used as fuel, the steam boilers being heated exclusively with this natural gas. All the wells, with the exception referred to, are pumped once a-day, a 1¾in. pump with 24in. stroke, worked in the usual manner through the medium of the rocking beam, being employed. Mr. Mentry stated that the oil did not, as a rule, vary greatly in quality, but one well (No. 13) yielded an oil containing so large a proportion of solid hydrocarbons, that difficulty was sometimes experienced from the clogging of the pump tubing with paraffin. I obtained an average sample of the crude petroleum, to which I shall have occasion to refer later. The oil passes from the wells to a receiving tank holding 25,000 barrels, and is thence conveyed, partly by gravitation and partly by pumping, through a 2in. pipe to Newhall, where it is run into tank waggons on the railway for conveyance to San Francisco. The whole of the Pico Cañon oil-field is now under the control of the Pacific Coast Oil Company, though there are still some separate subsidiary interests. The Company have not drilled any wells recently, but they contemplate making further developments at an early date. The derricks used are 72ft. in height, and the wells are usually commenced with a bore of 10 to 12in., but this is necessarily reduced, on account of "caving," as the drilling proceeds, and although efforts are made to complete the well with a diameter of not less than 5⅝in., some of the wells are at the bottom only 3¾in. in diameter. What is known as a "stove-pipe" casing of sheet iron is generally used instead of a wooden conductor in starting the well, and this casing is commonly from 10 to 20ft. in length. The wells are cased throughout, but are frequently not provided with any arrangement for shutting off the water, which is met with at a depth ranging from 100 to 300ft. The drilling is exclusively conducted with cable tools, and the wells are never torpedoed. It takes from four to five months to drill to a depth of 1500ft. under favourable circumstances in the Pico Cañon. Before drilling was commenced in this locality attempts were made to obtain petroleum by driving tunnels of 20 or 30ft. in length into the hill side, and our attention was called to one of these tunnels, from which, at one time, about half a barrel of oil per day was obtained, and from which we saw a small quantity of petroleum still flowing.

While at San Francisco we visited the refinery of the Pacific Coast Oil Company, situated at Alameda Point, 11 miles from San Francisco. There is a small refinery at Newhall where a portion of the crude petroleum from Pico Cañon is distilled, but the refinery at Alameda is the only one in California where finished kerosene is made. The present capacity of this refinery is about 500 barrels of crude oil per day, but the works are situated in an enclosure of considerable size, and it would be easy to increase the plant. At the present time, however, only the oil produced in the Pico Cañon is being refined, much of the oil found in California being a black heavy oil, not available as a source of kerosene, and the existing arrangements are amply sufficient for dealing with this. The crude oil, which has a specific gravity of 39° to 40° B., is stated to yield about 44 per cent. of kerosene of good burning quality, having a specific gravity of 44° B., and a fire-test of 110° F., but as much as 65 per cent. of 110° test oil can, it is said, be obtained. Of what is known as water white oil, of a nominal fire-test of 150°, the crude petroleum is stated to yield about 20 per cent. The yield of naphtha is given as about 15 per cent.

I have examined and subjected to fractional distillation the sample of crude petroleum which I brought from Pico Cañon. The petroleum has a specific gravity of 0·844. It is dark brown in colour, and has a rather pleasant odour. It yields, by the method of distillation I am accustomed to adopt—

Naphtha	15 per cent.
Kerosene	45 ,,
Intermediate and lubricating oils	32 ,,

Before leaving San Francisco I had a lengthened conversation on the subject of Californian petroleum with Mr. Henry G. Hanks, formerly State Mineralogist. Mr. Hanks, whose fourth annual report to the Californian State Mining Bureau contains a good deal of valuable information concerning the petroleum industry of the State, has been good enough to furnish me with the following interesting specimens—

1. Asphaltum in sand, Santa Cruz.
2. Crude bréa-asphaltum, Los Angeles.
3. Crude maltha or tar, Sargent's Ranch, Santa Clara County.
4. Crude bréa-asphaltum, Sargent's Ranch, Santa Clara County.
5. Refined asphaltum—artificial, Sargent's Ranch, Santa Clara County.
6. Asphaltum refined by natural process, Sargent's Ranch, Santa Clara County.
7. Crude bréa-asphaltum, Coral de Piedra, San Louis Obispo County.
8. Maltha, so-called "tar," San Louis Obispo County.
9. Asphaltum, San Louis Obispo County.
10. Asphaltum, ,, ,,
11. Asphaltum, ,, ,,
12. Bituminous sandstone, San Louis Obispo County.
13. Crude petroleum, Pico Cañon, Los Angeles County.
14. Maltha, first yield of wells at Petrolia, Los Angeles County.
15. Crude petroleum, Tunitas Creek, San Mateo County.

Sample No. 1 consists of 19·8 per cent. of asphalt and 80·2 per cent. of sand. Sample No. 2 is from La Bréa Rancho, so named from the Spanish word "bréa," signifying pitch, which lies about six miles west from the city of Los Angeles. Mr. Hanks states that the deposits here, which cover a large area, consist mainly of bitumen and maltha, the latter occuring in the form of pools or wells. As at Carpentaria, in Santa Barbara County, the tar-like substance flowing from the numerous apertures becomes mixed with such quantities of mineral and vegetable matter, that the whole mass has to be melted, and the impurities separated from the asphalt to fit the latter for market. To effect this the material is melted in iron kettles, and the impurities floating on the surface being skimmed off, additional material is thrown in until the kettle is nearly filled with comparatively pure asphaltum, when the charge is poured out into trenches dug in the earth. The pigs on being broken up after cooling constitute commercial asphaltum. From this locality the Catholic fathers obtained asphaltum for roofing the missions and other buildings put up at Los Angeles, San Gabriel, and elsewhere in the vicinity. Samples Nos. 3, 4, 5, and 6 are from Sargent's Ranch, a few miles south of the town of Gilroy, in Santa Clara County. Petroleum is here found exuding from the sandstone at several points along Tar Creek. Upon exposure the liquid becomes converted into maltha and asphaltum, considerable quantities of which have accumulated. The petroleum, according to Mr. Hanks, exudes from the hill-side in a thin tarry stream, with a motion that is almost imperceptible when the weather is cool, but which increases with the temperature of the atmosphere. Much of the asphalt presents a vitreous appearance, resembling that of the best quality from Trinidad. Some of the pools formed are as much as 10ft. in diameter, and of unknown depth. In cool weather the surface is sufficiently firm to admit of walking over it, but on warm days the surface is too yielding to bear the weight of a man. When dug up and thrown into heaps the hard asphaltum at common temperatures gradually softens and spreads out into a thin sheet. At the point where the first deposits are met with going up the creek, works have been erected for purifying the bréa by fusion and straining. Some 20 or 30 tons of asphaltum have been obtained here. Half-a-mile up the creek other large beds of asphaltum exist, which are fed from springs on the bank of the stream, and about 30ft. above its bed. From these deposits seventy-five car loads of asphaltum have been sent to San Francisco. A mile and a half further up the creek a third, and by far the largest, bed of asphaltum in this series is met with, the deposits here covering several acres. The land at this place spreads out into a plateau, and the supplying springs, many in number, are located on the neighbouring hillside. From the surface of the tarry pools bubbles of gas escape, similar to those observed at the Mud Lakes on the Colorado desert, and remains of birds and small animals which have become ensnared in the tar are to be seen. From this locality 200 car loads of asphaltum have been sent to market.

According to Mr. Hanks, the following comprise the more notable localities of asphaltum and maltha in the State :—Santa Ynez and Kayamos Valleys; near Mission, San Buenaventura; at the Goleta Landing, seven miles west of the town of Santa Barbara; on the Laguna Todos Santos and Los Alamos Ranchos; in the vicinity of Dos Pueblos, and near Carpenteria, in Santa Barbara County; at the oil wells near Sulphur Mountain, Ventura County; Rancho La Bréa, Los Angeles County; on the Corral de Piedra, San Louis Obispo County; about Buena Vista Lake, Kern County; and on Sargent's Ranch, Santa Clara County.

The quantity of asphaltum consumed in the State in 1884 was about 3500 tons per annum, the annual receipts at San Francisco reaching 2500 tons. The principal supplies come from Santa Barbara County, and the product from this locality being preferred, commands a price from 20 to 30 per cent. higher than that obtained for asphaltum from other deposits in the State. The wholesale price of asphaltum in 1884 was 13dols. per ton for the best, and from 9dols. to 11dols. per ton for poorer qualities. The cost of extraction ranges from 2dols. to 3dols. per ton, according to the hardness of the material, it being necessary occasionally to resort to blasting.

The material is largely used in California, as elsewhere, for street pavements, cellar floors, and roofing. It has also been used in the construction of water pipes, the process consisting in coiling on a mandril the cloth known as burlap, previously soaked in melted asphaltum, glazing the interior of the pipe thus formed by pouring in melted asphaltum, and finally rolling the pipes on a table covered with coke dust, whereby they acquire a smooth, dry, and hard surface. The pipe thus manufactured is light, durable, and cheap, the price, inclusive of couplings, being a sum per foot equal to the diameter of the pipe in inches, multiplied by 10 cents. Thus, 2in. pipe costs 20 cents per foot, 4in. pipe 40 cents, etc. Such pipe is said to have been made to stand an internal pressure of 500lb. per square inch.

Mr. Hanks states that the Californian petroleum-bearing rocks belong to the tertiary age, as shown by the fossils. At Pico Cañon the sand rocks are stratified with much regularity, and are interstratified with plates or seams of gypsum. There also occur here a black shale and a coarse conglomerate.

According to Professor S. F. Peckham, who has devoted much attention to the subject, the maltha of Southern California passes by insensible gradations from a material scarcely to be distinguished from heavy petroleum to solid asphalt, and varies in specific gravity from 0·9906 to 1·10; the heavier description still remaining plastic, like mortar.

When I visited Canada in 1877—78, the refining of petroleum was principally conducted in the city of London, Ontario. At the present time Petrolia, Ontario, is the chief seat of the industry, and it was accordingly to this city that we made our way. Here we were treated with the greatest kindness and hospitality by Mr. John D. Noble, vice-president of the Petrolia Crude Oil and Tanking Co., and his brother, Mr. R. D'Oyley Noble, and were enabled in the short time at our disposal to visit typical portions of the producing territory, and some of the principal refineries.

The development of the Canadian petroleum industry may be said to date from 1857, when a well dug for water was found to yield a considerable quantity of petroleum, but long previously, indeed from the time of the earliest settlements in the county of Lamberton, in the western part of the province of Ontario, petroleum was known to exist in Canada. In 1862 productive flowing wells were drilled at Oil Springs, but these wells, which were comparatively shallow, quickly became exhausted, and the territory was deserted on the discovery in 1865 of oil at Petrolia, seven miles to the northward, and about 16 miles south-west of the outlet of Lake Huron. Recently the Oil Springs wells have been drilled deeper, and are now producing 10,000 to 12,000 barrels (of 42 American gallons) per month. Petroleum has also been found at Bothwell, 35 miles from Oil Springs, but this district has ceased to yield. Quite recently a new territory has been discovered at Euphemia, 17 miles from Bothwell, where, at the time of our visit, there were four wells producing collectively 70 barrels per day. This territory is by some regarded as part of the Bothwell field.

The present producing oil-belt extends from Petrolia in a north-westerly direction, to the township of Sarnia, and in a south-easterly direction to Oil Springs, but in the latter direction there is a break of about four and a quarter miles, commencing at a point about two miles from Petrolia. At Oil Springs there appears to be a pool about two miles square. The extension of the belt then continues in the same direction, with another break of about nine miles, to the new oil field of Euphemia, the average width of the oil-belt being about two miles. In all, about 15,000 wells are believed to have been drilled in the Canadian oil-fields, and of these about 2500 are now producing, the average yield being about three-quarters of a barrel per well per day. The aggregate production is probably about 700,000 barrels per annum, the greater part of which is obtained in the Petrolia district, and the stocks were at the time of our visit stated to amount to from 400,000 to 450,000 barrels.

In the Canadian oil-fields the drilling contractor usually employs his own derrick, engine, boiler, and tools, furnishes wood and water, cases the well, and fixes the pump; the well owner providing the casing and pump, and subsequently erecting the permanent derrick. The wells in the Oil Springs field were formerly from 200ft. to 300ft. in depth, but the oil stratum then worked became waterlogged, and the wells are now sunk to a depth of about 375ft., and are cased to a depth of about 275ft. to shut off the water. The contract price for drilling a 4⅝in. hole to a depth of about 375ft. under the conditions mentioned is 150dols. (£30), and the time occupied in drilling is usually about a week when the work is continued night and day. The wells in the Petrolia field have a depth of 480ft., the contract price, including the cost of 100ft. of wooden conductor, being 175dols. (£35), and the time occupied in drilling being from six to twelve days. Pole tools are used in drilling, the poles being of white ash, 37ft. in length. The derrick is about 48ft. in height. An auger some 4ft. in length, and about a foot in diameter, is used to bore through the earth to the bed rock, the auger being rotated by horse power. The drilling tools commonly consist of a bit, 2½ft. in length by 4⅝in. in diameter, weighing about 60lb.; a sinker bar, into which the bit is screwed, 30ft. in length by 3in. in diameter, weighing about 1040lb.; and the jars, inserted between the sinker bar and the poles, about 6ft. in length, and weighing 150lb. The tools are suspended by a chain, which passes three times round the end of the walking beam and thence to the windlass, with ratchet wheel, fixed on the walking beam, by means of which the tools are gradually lowered as the drilling proceeds. The cable is thus only employed in raising the tools from the well, and lowering them into it. The sand pump or bailer is frequently as much as 37ft. in length, and is about 4in. in diameter. The casing (4⅝in. diameter) costs about 45 cents (1s. 10½d.) per foot, and the 1¼in. pump, with piping, costs from 65dols. (£13) to 85dols. (£17), according to the length of pipe required. An ordinary square-frame derrick costs, with mud-sill, from 22dols. (£4 8s.) to 27dols. (£5 8s.), and the walking beam about 8dols. (£1 12s.). In many cases, however, a three-pole derrick, which can be erected at an expense of about 10dols. (£2), is employed. A 100-barrel wooden tank costs, erected, 50dols. (£10.) The wells are torpedoed on completion with from 8 to 10 quarts of nitroglycerine, at a cost of 4dols. (16s.) per quart. The torpedoes employed in the Canadian oil-field are much smaller than those used for a similar purpose in the United States, the tin shell being only 6ft. in length by 3in. in diameter. We were enabled to witness the operation of torpedoing a well, and the following particulars, based on notes taken at the time, may be of interest:—The torpedo case, which was furnished with a tube or "anchor" at the lower end, 8ft. in length, was placed in the mouth of the well and suspended so that its upper end was level with the surface of the ground. Eight quarts of nitroglycerine, which was in a tin can, was then poured into the torpedo case, and the torpedo was carefully lowered into the well, which contained at the time about 250ft. of water, until the end of the anchor rested on the bottom of the well. A travelling primer or "go-devil squib" was then prepared as follows:—A tin cone, 14in. in length by 2in. in diameter at the open end, was partially filled with sand to give it the necessary weight. A piece of double tape fuse, 2ft. long, was inserted into a Nobel's treble detonator, and over the detonator and a portion of the fuse a perforated tin tube or sheath was passed. This tube was then inserted through a hole in a strip of tin fixed across the mouth of the conical cup into the sand, so that the detonator was embedded. The sand was then saturated with nitroglycerine, the fuse lighted, and the primer dropped into the well. In about 45 seconds there was a perceptible tremor of the ground, immediately followed by a slight sound of the explosion. After an interval of a second or two there was a gurgling noise, and a magnificent black fountain shot up twice as high as the derrick, upon which all the spectators ran for shelter from the impending shower of oil and water. The well not being a flowing one, the outrush was only of momentary duration, and within a few minutes the drillers were at work removing from the well, by means of the sand pump, the fragments of rock which had been detached by the explosion. On the table are specimens of this rock, which I obtained at the time.

The maximum yield per well is ten barrels per day, and the minimum yield for which it is considered profitable to pump is a quarter of a barrel per day. The yield being in some cases so small, it is usual to pump a number of wells through the agency of one engine, the various pumps being connected with the motor by means of wooden rods. In one instance I saw as many as eighty wells being thus pumped from one centre. The motive power was a 70h.p. engine, which communicated motion, similar to that of the balance-wheel of a watch, to a large horizontal wheel. From this wheel six main rod lines radiated, the length of stroke of the main lines being 16in., and the rate of movement 32 strokes per minute. Some of the wells being pumped from this centre were from one-half to three-quarters of a mile distant, and altogether about eight miles of rods were employed in the pumping of the eighty wells.

The pipe line system in Canada has not been fully developed, and accordingly the well owner has to convey his oil by road to the nearest receiving station. Thus from the Euphemia oil field the oil has to be "teamed" 17 miles, to Bothwell. For the conveyance of the oil by road a long and slightly conical wooden tank or barrel, resting horizontally on a waggon, is employed. These vessels hold from eight to ten barrels of oil. The Petrolia Crude Oil and Tanking Company is the principal transporting and storing company. The storage charge is one cent (½d.) per barrel per month, and the delivery charge two cents per barrel. The petroleum produced in the Oil Springs field is stored separately from that obtained in the Petrolia field.

The storage takes place for the most part in large underground tanks excavated in the retentive clay. These remarkable tanks are often as much as 30ft. in diameter by 60ft. in depth, and hold from 5000 to 8000 barrels. In the construction of the tanks the alluvial soil, of which there is about 18ft. or 20ft. above the clay, is kerbed with wood and thoroughly puddled with clay. On the completion of the excavation, the entire vertical surface is then lined with rings of pine wood, so that the upper part down to the solid clay is doubly lined. The bottom is not lined. The roof of the tank is of wood, covered with clay. The cost of such a tank is about 22 cents (11d.) per barrel, or 1760 dols. (£363) for an 8000-barrel tank, and the time occupied in making such a tank is about six weeks.

The crude petroleum from the Petrolia field usually has a specific gravity ranging from 0·859 to 0·877, while the specific gravity of the petroleum from the Oil Springs field ranges from 0·844 to 0·854.

The oil occurs in the corniferous limestone, and buildings constructed of this stone frequently exude petroleum in hot weather.

Canadian crude petroleum is of a black colour, and possesses a very disagreeable odour, due to the presence of sulphur compounds. These characteristics are shown by the samples on the table, for some of which I am indebted to Mr. James Kerr, secretary of the Petrolia Oil Exchange.

The stills used in the process of refining the crude oil are horizontal two-flued cylinders, 30ft. in length by 10ft. in diameter, provided with six 2in. vapour pipes. The charge is 260 barrels, and the following is an outline of the method of working. Assuming the still to be charged on Monday morning, heating is commenced about 7 a.m., and the naphtha begins to come over about 8 a.m. Of this product about six barrels is obtained in the case of Petrolia crude, or 7½ barrels in the case of Oil Springs crude. The distillation of the naphtha takes from 2 to 3 hours, say till 10.30 a.m. The heat is then increased, and the distillation of the kerosene commences about noon, and continues till about 10 p.m. Of the kerosene distillate about 80 barrels are obtained. The first portion of the kerosene distillate is usually collected separately, is steamed to drive off the more volatile hydrocarbons, and is then mixed with the remainder of the kerosene distillate. The product which then commences to distil is known as tailings. This is collected separately and is re-distilled. The distillation of the tailings continues till about 5 a.m. on Wednesday, by which time about 80 barrels has been obtained. Steam is then passed into the still through a perforated pipe extending to the bottom, and about 21 barrels of "gas-oil" is distilled over. The additional quantity of kerosene obtained on re-distilling the tailings brings up the total yield of this product to about 42 per cent. of the crude oil. The gas-oil is sold for the manufacture of illuminating gas. The residue is distilled for lubricating oils and paraffin.

The agitator in which the kerosene distillate is treated commonly takes a charge of 465 barrels. To this quantity of distillate two carboys of oil of vitriol is added, and the oil and acid are agitated together for 20 minutes. The tarry acid having been allowed to settle is drawn off, and seven carboys more of acid is added. Agitation having been effected for 30 or 40 minutes, the tarry acid is removed as before. Another similar treatment with seven carboys of acid follows, and occasionally a fourth addition of acid is made. The oil is next allowed to remain at rest for an hour, any acid which settles out being drawn off, and cold (or, in winter, slightly warmed) water is allowed to pass down through the oil in fine streams, this treatment being continued, without agitation of the oil, for half-an-hour, or until the dark colour which the oil assumed on treatment with acid is removed. The water is then drawn off, 10 barrels of solution of caustic soda (sp. gr. 15° B.) is added and agitation conducted for 15 minutes. The caustic soda solution having been drawn off, 30 barrels of a solution of litharge in caustic soda is added. This solution is made by dissolving caustic soda in water to a density of 18° B. and then adding the litharge. Agitation with this solution is continued for about six hours, or until the oil is thoroughly deodorised. About 100lb. of sublimed sulphur is then added, and the agitation is continued for another two hours. The oil having been allowed to settle all night, the litharge solution is drawn off, and the oil run into a shallow tank or "bleacher," where it is exposed to the light to improve its colour, and is, if necessary, steamed to drive off the lighter hydrocarbons and raise the flashing point to the legal minimum of 95° F. To raise the flashing point from 73° F. to 95° F. (Abel test) is stated to involve in practice a loss of 10 per cent., the burning quality of the oil being at the same time seriously impaired, and upon this ground the Ontario refiners in 1886 petitioned for a reduction of the test standard.

The average percentage yield of the various products is given in the following table :—

Naphtha	5
Kerosene	42
Gas-Oil	8
Tar	25
Coke	10
Loss (including water)	10
	100

There are a dozen petroleum refineries in Canada, and the annual out-turn of kerosene is about 200,000 barrels of 45 imperial gallons per annum. The total consumption of kerosene in Canada is about 300,000 barrels, one-third of which is manufactured in the United States. The United States oil is subject to a duty of 40 cents on the package and 7½ cents per imperial gallon on the contents, besides which there is an inspection fee of 30 cents per package. Of lubricating oils the out-turn is from 75,000 to 100,000 barrels per annum.

The quality of Canadian kerosene has been greatly improved of late years, but notwithstanding the elaborate process of refining, the oil, though thoroughly deodorised and of good colour, contains sulphur, and of course evolves sulphur compounds in its combustion.

The rules of the Petrolia Oil Exchange provide that refined kerosene shall be of the odour "locally known as inoffensive," and shall "absolutely stand the test of oxide of lead in a strong solution of caustic soda without change of colour."

The "burning percentage" in the case of "Extra Refined Oil," "Water White" in colour, and of specific gravity not exceeding 0·800, is required to be not less than 70 : in the case of "No. 1 Refined Oil," "Prime White" in colour, not less than 60 ; and in the case of "No. 2 Refined Oil," "Standard White" in colour, to be not less than 55.

The "burning percentage" is determined by the use of a lamp thus described :—"The bowl of the lamp is cylindrical, 4in. in diameter and 2¾in. deep, with a neck placed thereon of such a height that the top of the wick tube is 3in. above the bowl. A sun-hinge burner is used, taking a wick ⅞in. wide and ⅛in. thick, and a chimney about 8in. long." The test is conducted as follows :—"The lamp bowl is filled with the oil and weighed, then lighted and turned up full flame just below the smoking point, and burned without interference till 12oz. of the oil is consumed. The quantity consumed during the first hour and the last hour is noted." The ratio of the two quantities is the measure of the burning quality, and the percentage that the latter quantity is of the former is the "burning percentage" referred to.

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NOTE ON VISCOSIMETRY.

BY BOVERTON REDWOOD, F.I.C., F.C.S.

The following correction relates to the paper on Viscosimetry, published in the *Journal of the Society of Chemical Industry* for March, 1886.

In my reference to the viscometer described in the *Chemical News* for October 31, 1884, by Dr. William P. Mason, who is now Professor of Analytical Chemistry at the Rensselaer Polytechnic Institute, Troy, N.Y., I stated that the arrangement adopted for eliminating differences due to specific gravity had, I understood, been suggested by Professor H. B. Nason, of the same institute.

From a correspondence I have had with the professors named I find that Professor Nason proposed to Professor Mason, who was then his assistant, to look up the subject of the determination of viscosity, with a view of improving the methods of testing in use, and naturally talked the matter over very freely with him ; but Professor Nason never desired or intended to take credit for anything new in principle or application that was the outcome of the investigation.

Professor Mason is anxious that it should not be thought that he was sailing under false colours when he published his article in the *Chemical News*, and I gladly take this opportunity of removing any misapprehensions that may have arisen from my statement, and of expressing my regret that I should have mistaken the purport of Professor Nason's remarks.

Manchester Section.

Chairman: Sir H. E. Roscoe, M.P.
Vice-Chairman: I. Levinstein.
Committee:

Dr. Bowman.
R. F. Carpenter.
C. Estcourt.
H. Grimshaw.
Peter Hart.
Dr. Gerland.
C. Schorlemmer.
Dr. Schunck.
Dr. Watson.
Wm. Thomson.
L. Siebold.
Dr. Hewitt.

Local Secretary:
J. Carter-Bell, Bankfield, The Cliff, Higher Broughton, Manchester.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held Friday, May 6, 1887.

T. WARDLE, ESQ., IN THE CHAIR.

REMARKS ON DYEING WITH CHLOROPHYLL.

BY DR. E. SCHUNCK, F.R.S., ETC.

The author, after referring to a paper on the same subject by M. J. Hartmann and the report thereon by M. Cordillos dit Luzy (*Bulletin de la Société Industrielle de Mulhouse*, xxvi. pp. 283—296), mentioned the difficulties to be encountered in endeavouring to fix the colouring matter chlorophyll on ordinary tissues, in consequence of its extremely fugitive character, and the slight affinity which it manifests for ordinary mordants. He then described a method by which these difficulties can to a great extent be overcome, so as to impart great relative stability to the substance without impairing its fine green colour. Having obtained solutions of compounds which contain, along with colouring matter, various metallic oxides, such as cupric and zinc oxides, he showed that these solutions impart very little colour to cotton, silk, or wool, but that coagulated albumen, gelatin, and more especially the animal products yielding gelatin, such as skin, the ossein of bones, etc., readily attract the colour, and are really dyed when immersed in the solutions. Specimens of leather dyed in this manner were exhibited to the meeting, showing various shades of green, which, in daylight at least, are very pleasing, though by gaslight they share the fate of ordinary greens, and appear dull and dingy. These colours stand the action of soap and dilute acids in the cold, but are not materially improved by the treatment. In the opinion of the author, the tannin of the leather does not assist in fixing the colour. The peculiar compounds of colouring matter with acids and metallic bases, which the author employed in his experiments, do not yield lakes by treatment with ammonia, being in themselves lakes, which dissolve in alkaline lyes without undergoing any change. It would be possible to modify the method so as to make it practicable on a large scale, but the cost would probably prevent it being successfully applied even if the colours obtained were sufficiently bright and intense to make success desirable.

DISCUSSION.

Mr. Grimshaw asked whether the greater tinctorial power of the copper compound of chlorophyll, compared with the zinc compound, resulted in any way from the green or blue colour of copper salts, or whether the proportion of metal present was, as in the case of ordinary mordants and dyes, so small that the metal *per se* was not an element in the tinctorial effect. He presumed the latter was the case, from Dr. Schunck's remarks.

Dr. Bailey remarked that in considering the subject of chlorophyll, as brought forward by Dr Schunck in his interesting paper, one was led to compare with "Lokao," or Chinese green, used as pigment for wall papers, and as this is acted on readily by oxidising and reducing agents, he was curious to know whether the copper compound described by Dr. Schunck had been examined in their relation to such agents. With regard to the greater stability of the copper compounds as compared with zinc, it was a remarkable coincidence that in feathers of a bright red colour there is sometimes as much as six per cent. of copper.

Mr. Riley asked if Dr. Schunck could say what would happen if the acid solution of the copper compound were neutralised with ammonia. Would a pigment green be thrown down, or would the green compound be decomposed? He further inquired whether or not the cost of the extraction and preparation of the colouring matter would prevent its application for tinctorial purposes if a satisfactory method of fixing it were discovered. Referring to the difference exhibited by the copper compound and the zinc compound when exposed to the action of light, he remarked that chlorophyll was not singular in this respect. He mentioned an instance of an aniline blue which, when dyed by means of a mordant of alumina and alizarin oil (same as is used in Turkey-red dyeing), was very fugitive, but when fixed with a tin mordant was comparatively permanent. He also referred to the remarkable action of tartar emetic in the fixation of certain aniline colours. Many of these colours which are fixed by tannic acid will not stand the action of light, or of soaping, unless they are passed through a hot solution of tartar emetic, or some other antimony compound.

Mr. Wm. Thomson said it was an interesting fact that a fugitive colour like chlorophyll should be made more permanent by its combination with copper, whereas with the more stable colouring matter of logwood the action is the reverse—the copper tending to make the colour "logwood black" more fugitive.

The Chairman said he had been struck with the similarity of some of the experiments referred to by Dr. Schunck with experiments carried out by himself in connection with silk dyeing. He would like to ask Dr. Schunck if he had tried other mordants, such as tannin, alum and chromium. With regard to the difference between copper and zinc oxides, he (the Chairman) had found generally in his experience in the dyeing of silk that zinc oxide was practically of no value either in fixing or developing colours; on the contrary, copper was without doubt of value. One of the old fashioned methods of dyeing black was with fustic and logwood, using copper acetate and ferrous sulphate or tannin and logwood. Possibly presence of tannin might have something to do with the greater development of the green colour obtained with the addition of gelatin on leather.

Dr. Schunck, in reply, said: Mr. Grimshaw asks whether the green colour of the solution might be in any degree due to the copper salts? Of course, the colour is to some extent due to the copper contained in it; but the amount, for instance, in this solution of the cupric compound, if it were dissolved in acetic or any other acid, would be so trifling that it would be hardly perceived. Dr. Bailey referred to Lokao or Chinese green, and wanted to know whether there was any connection with this and chlorophyll. Lokao has been tolerably well examined, and it appears that it has no connection with, or relation to, chlorophyll. Mr. Riley asks whether the cost of preparation would be any obstacle to the use of these colours? With regard to chlorophyll, there are difficulties which would prevent its use in practice as a dyeing material, and these difficulties have no doubt often presented themselves to those making experiments with it with a view to its utilisation.

Mr. Riley asked if the action of ammonia had been tried?

Dr. Schunck said he did not know with what object he would suggest this.

Mr. Riley: As a pigment colour to be fixed with albumen by the steaming process, in the same way as chrome green.

Dr. Schunck: No, pigment colours would be produced in the way suggested by Mr. Riley. With regard to tannin, Dr. Schunck said he did not think the tannin in leather had anything to do with the fixing of these coloured compounds. He thought it was the animal tissue which really fixes the colour. The experiments which he made with a view of fixing the green colour on fabrics by means of alumina and metallic oxides led to no result.

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Meeting held Tuesday, June 7, 1887.

IVAN LEVINSTEIN IN THE CHAIR.

DETERMINATION OF VISCOSITY OF LUBRICATING OILS.

BY DR. T. TRAUBE.

The determination of the viscosity of oils has given rise to several discussions (see this Journal, vol. v. 121—133, 148—149, and 359), in view of which I think it desirable to give a preliminary description of the essential features of my own method of determining the viscosity, a full and exhaustive account of which will appear shortly in the *Zeitschrift des Vereins Deutscher Ingenieure.*

I will state at once, that I fully agree with the views of Professor E. J. Mills, that we can only achieve satisfactory results in the determination of viscosities by closely approximating to Poiseuille's method.

There is one point, however, not sufficiently noticed by Professor Mills, which has given rise to more errors and consequent disagreements in the results obtained by the instrument at present in use than the non-compliance with many other conditions demanded by theory.

The point is this: According to theory, it is not permissible to compare directly the times of efflux of heavy and light oils, and still less the times of efflux of oils and water observed in one and the same apparatus. Though the results of observations made with different apparatus may yield apparently concordant results, the direct comparison of times of efflux thus obtained will be liable to lead to serious errors.

This remark will be better understood, if we compare the formula given by Poiseuille for the coefficient of friction in narrow tubes:

$$\eta = \frac{\pi p r^4}{s.v.l} t.$$

with the enlarged formula of Hagenbach:

$$\eta = \frac{\pi p r^4}{s.v.l.} t - \frac{v.s}{2 g \pi l} \cdot \frac{1}{t}$$

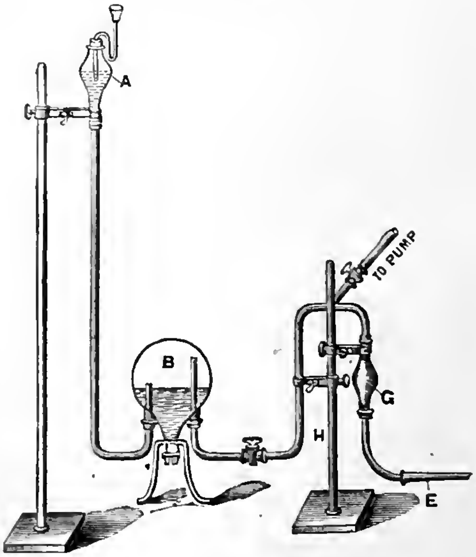
in both of which formulas, η is the co-efficient of friction, t the time of efflux, v the volume of the fluid discharged, p the hydraulic pressure, l the length, and r the radius of the capillary tube, and s the specific gravity of the liquid.

The comparison of these two formulas will show at a glance, that the simple one of Poiseuille cannot be considered applicable to the viscosimeters at present in use; at any rate, that the time of efflux is not directly a correct measure of the coefficient of friction, since even when the pressure is presumed to be equal, Hagenbach's correction (*i.e.*, the second term in Hagenbach's formula) assumes very different values for liquids for which the time of efflux differs considerably; or, what is the same thing, for liquids of different viscosity.* Consequently, in apparatus with tubes of such diameter that the time of efflux is still approximately proportional to the viscosity when thick heavy oils are used, that will be so no longer for thin oils, and still less for water.

It has been proposed by others, and at first sight the suggestion appears a practical one, to refer the viscosity of oils to a pure oil or to glycerol, or to a certain solution of sugar, instead of referring it to pure water; but all experiments which I have made in that direction have shown that it is very difficult to obtain fluids of sufficiently constant qualities; that small differences in specific gravity are productive of very considerable differences in the viscosity. For this reason, I think it is impossible to choose a better standard fluid than pure water.

I shall presently show how the errors I have mentioned are avoided in my method, of which the following is a short description:—

The annexed sketch represents the apparatus: A is a Mariotte bottle filled with water, which serves to compress air in the reservoir B and to keep the pressure constant. B is connected by means of pipe and cock to the efflux apparatus H, consisting of the bulb G, provided with two marks, to permit the measurement of volume of liquid to be discharged, and of the capillary tube E. The reservoir B is filled by means of a pump attached to branch and stopcock.



If the tube E is so narrow that the correction of Hagenbach becomes very small, almost equal to zero, the time of efflux may be considered to be proportional to the viscosity.

If that result is to be obtained, we must select a wider tube for heavy oils than for lighter ones or for water.

If with a very narrow tube we determine the times of efflux of water, and of another fluid the viscosity

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* In very many, perhaps in most of the viscosimeters in use, Hagenbach's correction amounts to more than the value of the first part of the formula itself.

of which lies between that of water and of a light oil, say glycerol of 80 per cent., and then in a wider tube we compare glycerol of 80 per cent. with glycerol of 100 per cent., and in a third still wider tube compare the glycerol of 100 per cent. with a viscous oil, it is easy to fix a corrected time of efflux for water for every tube, without knowing the dimensions of the tubes.

As these adjustments are difficult and troublesome, I have made arrangements with the firm, C. Gerhardt, in Bonn, to keep a stock of properly adjusted apparatus.

With two or three different discharge tubes attached to the same pressure apparatus it is thus possible to determine by one single and easy experiment the specific viscosity of any oil. The apparatus is easily cleaned by means of ether.

The following table shows for three different apparatus, A, B, C, the times of efflux *t* in seconds, the viscosity *v*, the most viscous oil being assumed 100.

	A.		B.		C.	
	t″	*v*	*t*″	*v*	*t*″	*v*
Cylinder lubricating oil ..	155·5	100·0	472	100·0	2960	100·0
Rapeseed oil	79·0	50·8	242	51·3	1503	50·8
Olive oil..................	71·7	46·1	222	47·0	1361	46·1

The diameter of the tubes were A = 1·5mm., B = 0·8mm., C = 0·5mm.; the length of the tubes and the volumes of oil discharged were nearly alike.

The figures in this table prove that for oils of such viscosity tubes of a diameter of 1·5mm. may be used, but when light oils or water were used considerable differences were manifest.

The figures show plainly that by means of suitable tubes the viscosity of any oil may be determined exactly in from two to three minutes.

For the determination of viscosities at higher temperatures suitable air bath is provided, which is also supplied by the firm Gerhardt, of Bonn, constructed in either copper or iron.

With regard to the dimensions of the tubes and the correctness of the values obtained, the *Zeitschrift des Vereins Deutscher Ingenieure* must be consulted, where another method is also detailed which offers advantages in many cases.

DISCUSSION.

Dr. **Bailey** said that it seemed to him the paper referred viscosity to specific gravity, whilst it had been shown by Graham long ago and by others that the rate of flow in narrow tubes was not entirely dependent on the specific gravity, but that it was dependent on the chemical character of the substance. He thought, therefore, in comparing the viscosity of oils it seemed likely that the chemical character of the oil had an influence on the rate of flow, and it would be interesting to know whether this was the case or not. Should it be so, the use of tubes of different diameters as suggested by the author would not be received with confidence.

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A DOUBLE SULPHATE OF LEAD AND ALUMINA.

BY G. H. BAILEY, D.SC., PH.D.,
The Owens College.

Some weeks ago my friend, Mr. Cecil Watson, of Foxhill Bank Print Works, was good enough to forward to me some crystals which he had noticed in a mordanting liquor. The mordanting liquor in question (nitroacetate of alumina) is made by dissolving up alum, lead acetate and lead nitrate in water and allowing to settle. The clear liquor is of the strength 20° Twaddell, and is used as a mordant for alizarin, which is especially valuable from its slow dissociation on steaming.

Lead sulphate separates out of the mordanting liquor, and in winter there appear also beautiful crystals of the regular system, crystallising in fact in octahedra in cruciform aggregates like alum. They are, however, not transparent, and are quite unaltered by exposure to air. The lead was determined as sulphate by digesting the finely powdered crystals with excess of sulphuric acid, the alumina appearing in the filtrate; the sulphuric acid by treating with excess of lead nitrate and nitric acid and weighing as lead sulphate. The water of crystallisation is almost entirely driven off at 150°, but the last traces only at 250°. The crystals contain the merest trace of nitric acid.

Analysis determines these crystals to have the composition $PbAl(SO_4)_2 10H_2O$. We have here a most interesting addition to the analogies already noticed in the chemical relations of lead, thallium and the alkalis.

The alkalis form alums, whilst thallium, resembling on the one hand the alkalis and on the other hand lead, forms a well defined alum; and in this salt we have what is essentially a lead alum formed under special conditions of concentration and temperature.

Note to the above Paper.—The sulphuric acid determination referred to above has been carefully repeated, and the result of the full analysis is appended:—

	Found.	Calculated for $Pb_2Al_2(SO_4)_5 20H_2O$
Pb	31·50	31·65
Al	4·34	4·13
SO_4	36·41	36·70
H_2O	27·34	27·52

The body, therefore, resembles the alums in composition as in crystalline form, and lead is as might have been expected divalent.

For the analysis of the salt, I am indebted to Mr. Read, a student of Owens College.

DISCUSSION.

Mr. **George E. Davis** asked if Dr. Bailey had established the formula $PbAl(SO_4)_2$ by analysis of the crystals, as the formula given was not consistent with that of the alums. Lead was a dyad, while aluminium was triadic, so that there was an uneven number of atomicities to be satisfied on the side of the bases, and an even number on the acid side.

Dr. G. H. **Bailey**, in reply, said it was well known that crystals of a mixed character did form, and it was impossible to say whether they were simple in character or not unless sections were made and examined optically, and in this case it was impossible to do so inasmuch as they were not transparent. The only check at disposal was the fact that several analyses made on different portions gave results agreeing amongst themselves. With regard to Mr. Davis's remarks he was yet in some slight doubt as to the sulphuric acid since the two determinations already made did not agree well enough. The result, however, was in accordance with the formula given, and should lead be divalent (and it would be certainly strange, as Mr. Davis remarked, were it otherwise) they would require half a molecule more of sulphuric acid, and double the formula. He apologised for bringing, under pressure of work, a somewhat incomplete analysis before the Society, but would repeat the sulphuric acid determination. (See above). In reply to Dr. Dreyfus, the crystals were not soluble in water.

A DELICATE TEST FOR BISMUTH.

BY F. B. STONE.

THE delicacy of the following test for traces of bismuth has not, so far as I am aware, been noticed. It depends on the fact that a strong solution of potassium iodide produces a bright yellow colour when added to a very dilute solution of bismuth sulphate, containing only a small quantity of free sulphuric acid. So delicate is this test that 0·00001 grm. of bismuth oxide in 10cc. (=1 part in 1,000,000) will show a distinct colouration on addition of a few drops of strong solution of potassium iodide. Very small quantities of bismuth can also be estimated colorimetrically by means of this test, as the following results will show:—

A standard solution of bismuth sulphate, containing 0·0001grm. of bismuth oxide in each cc., was prepared, and six unknown quantities of this solution were measured off to test the accuracy of the assays.

Number of cc. of Standard Solution of Bismuth Sulphate required. (Each cc. 0·0001grm. Bi_2O_3.)		Test Quantities taken. (Each cc. = 0·0001grm. Bi_2O_3.)	
cc	Grms. Bi_2O_3 Found.	cc.	Grms. Bi_2O_3 Taken.
1·1 =	0·00011	1·0 =	0·0001
1·3 =	0·00013	1·5 =	0·00015
2·1 =	0·00021	2·0 =	0·0002
3·5 =	0·00035	4·0 =	0·0004
7·3 =	0·00073	7·0 =	0·0007
9·2 =	0·00092	10·0 =	0·001

The above results are quite as accurate as a colorimetric process can be expected to give.

As little sulphuric acid as possible was used for making up the standard bismuth sulphate solution, and the assays were in every case made up to 10cc, to which was previously added 1cc. of a 2p.c. solution of sulphuric acid.

This test is also very convenient for detecting traces of bismuth in copper, for although a small quantity of bismuth is dissolved, when ammonia and carbonate of ammonia are added to a bismuth solution, this is not the case when a large amount of copper and also a small quantity of iron are present. Quantities as small as 0·0001grm. of bismuth in 10grms. of copper (= 0·00001 per cent.) showing quite distinctly. The precipitated carbonate of bismuth is washed with a little dilute ammonia and carbonate of ammonia, till the filter is quite free from blue colour, dissolved in a very small quantity of dilute sulphuric acid, a few drops of potassium iodide added, and afterwards a few drops of sulphurous acid till the solution smells distinctly, to remove the yellow produced by the liberation of iodine due to the ferric sulphate present.

DISCUSSION.

Dr. G. H. BAILEY could not see any dependence on a colorimetric determination. If a sample of pure sulphate of bismuth was obtained, then he thought the best method of determination would be evaporating to dryness and weighing, but to use potassium iodide as a colorimetric test under any other conditions would surely be a most dangerous proceeding, because such a number of circumstances of which there could be no previous knowledge might bring about the separation of iodine, and the author gives no sufficient precautions for avoiding all substances which might act as oxidising agents. If he did so he would find he had as much trouble, because it would be very difficult to make sure that one had a solution in which no action is taking place. On adding sulphurous acid in the presence of copper one would certainly get cuprous iodide separating which would probably interfere with the sharpness of the reaction.

Dr. WATSON said: The test here brought under their notice might be useful as a confirmatory test for bismuth, but seemed to be capable of a very limited application. The proposal as a test for bismuth appeared to him to be a new suggestion. He was accustomed to use for the purposes for which the new test was available an exceedingly delicate and more characteristic test, which he thought would be found preferable to the one under discussion. It was performed as follows:—To a small quantity of the solution containing bismuth, which may be neutral or slightly acid, is added a small quantity of lead nitrate, and then a solution of potassium iodide, causing a precipitation. The presence or absence of bismuth is judged from the colour of the precipitate. If bismuth is absent the colour is, of course, a lemon yellow. If bismuth be present the colour varies with the relation between the amounts of bismuth and lead present from a light orange to a deep Indian red. With careful manipulation very distinct indications could be obtained with a few drops of a solution containing less than one millionth of bismuth. He was unable to say to whom credit was due for the introduction of the method, but he had made use of it himself for many years past.

Mr. WATSON SMITH, who read Mr. Stone's paper, remarked, in reply to Dr. Bailey, that Mr. Stone only claimed usefulness for it as a test for traces of bismuth, which practically defied further gravimetric manipulation, owing to their smallness. He had understood the author that these traces were first to be separated from other constituents likely to effect results before titration, and as the author gave tabulated results indicating a considerable accuracy, they must accept his method, at least for what it demonstrated itself to be worth. The test, in presence of copper, was only intended by the author to be a qualitative one.

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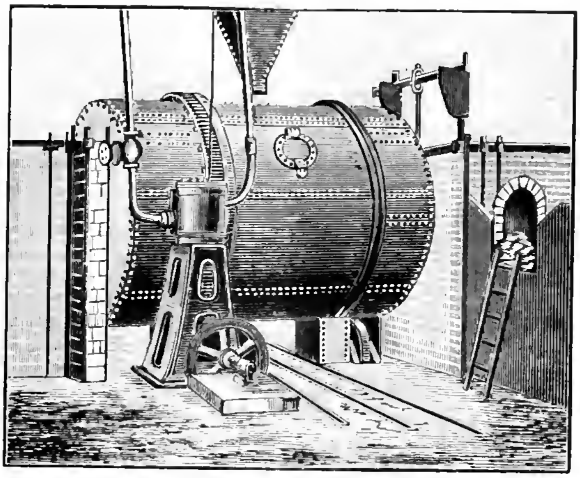
A NEW MONSTER REVOLVING BLACK ASH FURNACE AND THE WORK DONE WITH IT.

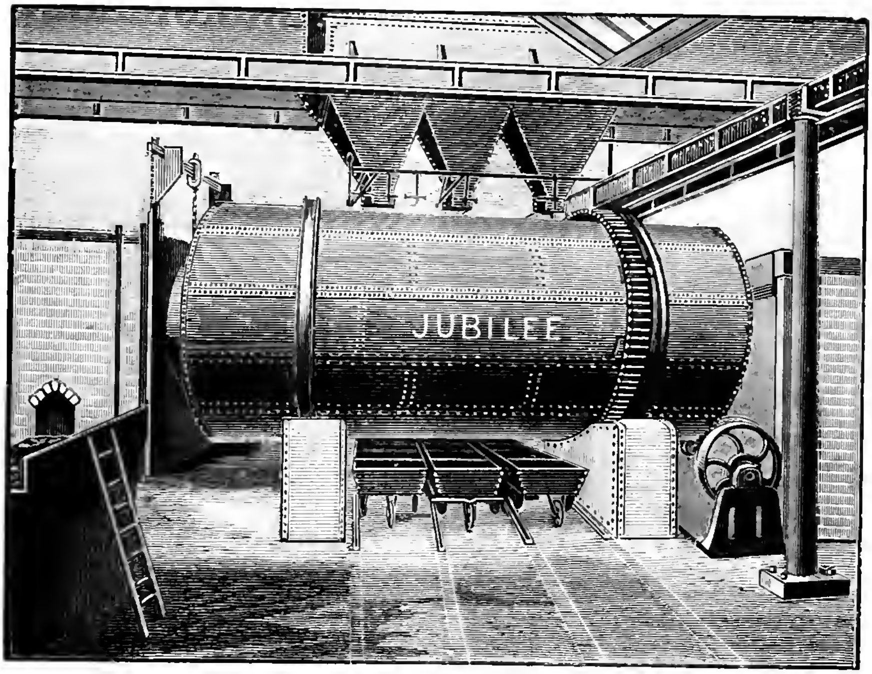
BY WATSON SMITH,

Lecturer in Chemical Technology in the Victoria University, etc.

THE Widnes Alkali Company, Limited, to which I am indebted for permission to describe this latest addition to a family of revolving black ash furnaces, of late not only increasing in number, but also individual size, has kindly allowed my friend, Mr. H. Baker, to photograph the great revolver in question, and I have pleasure now in throwing on the screen a picture of it, and also one of a revolver of ordinary size, so as to render a comparison possible. The revolver of ordinary size measures at most 18½ft. long, with a diameter of 12½ft. The boiling-down pans connected with such a furnace measure 60ft. in length. Each charge contains four tons of salt cake, and some of these revolvers get through 18 tons of salt cake per day and consume 13cwt. of coal per ton of cake decomposed.

With regard to the larger revolver, it may be just said that the Widnes Alkali Company has not at

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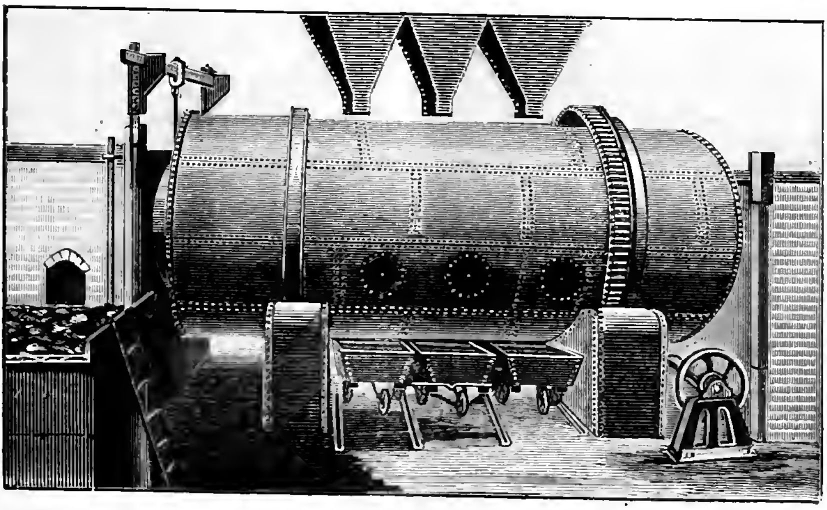


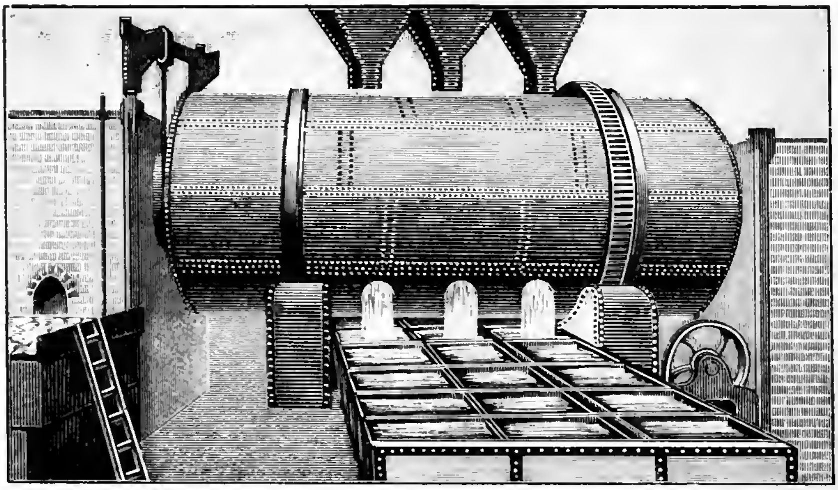
once sprung to the adoption of a furnace of the immense size to be presently given, but in 1884 it erected a revolver only about 3ft. to 4ft. short of the length of that one, and having two discharging holes. The giant revolving furnace to be described measures in length 30ft. and has a diameter of 12ft. 6in. Inside length is 28ft. 6in., with a diameter of 11ft. 4in. It is lined with 16,000 fire-bricks and 120 fire-clay blocks or breakers, weighing each 1¾cwt. The bricks weigh per 1000 about four tons. The weight of saltcake per charge (*i.e.*, contained in each charge of saltcake, limestone, mud, and slack) is 8 tons 12cwt. For 100 tons of saltcake charged, there are also charged about 110 tons of lime-mud and limestone, and 55 tons of mixing slack. In a week of seven days about 48 charges are worked through, weighing of raw materials about *25 tons per charge.* The total amount of saltcake decomposed weekly is about 400 tons, and may be reckoned as yielding 240 tons of 60 per cent. caustic soda. As regards fuel used for firing, this may be put down as 200 tons per week, or about 10cwt. per ton of saltcake decomposed. Also with regard to the concentration of liquor from 20° Tw. to 50° Tw., there is sufficient of such concentrated liquor evaporated down to keep three self-fired caustic pots working, which are boiled at a strength of 80° Tw. Were it not for this liquor, no less than seven self-fired pots would be required to do this work, showing a difference of 80 tons of fuel.

The question may be asked, "Why increase the size of these huge pieces of apparatus?" The answer, I apprehend, is that owing to competition and reduction of prices, greater efforts are necessary to reduce costs. With automatic apparatus like the black ash revolver, we may consider no very sensible addition of man-power would be needed, in passing from the smallest-sized to the largest-sized revolver. Then, again, we may, reckoning a certain constant amount of heat lost per each revolver furnace of the small size, consider that if we doubled the size of such revolver, we should lose by no means double the amount of heat lost with the small apparatus; but only the same as that lost in the small furnace *plus* a certain fraction of that quantity, which will be smaller the better and more efficient the arrangements are. Then, again, there is an economy in iron-plate for such a large revolver; there is economy in expense on the engine-power and on fuel consumed, as well as in wear and tear.

Just to mention fuel alone, we saw that with an ordinary large-sized revolver, the coal consumption was 13cwt. per ton of salt-cake decomposed in the black ash process; but with the giant revolver we have been describing, that consumption is reduced to 10cwt. per ton of cake decomposed.

The question will be probably asked, how is it possible to get a flame from one furnace to carry through such a long revolver and do its work in fusing the black ash mixture effectively from one end to the other? The furnace employed viewed in front looks very like an ordinary revolver fireplace, but at the side, thereof in line with the front of the revolver, at which the discharge of the "crude soda" takes place, there are observed to be three "charging holes," rather than doors, through which fuel is charged from a platform directly into the furnace through those holes.

The furnace is of course a larger one than furnaces adjusted to revolvers of the usual size; but the effect of one charging-door in front and three at the side, which after charging are "banked" up with coal, with the exception of a small aperture above for admission of air, is very similar to that sometimes adopted in the laboratory for increasing heating effect by joining several Bunsen lamps together to produce one large powerful flame. In this case, the four charging holes represent, as it were, the air apertures of the several Bunsen lamps. Of course the one firing-door at front would be totally inadequate to supply and feed a fire capable of yielding a flame that would be adequate for the working of so huge a revolver. As an effort of chemical engineering, it is a very interesting example of what skill and enterprise in that direction alone will do in reducing costs, without in the least modifying the chemical reactions taking place.



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THE FRACTIONAL REDUCTION OF ORTHO- AND PARANITROTOLUENE, AND NOTES ON THE QUANTITATIVE ANALYSIS OF ORTHO- AND PARATOLUIDINE.

BY T. MINIATI, H. BOOTH AND J. B. COHEN.

It is well known that aromatic nitro-compounds on reduction yield amido-compounds. When toluene is nitrated, two isomeric nitrotoluenes, ortho- and paranitrotoluene, are the principal products formed, and always occur in varying proportions in commercial nitrotoluene. On reduction they are transformed into the isomeric ortho- and paratoluidines. It was thought interesting to determine which of these isomeric nitrotoluenes is the more readily reduced, or whether reduction goes on *pari passu* in both cases. The principle of the method employed for determining this is as follows:—Supposing equal quantities, say 10grs., of pure ortho- and paranitrotoluene are taken, and tin and HCl sufficient to reduce half the total quantity (10grs.) added, then it is evident that the product will consist of one of three things. It will contain only orthotoluidine and only paranitrotoluene—*i.e.*, if the orthonitrotoluene is reduced first, or if the inverse reaction occur, only paratoluidine and orthonitrotoluene; if both are reduced, the toluidine and nitrotoluene, obtained after reduction, will consist of mixtures of the two isomers. An analysis of the unattacked nitro compounds, or the toluidine formed, will then show with which isomer and to what extent reduction has occurred. From a series of experiments, which are not yet completed, it appears that para- and orthonitrotoluene are acted on *concurrently* and not separately. The results have, however, not been of a nature to be able at present to state definitely the rate at which reduction has occurred, nor has the action been extended to various reducing agents, which may possibly give different results. Before beginning the analytical work it was necessary to determine whether the reduction could be so regulated that approximately the same quantities of nitro toluene could be reduced with a given quantity of the reducing agent. With care this may be readily accomplished. The separation and isolation of the nitrotoluene and toluidine is a simple though tedious operation. Among the various methods tried, the following is satisfactory:—After reduction, the resulting acid solution is distilled in steam, and the unattacked nitrotoluene driven over, the toluidine remaining behind. The toluidine solution is freed from Sn by H_2S and filtered. If the precipitation is done hot, the sulphide settles down in a dense form, and is less difficult to filter. The filtrate is then made alkaline and distilled in steam, and the toluidine distils. Both distillates are extracted with ether, the ether distilled off, the residue dried and weighed. The first gives the weight of nitrotoluene, the second that of the toluidine. All that is necessary for the analytical part is (1) to be assured of the purity of the original materials, and (2) of the reliability of the method of analysis. The para- and orthonitrotoluenes were obtained from C. A. F. Kahlbaum. The para was in fine crystals, melting at 54°, the ortho, as might be expected, contained about 15 per cent. of para-compound, estimated by reduction and analysis by Rosenstiehl's method. To arrive at a result it is not necessary that both products after reduction should be analysed. Having the weight of the nitrotoluene and the toluidine, an analysis of the one or the other, and the determination of the quantity of ortho and para present in it, will suffice to find exactly how the reduction has gone. The simplest method which naturally suggests itself is the analysis of the resulting nitro-compound, which does away with the tedious extraction of the toluidine. A few experiments were made to determine how far the method of freezing might answer. The para-nitro-compound is solid at ordinary temperatures, the ortho-nitro liquid. Various mixtures of the two were made, and it was found that when not more than 50 per cent. of paranitrotoluene was present, the mass at the ordinary temperature was semi-solid. In the proportion of four parts para to one part ortho, the mass is quite hard. In a mixture of salt and snow (about $-15°$ to $-20°$), when only 30 per cent. of the para-compound is present, the mixture becomes nearly solid. But on draining the frozen cake, on a porous tile, placed in a metal vessel, surrounded by a freezing mixture, only about two-thirds of the total amount of the para-compound could be regained.

Some little time ago a method described by Mr. P. Schoop appeared in the *Chemiker Zeitung* (No. 9, p. 1785), for the quantitative analysis of ortho- and paratoluidine, based on the different solubilities of the acetyl derivatives in water, first pointed out by Weith and Merz in 1869 (*Ber.* 2, 433).[*] Our results by this method were by no means satisfactory, possibly because the proportion of para compound taken was considerably smaller than usually occurs in the commercial product. But this can scarcely be cited as an apology for the method. Two determinations gave the following results—

Taken.	Found.	Melting Point.
1. 9·75grms. orthotoluidine 0·25grm. paratoluidine	2·3950 acetoluide	107° = 1·71grms. toluidine.
2. 9·75grms. orthotoluidine 0·25grm. paratoluidine	3·1325 acetoluide	110° = 2·25grms. toluidine.

Now, as the melting point of the para compound is 147°, and the ortho 107°, it is very evident that in the first instance the acettoluide consists of nearly pure ortho compound. In fact, it is not readily seen how, if 1000 parts of water dissolve only 8·6 parts orthoacettoluide at 19° (which corresponds to 5·8 parts orthotoluidine) as stated, it is possible that in a mixture containing 9·75grms. orthotoluidine, all the orthotoluidine can be dissolved in 800cc. of water. And yet the author of the method says that he obtains results to 0·5 per cent. for all proportions of mixed toluidines. On the other hand, in reducing mixtures of ortho- and parnitrotoluene, and analysing the product by the above method, we have often found that little or no para compound was precipitated on addition of water, although a considerable quantity was certainly present, as we subsequently proved by employing Rosenstiehl's method. It is difficult at present to say to what this is due.

The other method which we tried and found to give reliable results when employed with certain precautions, is the well-known one of Rosenstiehl (*Ann. Chem. Phys.* 26, 249). It is based on the different solubilities of the bioxalates of ortho- and paratoluidine in ether. The para-compound requires 6660 parts ether for complete solution; the ortho compound is very much more soluble, requiring only 200 parts of ether. Rosenstiehl makes up a standard solution of oxalic acid in anhydrous ether, free from alcohol, so that each cc. = 0·005grm. toluidine. The number he gives is slightly wrong. Instead of 1·062grms. it should be 1·059grms. of anhydrous oxalic acid, or 1·177grms. of the hydrated acid per 250cc. Rosenstiehl determines the end of the reaction by running the ethereal solution of oxalic acid into 0·2grm. of toluidine, dissolved in 80grms. ether until no further precipitate is observed. We found this to be almost impossible to carry out practically, as the precipitate being light, does not readily settle or attaches itself to the sides of the vessel and masks the effect. It is equally impossible to determine the end of the reaction by means of litmus paper or litmus solution, as recommended by Lorenz (*Ann.* 172, 1190). The change of colour is only very gradual.

The only method we found practicable was to add excess of oxalic acid solution, bring the precipitate on to the filter paper, wash three or four times with ether, and weigh on a watch glass. Any residue

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[*] 10cc. toluidine and 10cc. acetic anhydride are heated together in the oil-bath for two hours to 140° C. 30cc. glacial acetic acid are then added, and the mixture poured into 400cc. water, and washed out with 400cc. more water. The mixture is allowed to stand 48 hours, filtered, washed with dilute acetic acid, dried at 90° and weighed.

remaining in the flask (and very often the precipitate stuck to the sides), and any residue in the filter paper were dissolved together in water and titrated with decinormal potash solution.

By proceeding in this way reliable results may be obtained. With paratoluidine, m.p. 45°, we found that precipitation was not complete unless the mixture was allowed to stand 12 hours. At the end of this time the whole of the para compound is thrown down as oxalate.

With pure orthotoluidine (samples were made by ourselves and also obtained from Kahlbaum and Schuchardt) there is no immediate precipitation, but on standing 12 hours from 4—5 per cent. of the ortho compound crystallises out.

It therefore follows that in performing the analysis the error due to precipitation of the ortho compound must be allowed for if the solution stands 12 hours, or the error due to incomplete precipitation of the para compound must be allowed for if the precipitate is filtered immediately. The better method, therefore, would be to obtain an approximation of the amount of para compound present in one determination, and then run in just sufficient oxalic solution to precipitate this quantity, and let stand 12 hours. The error due to the precipitation of the orthotoluidine will then be reduced to a minimum. Most of the practical part of the work was carried out by Mr. Miniati, and Mr. Booth has made a series of experiments on Rosenstiehl's method.

DISCUSSION.

Dr. **Dreyfus** said if the method of partial reduction referred to by Dr. Cohen could be carried out it would be a very great benefit to the manufacturers of toluidines, but he hardly thought that the method as it stood at present would give practical results. A better method of preparing toluidines would be to effect the separation of the ortho- and paratoluidines from commercial toluidine, which contained a mixture of the two. Various methods were employed for effecting that separation, which varied at the different works where the methods were carried out, and such methods were kept secret by the works employing them. As far as he knew, the principle of the separation methods rested in the fractional saturation with acids. There had been a method patented by Dr. Loewy for the separation of the toluidines by means of phosphates, but from his experience he considered that method long and tedious, and he did not think that it had been found useful in practice. The methods which he knew had been successful in the production of a fairly pure article rested, as he had before stated, on the fractional saturation with acid.

Dr. **Cohen**, in reply, said that unless it was known beforehand it was quite impossible to carry out the distillation, which certainly gave very fair results in the laboratory.

NOTES ON SOME PLANTS POSSESSING PROPERTIES USEFUL IN MEDICINE AND INDUSTRY, FROM THE CONGO.

BY R. C. PHILLIPS.

The following vegetable products of Africa, not articles of commerce, have attracted my attention during a long residence on the West Coast :—The *Pawpaw*, *Cassia Occidentalis*, *Euphorbias*, *Vernonia Febrifuga*—a plant named by the natives *Saaka*—and some others, on which I propose to make a few notes.

Pawpaws.—These trees are known as yielding a juice with properties similar to pepsin. The effect of making tough meat tender is very remarkable ; half-a spoonful of the juice mixed with a tureenful of water will, in the course of four or five minutes, completely soften a tough joint of old goat, an old duck, or other meat. If the action be unduly prolonged for, say, twenty minutes, the meat will have the appearance of being boiled to rags. Meat thus treated is said to putrefy rapidly if not cooked at once. Wrapping meat in the leaves of the tree is said to produce the same effect in the course of a night. In his "Histoire Naturelle," Dr. Chenu states that the juice is reputed to remove freckles. I have never had the opportunity to verify this, but from its energetic action on flesh, it is not improbable. The seeds have the taste of cress. I have tried to dry the juice by wounding the fruit and catching the milk on plates, and drying in the sun, but the trouble was that the dried product refused to redissolve in water or alcohol. The taste of the water showed that some portion of the dried fruit had undergone solution, but only to a small extent. I then caught a number of drops of the milk in a glass of water, and observed that the solution was only partial ; a precipitate of albuminous appearance was formed, which would not disappear on the addition of a considerable quantity of alkali or acid. I used spirit—brandy—in a similar manner, but with the same result. Obviously the active principle is not the insoluble portion of the milky juice ; but, when all is dried together, the soluble portion may be prevented from dissolving by its association with the insoluble portion, or may itself become changed and insoluble. I never had the opportunity of ascertaining if this be the case. The pawpaw grows freely on most parts of the coast near the Congo ; the best place is the newly - acquired Portuguese territory of Cabinda. The vexatious conditions imposed by the Independent Congo State, and the inferiority of the territory, negative success in those parts.

Further Note on the Pawpaw.—I once knew of a number of pawpaw seeds being thrown away ; a large number took root — perhaps 100—but all were males. This would be an inconvenient experience in planting.

Cassia occidentalis.—This plant grows freely on most parts of the coast, the seeds ground after roasting being a fair substitute for coffee. They are reputed to possess pectoral qualities when thus used, and do not cause sleeplessness, as is so much the case with coffee. I have often used these seeds when short of coffee, and have offered this "coffee" to others without having the substitution discovered. The roots are bitter and reputed febrifugal.

Euphorbias.—These grow in great abundance on many parts of the coast, and their milky juice is well known as a drastic purgative. It is not now made use of in medicine, through, I am informed, its variability of effects. One species, the Cassoneira, is used by the natives of Kinsembo to stupefy fish in their river ; the fish are then taken at palisades which are formed across the river. This drug might probably be of high service in homœopathic therapeutics if properly proved. The Cassoneira is used by the Misorongo tribes to form hedges round their towns, its immense bushes forming a perfect barricade against native tribes, who greatly fear getting the juice in their eyes, the result of which would be temporary, if not permanent, blindness. The branches are very brittle, and bleed copiously when broken. The columnar Euphorbias yield a similar juice in great abundance and with probably analogous properties.

Vernonia febrifuga (Soyaux).—This tree possesses an intensely bitter bark ; but I am unaware by what means Soyaux made out its febrifugal properties; probably from some of the native herbalists. It might be worth investigation.

Saaka.—This is a native bush which would probably repay cultivation and improvement. The fruit is spindle-shaped, some ⅞in. in length, red skinned, and has an agreeable pulp enclosing the seed. At first sight, there is nothing special to recommend it to notice, but it will be found that, although not particularly sweet, it has the remarkable power of making any fruit eaten afterwards taste very sweet. It is usually eaten with limes, but oranges, pine-apples, and mangoes are sweetened by Saaka even an hour after eating it, and when all taste of the fruit has left the mouth. Vinegar and dilute mineral acids show the same phenomenon.

Rubber Plants.—The rubber-bearing plants are not cultivated; the natives simply select such as they please for tapping for the milky juice. It has been suggested to me that the trees might be profitably cultivated and methodically tapped, avoiding waste and the intermixture of bark and other impurities. There are several species of rubber-bearing trees, the best of which, I am told, is a straight-trunked tree of compact habit, which I well know by sight, and, if it be true that this is the best rubber-yielder, I should think that it would be very suitable for plantation. Some other species of rubber-bearing plants are thin-stalked bushes, running about among the other bush, and unsuited for orderly culture. Among the promises of extended trade when the upper Congo is exploited, we are regaled with accounts of vast forests of rubber trees that will yield fabulous amounts of rubber. I, in turn, can point to immense woods of these trees not five miles from the coast, but hardly touched by the natives. Unless plantations are made by Europeans, the yield of rubber on the coast can increase but slowly—nay, it may easily diminish instead of increasing. What is of the first importance is a population, large, friendly and intelligent, to permit of increasing commerce: a little thought in this direction would be of far more value than all the egregious announcements of unlimited trade for those with enterprise enough to open up the upper river, with which the world has been lately entertained.

Castor-oil Plants grow in abundance, but are not used commercially; perhaps they are more easily obtained from America. It has been said that the oil flavours the other cargo of the ship in which it may be exported; this is, however, only hearsay; certainly nobody has attempted the experiment during the last fifteen years, and probably for many years previously.

Indigo.—There are many plants of the Indigofera family, and through the kindness of Mr. Watson Smith, who sent me seeds, I know that indigo may be cultivated; the irregularity of the rains, and absence of convenient supplies of water, militate against the growth of small plants whose roots penetrate only a small distance below the surface of the ground.

Nkasa.—This tree is described by botanists under the name of "Sassy" tree, its powdered bark being used by the natives for their ordeals by poison. The effect of the bark is sometimes of the nature of an emetic, sometimes it produces purging, and I have seen one instance of comatose state produced. It is so seldom that a white man is present at these ordeals, that we know little with certainty about the action of this drug; but it certainly has very active properties which the homœopath would soon turn to account. Compare the cardinal importance of rhus, which is of analogous use in Madagascar.

Besides the foregoing, there are various other products obtainable, the chief difficulty of developing which lies in the fact that the workers are employed in other pursuits, which they will not be induced to leave, except with the plainest demonstration that the new occupation will be more profitable. This is not easy to give to the native, who is conservative of old customs, and sceptical concerning anything new.

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MR. J. NEILSON CUTHBERTSON IN THE CHAIR.

THE ESTIMATION OF IRON IN CHARS.

BY ROBERT DAVIDSON.

THE estimation of iron by means of stannous chloride has been fully investigated by Fresenius and others, but only where it exists in large quantities. So far as I am aware, no one has yet tested the accuracy of this process in the case of substances, such as animal charcoal, containing only from 0·1 to 1 per cent. ferric oxide. Some experiments which I have made in this direction I now take the opportunity of bringing before you.

A standard solution of ferric chloride was prepared containing 0·01grm. Fe_2O_3 per cc.

The stannous chloride was made up of such a strength that about 2·5cc. equalled 1cc. of the standard Fe solution, and was always prepared immediately before use.

The iron solution was delivered into a 100cc. flask with 5cc. hydrochloric acid (sp. gr. 1·185) and 10cc. water. The solution was maintained just at the boiling point during the titration. The end reaction is very delicate, one drop of the $SnCl_2$ being sufficient to discharge the colour.

The following are the results:—

Fe_2Cl_6 Solution.	$SnCl_2$ Consumed.
1·0cc.	2·63cc
1·0	2·63
0·5	1·32
1·6	1·16
0·9	2·35
0·4	1·10
2·2	5·80
1·1	2·90

The mean experimental error ± 0·0092cc.

I now sought to compare our tin process with the "bichrome" and "permanganate."

Permanganate Process.

For the standard permanganate solution 1grm. was dissolved in 1000cc. water, and the ferric chloride was reduced by 0·8grm. zinc dust in a flask provided with a narrow exit tube, and containing 5cc. HCl and 10cc. water. After complete solution, 50cc. boiled and cooled distilled water were added.

Blank Test:—

0·8grm. zinc consumed 0·60cc. } Mean, 0·565cc.
" " " 0·53

Fe_2Cl_6 Solution.	$KMnO_4$ Consumed.	
1·0cc.	4·85cc.	Mean, 4·835cc.
1·0	4·85	
1·0	4·82	
1·0	4·82	
1·9	8·45	
0·6	3·20	
1·2	5·80	
0·3	1·70	
0·9	4·45	
0·5	2·70	
1·6	7·20	
2·0	9·00	

Mean experimental error ± 0·0294cc.

Bichrome Process.

Half decinormal solution of bichromate of potash was used, and zinc to reduce the iron. Acid, etc., same as with the permanganate process.

Blank experiment showed mere trace of iron.

Fe_2Cl_6 Solution.	$K_2Cr_2O_7$ Consumed.
0·6cc.	1·20cc.
1·1	3·30
1·7	4·70
0·4	1·10
0·8	2·30
1·9	5·40
2·4	6·50
1·5	4·10
1·3	3·50

Mean experimental error ± 0·0548cc.

Another series was made with "bichrome," but $SnCl_2$ was the reducing agent.

Mean of 4 experiments with 1cc. Fe_2Cl_6, gave 2·55cc.

Fe_2Cl_6 Solution.	$K_2Cr_2O_7$ Consumed.
2·1cc.	5·05cc.
0·9	2·30
0·5	1·35
0·7	1·75
1·1	3·50
0·3	0·95
1·1	2·80
1·8	4·55

Mean experimental error ± 0·0354cc.

I next tried those three methods with the actual char, but before describing them, allow me to say a word about the state of oxidation of iron in chars. It exists, probably, in both the ferrous and ferric conditions; even metallic iron is met with in new char. But it appears impossible to determine their respective amounts, owing to the reducing action of the carbon present. When a char is boiled in dilute hydrochloric acid, all the iron is found as FeO, but Fe_2O_3 can be detected, if it is dissolved in the cold; even under these conditions the carbon still exerts its action. For example: The carbon was separated by means of acid, from both a new and a stock char, carefully washed, and then simply mixed with 1cc. of standard solution of iron, 5cc. HCl and 10cc. H_2O, allowed to digest for an hour in the cold, when over 80 per cent. of iron with the former, and about 60 per cent. with the latter, were found to be reduced. However, we generally report it in the trade as Fe_2O_3.

We now proceed to detail the char experiments. The samples were passed through a "60" mesh sieve, and 2grms. weighed off in a platinum capsule, and thoroughly ignited, then dissolved in 5cc. HCl and 10cc. H_2O. Two chars were used throughout, one being a new, the other a stock char, except in the case of the bichrome "new char" tests, when another sample had to be used, owing to my supply having failed. In the case of the bichrome process, I had to abandon the use of zinc as a reducing agent, as the results came out too low—*e.g.*, the new char, containing about 0·2 per cent. Fe_2O_3, scarcely gave a reaction with potassium ferricyanide. When, however, $SnCl_2$ was substituted, better results were obtained, though still on the low side.

Bichrome Process.

New Char.

Consumed	0·70cc.
"	0·50
"	0·40
"	0·70
Mean	0·575cc.

=0·113 % Fe_2O_3. (Tin process, 0·161%.)

Mean experimental error ± 0·125cc., equal to 0·024% Fe_2O_3

Stock Char.

Consumed	4·2cc.
"	4·0
"	3·9
"	3·95
Mean	4·013cc.

=0·787 % Fe_2O_3.

Mean experimental error ± 0·074cc., equal to 0·0135% Fe_2O_3

Permanganate Process.

Blank Test.—Mean of 2 experiments, consumed 0·565cc.

New Char.

Consumed	2·1cc.
"	2·3
"	2·0
"	2·0
Mean	2·1cc.

= 0·180% Fe_2O_3.

Mean experimental error ± 0·1cc. = 0·0117% Fe_2O_3

Stock Char.

Consumed	7·8cc.
"	7·7
"	7·5
"	7·8
Mean	7·7cc.

= 0·835% Fe_2O_3.

Mean experimental error ± 0·1cc. = 0·0117% Fe_2O_3

I may here parenthetically remark that Tucker, in his "Manual of Sugar Analysis," recommends the filtrate from the carbon to be titrated, but the organic matters in solution cause too high results. The above new char, for example, instead of yielding 0·18 per cent., gave 0·33 per cent, and the "stock" char gave 0·89 per cent. instead of 0·835 per cent.

Tin Process.

The iron should be fully oxidised, with 5 drops of peroxide of hydrogen (20 vol.) and boiled gently for three minutes, to expel the excess. This causes no loss through volatilisation. I prefer hydroxyl to potassium chlorate, because one can add a definite quantity without weighing, and an excess appears to be more readily expelled.

Standard Tin Solution.—Mean of 5 experiments, 2·89cc. = 1cc. standard Fe.

New Char.

Consumed	1·35cc.
"	1·35
"	1·28
"	1·30
Mean	1·32cc.

= 0·228 % Fe_2O_3

Mean experimental error ± 0·03cc. = 0·0059% Fe_2O_3

Stock Char.

Consumed	1·7cc.
"	1·8
"	1·8
"	1·8
Mean	1·775cc.
	= 0·826 % Fe_2O_3.

Mean experimental error ± 0·037cc. = 0·0065 % Fe_2O_3

The end reaction is not quite so distinct as with the pure Fe_2Cl_6 solution, owing to the presence of a little insoluble matter which floats in the liquid. This may be obviated by filtration, but at the same time avoiding any unnecessary excess of wash water, which would of course interfere with the reaction.

In conclusion, I confidently recommend the tin process in preference to either the permanganate or bichrome. For both, with the pure Fe_2Cl_6 solution and the chars, we find the experimental errors to be less. Besides being the most accurate, it is also the most speedy—five minutes sufficing for a single estimation.

Allow me to take the opportunity of acknowledging my best thanks for the time afforded by my employers, John Walker & Co., for carrying out the above experiments.

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NOTE ON THE DETERMINATION OF AMMONIA IN COMMERCIAL PRODUCTS.

BY J. M. MILNE, PH.D., F.I.C.

Two methods are in general use for the determination of ammonia—viz., by conversion into the double chloride of ammonium and platinum—a process too well known to require description, or by previous liberation of the ammonia, either by combustion with soda-lime or distillation with strong solution of caustic soda, and absorption in an excess of hydrochloric acid, with subsequent conversion into the platinum salt on the one hand, or absorption in a measured excess of standard sulphuric acid and reverse titration with standard alkali.

The platinum method, although an elegant and accurate one where nearly pure salts have to be dealt with, has one or two drawbacks for commercial work. It is expensive, and occupies a good deal of time. As regards the other method, anyone who has tried the soda-lime process in the case of ammonia salts, even with previous addition of starch or sugar, will have realised the annoyances incidental to it. Distillation with caustic soda is also troublesome, from the tendency of a strong alkaline solution to froth up and bump when boiled, with possible projection of a little of it into the condensing arrangement, to the detriment of the determination. Some time ago a German committee was appointed to report on the methods in use for the analysis of phosphates, manures, etc., and to make suggestions as to the adoption of uniform methods. With regard to the determination of ready-formed ammonia in manures and salts, this committee recommended the liberation of the ammonia by boiling with magnesia instead of caustic soda, and absorption in a measured excess of standard sulphuric acid. One great advantage of this modification is that the contents of the distilling flask boil quite quietly, and can be brought nearly to dryness without spirting, if the gas flame is properly regulated. As I have used the magnesia method for some time with very satisfactory results, and the apparatus is very simple, I thought it might be of interest to some of you to see it in actual operation. An 8 or 10oz. wide-mouth flask is fitted with an indiarubber cork, pierced with two holes, through one of which passes a small funnel with a tap, and through the other a somewhat wide exit tube. The latter is connected with a short inverted condenser, the lower end of which is tightly fitted to the neck of a nitrogen bulb of the new form, in which 20cc. of normal sulphuric acid have been previously placed. A weighed quantity of the sample is placed in the flask, together with 2grms. of magnesia, and about 60cc. of water, and the mixture kept gently boiling by means of a rose-burner. When the contents of the flask are nearly dry, the flame is removed, about 10cc. of water run in from the funnel, and the boiling continued. This operation is repeated two or three times. Finally the nitrogen bulb is connected with a small aspirator, and a gentle current of air drawn through the whole apparatus for a few minutes, in order to ensure complete absorption of all the ammonia. The exit tube is then disconnected from the condenser, and the latter rinsed, into the bulb, with a little water, a few drops of cochineal added, and the excess of normal acid determined with fifth-normal soda.

In using the apparatus, the committee recommend the following precautions to be observed:—(1) that the steam containing the ammonia be thoroughly condensed as it passes over; (2) that the end of the condenser tube does not dip beneath the surface of the sulphuric acid in the bulb flask; and (3) that complete absorption of the ammonia is ensured by attaching a small U-tube containing a little of the standard acid to the exit tube of the flask.

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ORTHO-CHROMATIC PHOTOGRAPHY.

BY C. H. BOTHAMLEY, F.I.C., F.C.S.,

Assistant Lecturer on Chemistry, and Lecturer on Photography in the Yorkshire College, Leeds.

It is well known that the ordinary photographic processes fail to give pictures with true values, or, in other words, they fail to render coloured objects with their proper degrees of relative brightness. Yellow, orange, and green objects, which are bright to the eye, are dark in a photograph, whilst blue, purple, and violet, which are comparatively dark to the eye, are bright in a photograph. Photographic effect is not coincident with optical effect.

In order to ascertain the cause of these differences it is necessary to separate ordinary white light into its component rays, and to measure the optical and photographic effects of the separated rays. This is done most conveniently by means of the spectrum, and the effects produced by different parts of the spectrum are best expressed in the form of a curve, the base line of which represents the spectrum, whilst the ordinates or heights of the curve above the base line at any given points represent the intensity of the action at those points. The abscissæ, or points marked off along the base line, represent the principal Fraunhofer lines.

The optical effect or relative luminosity of different parts of the spectrum has been estimated by several observers, notably by Vierordt, and more recently by an improved method by Abney and Festing.[*] The relative luminosity of the different parts varies with the nature of the source of light, with the absolute brightness of the light, and with different observers; but the general result is that the maximum luminosity is in the yellow, not very far from the line D. The brightness diminishes somewhat rapidly in the green and then very gradually in the blue and violet, the more refrangible part of the visible spectrum terminating close to the line H. On the less refrangible side of D the luminosity falls off gradually but rapidly through the orange and orange red to the line A at the termination of the red. (Fig. 1, No. 3.)

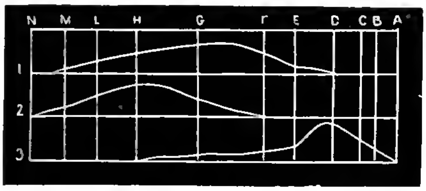

Fig. 1.

When the spectrum falls upon an ordinary gelatino-bromide plate—that is, a glass plate coated with a thin dry film of an emulsion of silver bromide in gelatin—it is found that the maximum photographic effect is produced by the blue about midway between F and G. A considerable amount of action is exerted by the violet, and the invisible rays beyond the violet, and on the less refrangible side of the maximum the action falls off rapidly, becoming very small in the green and ceasing altogether before it reaches the line D. By suitable treatment, however, the sensitiveness of the gelatino-bromide can be increased so that if the exposure is sufficiently long a sensible though slight amount of action is exerted by the yellow, orange, and even by the orange red. (Fig. 1, No. 1.) When silver gelatino-chloride is examined in the same way the maximum effect is produced close to the line H, and the action diminishes gradually but rapidly on either side, ceasing altogether in the green. (Fig. 1, No. 2.)

From these results it is evident that the rays which produce the greatest effect on the eye, the yellow, green, and orange, have little or no action on an ordinary photographic plate, whilst blue and violet rays, which have comparatively little action on the eye, produce the greatest effect on the plate. It follows that in order to photograph coloured objects in correct gradations the character of the photographic plate must be so altered that the sensitiveness to yellow, orange, and green is very considerably increased, whilst the sensitiveness to blue and violet is much diminished. According to Dr. Eder,[†] the orange near C and the full blue near F should exert about the same amount of action, whilst the effect of the yellow near D should be eight times, that of the yellowish green near D ten times, and that of the green near E three times, the effect of the blue. Violet, on the other hand, should exert only about one-tenth as much action as the blue. The term "Ortho-chromatic Photography" is used to denote the photographic representation of all classes of coloured objects with their proper degrees of relative brightness, or, to use the artistic term, with their proper "values." The power of photographing rays of low refrangibility is not only valuable from a pictorial point of view, but is of the greatest importance in spectrum photography.

In 1873 Dr. Hermann W. Vogel[‡] discovered that if certain dyes, such as corallin or aniline greens, are added to a sensitive dry collodion film, the film becomes sensitive to yellow or greenish yellow, and the rays to which the plates become sensitive correspond closely, but do not coincide, with the rays which are absorbed by the dye. Substances which produce this result were classified by Vogel as "optical sensitisers," on the ground that their action depends upon their power of absorbing light rays. These observations were confirmed by Carey Lea, Waterhouse, Becquerel, Abney and others, and on the Continent the principle was applied with considerable success to the reproduction of paintings. Cros and Ducos du Hauron[§] also made it the basis of an indirect process of photography in colour through the medium of chromo-lithography.

Shortly afterwards, however, the modern dry plate or gelatino-bromide process was introduced, and gradually displaced the older collodion processes. The first attempts to employ dyes with gelatino-bromide plates gave unsatisfactory results, but in 1882—83 Attout and Clayton, commonly known as Tailfer and Clayton, took out a patent[‖] in France and England for the application of eosin in conjunction with an alkali to gelatino-bromide plates, the term eosin being understood to include all the dyes belonging to the eosin group. By this treatment the plates, which are sold under the name of "Isochromatic" plates, are made very sensitive to the greenish yellow rays. Schumann confirmed the advantages resulting from the use of eosin, and Vogel introduced plates stained with a dye to which he gave the name "Azalin," but which is understood to be a mixture of cyanin, or quinoline blue, with quinoline red.

The question has been made the subject of a long and careful series of experiments by Dr. Josef Maria Eder, of Vienna, who has investigated the effect produced by more than 160 different dyes under a variety of conditions.

Two methods are employed for impregnating the silver gelatino-bromide with the dye. In the first the dye is added to the melted emulsion before coating the plates; in the second the coated and dried plates are steeped for a few minutes in a neutral or ammoniacal solution of the dye in water or alcohol. The proper regulation of the proportion of dye is found to be a point of the greatest importance. If too little dye is used the maximum effect is not obtained, whilst if the quantity of dye exceeds the proper amount its effect is likewise diminished. When the dye is added to the emulsion, 2—4 milligrams per 100cc. of melted emulsion is found to be sufficient, whilst for bathing the dry plates a solution of the dye in 20,000 or 30,000 parts of water may be used. The higher the tinctorial power of the dye, the smaller the amount that is required.

Eder[¶] found that comparatively very few dyes have any effect in increasing the sensitiveness of gelatino-bromide plates to the less refrangible rays, and in the majority of cases in which an effect is observed it is but small, and can only be recognised when the exposure is prolonged and the dye is present in the proper proportion. It is necessary to dis-

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[*] Bakerian Lecture, Royal Society, 1886.

[†] Sitzungsberichte d. kais. Akad. der Wissensch. Wien, 1881, Abth II. p. 1117

[‡] Ueber die Lichtempfindlichkeit des Bromsilbers für die sogenannten chemisch unwirksamen Farben. *Berichte*, 6, p. 1302.

[§] Traité pratique de photographie des couleurs. Paris, 1878.

[‖] Brevet, 152,615, December 13, 1882; Eng. Pat. 101, 1883.

[¶] Sitzungsb. d. kais. Akad. der Wissensch. Wien, II. Abth, 1881; II. Abth, 1885; and II. Abth, 1886.

tinguish between the effect of a dye on the general sensitiveness of a plate to light as a whole, and on its relative sensitiveness to particular rays. The majority of dyes render the plates less sensitive to ultra-violet, violet, and, in several cases, blue rays, and thus diminish their general sensitiveness to one-fifth, or even one-tenth, of its original value, whilst at the same time the relative sensitiveness to particular says, such a yellow, orange, or green, may be increased many times.[*] The results are represented in the form of curves.

Violet dyes, such as Hofmann's violet, gentian violet, methyl violet, acid violet, diminish the general sensitiveness, mainly by making the plate much less sensitive to ultra violet rays. At the same time the sensitiveness to green, yellow, and orange is considerably increased, the maximum effect being observed between D and C. (Fig. 2, No. 1.)

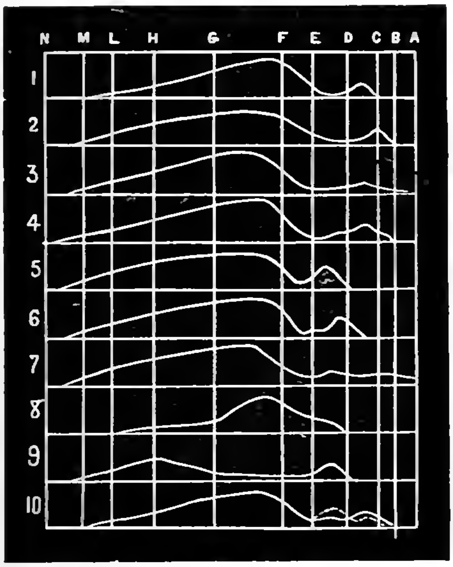

Fig. 2.

(1) Violets. (2) Greens. (3) Iodine Green. (4) Cyanin. (5) Eosin. (6) Rose Bengal + Ammonia. (7) Cœrulein. (8) Chrysaniline. (9) Eosin and Silver Chloride, (10) Eosin + Cyanin.

Green dyes, such as acid green, benzaldehyde green, ethyl green, methyl green, and their varieties, have very little sensitising action, and their effect can only be observed with prolonged exposure and brilliant illumination, great attention being paid to the proper regulation of the proportion of dye. Under favourable conditions the plate is made slightly sensitive to yellow, orange and red, the point of maximum effect being situated close to the line C. (Fig. 2, No. 2.) Iodine green is worthy of notice, since its sensitising action, although feeble, extends to the extreme red. (Fig. 2, No. 3.) In this respect, however, it is far inferior to certain dyes which were investigated subsequently.

Cyanin, or quinoline blue, confers on silver gelatino-bromide a high degree of sensitiveness to orange and red, a fact which was discovered simultaneously by Eder and Schumann. Ordinary or iodo-cyanin gives the best results, but all the commercial varieties behave similarly. The general sensitiveness of the plate is considerably diminished, but the sensitiveness to yellow, orange, and orange-red becomes comparatively great, the maximum effect being observed between D and C. The sensitiveness to orange is more than a hundred times as great as that of an undyed plate. If ammonia is added together with the cyanin, the effect of the latter is still more marked. (Fig. 2, No. 4.)

Eosin, and the dyes belonging to the same group, exert a considerable sensitising action for yellowish green and yellow, the maximum action being nearer D the bluer the shade of the dye. In the case of eosin (tetrabromfluorescein) itself the maximum is between E and D; in the case of rose Bengal, the sodium salt of tetra-iodo-dichlorofluorescein, the maximum is a little to the more refrangible side of D. Simultaneous addition of ammonia increases the effect of these dyes.

Naphthol blue[†] (which is not the same as indophenol blue), and the seemingly identical neutral blue of the Frankfort Anilin Farbenfabrik, have the remarkable property of rendering a plate sensitive without interruption to the whole length of the spectrum, from wave-length 3600 to wave-length 7600. The first maximum is at the usual place in the blue, about midway between G and F, and there is a second smaller maximum close to C. In order to apply these dyes to the plates, the latter are steeped in a solution of 1 part of the dye in 3000 to 10,000 parts of water, to which has been added 1—2 per cent. of ammonia. Notwithstanding the behaviour of such plates to the spectrum, no satisfactory results were obtained when these dyes were applied to the photographing of paintings.

Cœrulein,[‡] used in the form of cœrulein S, which is a compound of cœrulein with sodium hydrogen sulphite, excels even naphthol blue in its power of sensitising for the less refrangible rays. It has the additional advantage that it does not make the plates so liable to fog under the action of the developer, and thus gives clearer and better negatives.

Gelatino-bromide plates stained with any of the last three dyes excel all known photographic preparations in their qualitative sensitiveness to rays of different wave-lengths, the sensitiveness extending from the ultra-violet to at least a short distance into the infra-red.

Chlorophyll, which was found by Ives[§] to give excellent results with collodio-bromide plates, gives very uncertain results with gelatin plates, but some recent experiments by Dr. Maddox[‖] indicate that this point is worthy of further investigation.

Rosaniline, Magdala red, Coupier's blue, many indulin dyes and others, sensitise for the less refrangible rays, but their action is comparatively feeble. Chrysaniline is a good sensitiser for green. (Fig. 2, No. 8.) Other dyes, such as corallin, acid magenta and resorcinol blue, do not increase the sensitiveness to yellow, etc., but render the plates much less sensitive to the ultra-violet and violet rays, and thus increase the *relative* sensitiveness to blue, whilst they greatly reduce the general sensitiveness of the plates. Chrysaniline likewise shows this action in a very marked degree.

When the silver gelatino-bromide is not pure, but, as frequently happens, contains a certain proportion of silver iodide, the phenomena are of the same order, though not always of the same magnitude. The presence of silver iodide does not appreciably affect the sensitising action of the dyes, provided that the proportion of iodide does not exceed about 3 per cent., but if the amount exceeds 10 per cent. the sensitising action is diminished.

The effect of dyes on silver gelatino-chloride is of the same general character as their effect on the bromide. In the case of a gelatino-chloride plate

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[*] *Loc. cit.* 1st paper, p. 1117.

[†] *Loc. cit.* 2nd paper, p. 1357.

[‡] *Loc. cit.* 3rd paper, p. 76.

[§] Photographic News, 1886, pp. 359 and 439.

[‖] British Journal Photographic Almanac, 1887, p. 77.

stained with eosin, the sensitiveness to yellowish green is so much increased, whilst that to ultra-violet and violet is so much reduced that the former becomes equal to the latter. (Fig. 2, No. 9.)

In almost all cases, the curve representing the effect of the spectrum shows two maxima separated by a minimum which is usually in the green or yellowish green. The first maximum is in the blue, and this part of the curve corresponds with the ordinary action of the blue, violet, and ultra-violet rays on an undyed plate. The second and smaller maximum is in the less refrangible half of the spectrum, and varies in position and magnitude according to the nature of the dye. When the exposure is very brief, the minimum portion of the curve disappears, and the action is represented by two detached curves, one in the more refrangible and the other in the less refrangible half of the spectrum, separated by a region in which there is no perceptible action.

When ammonia is added simultaneously with the dye, the sensitising action is greater, and extends further on each side of the maximum. In none of Eder's experiments, however, was the plate as sensitive to the less refrangible rays of the solar spectrum as to the blue and violet.

With a large number of dyes, the negatives are much more intense with the dyed plates than with the undyed plates. The dyes, in fact, behave in much the same way as an excess of alkaline bromide in the emulsion, and give stronger and denser negatives at the cost of reduced sensitiveness.

The fact that with different dyes the second maximum is situated at different points in the less refrangible region, at once leads to the supposition that by mixing the dyes it might be possible to make the plates uniformly sensitive to this region of the spectrum. This conclusion, however, is not completely supported by experiment. It is found that one dye interferes with the action of another. With a mixture of eosin and cyanin, for example, if the former is in excess, the sensitiveness to orange is less than with the same proportion of cyanin alone; and if the latter is in excess, the sensitiveness to yellowish green is less than with the same proportion of eosin alone. The action of the spectrum on plates dyed with such mixtures is shown by curve 10, Fig. 2, in which the dotted curve represents the result with eosin in the greater proportion, and the unbroken curve the result when cyanin is in the greater proportion.

The results of Vogel's and of Eder's investigations have been extensively applied on the Continent to the preparation of gelatino-bromide plates sensitive to yellow, green, and orange, for the purpose of photographing paintings and coloured objects generally. The spectrum experiments show that although by treating the plates with various dyes their sensitiveness to the less refrangible rays is very greatly increased, the sensitiveness to blue and violet still remains much greater, and therefore, in order to obtain correct gradations in the photograph, it is necessary to diminish the intensity of the blue and violet rays before they reach the plate. This is done by interposing a transparent yellow screen between the object and the lens. Although many successful results have been obtained, the reports of different experimenters as to the value of the processes are conflicting. An additional difficulty is introduced by the fact that the same dye is met with under a large number of different trade names, and in some cases different dyes have the same or very similar names. Moreover, commercial dyes vary considerably in purity, and therefore in the effects which they produce. Vogel states,* for example, that eosins from different sources give very different results; rose Bengal of French manufacture is a very good sensitiser, whilst that from a Belgian source is very much inferior in its action.

The scientific interest of this question, and its great importance from a photographic point of view, led me to undertake a series of experiments, the results of which I have the honour of bringing before the Society in this paper. Eder's researches show that the fluorescein dyes and cyanin exert the greatest sensitising action, and this has been confirmed by Mallman and Scolik and others, who have actually applied these dyes to ordinary photographic purposes. I therefore confined my attention almost exclusively to these dyes, and my experiments may be classified under three heads—(1) a comparative examination of commercial samples of the fluorescein dyes; (2) the action of the prismatic spectrum on plates stained with these dyes; (3) the application of such plates to the photography of flowers, paintings, and other coloured objects.

Comparative Examination of Dyes.—The principal dyes derived from fluorescein are eosin, which is tetrabromofluorescein: phloxin, which is dichloro-tetrabromofluorescein; erythrosin, or tetra-iodofluorescein; and rose Bengal, or dichloro-tetra-iodofluorescein. All these compounds are insoluble in water, but they are usually met with in the form of sodium or potassium salts, which are readily soluble in water. Very many different samples of these dyes are put into the market by different manufacturers, and are distinguished by letters, such as eosin A, eosin JJ, erythrosin B, erythrosin RE. When used for dyeing they produce somewhat different shades of colour. They differ considerably in the proportion of water which they contain. One sample of erythrosin, for example, lost 8·8 per cent. when dried at 115—120°, whilst another sample lost 12·5 per cent.; one sample of rose Bengal, under similar conditions, lost 17·4 per cent., whilst another lost 18·0 per cent. The eosins show a strong yellowish green fluorescence; the fluorescence of phloxin is less marked, and is of a deeper tint; erythrosin and rose Bengal are not fluorescent at all. The various samples were compared by examining the absorption spectra of their aqueous solutions. This method of examination gives no exact information as to the magnitude and position of the sensitising effect of the dyes when they are applied to a gelatino-bromide plate, where they are in the dry condition and are intimately associated with gelatin and silver bromide; but it serves, in a great measure, to determine the identity of different samples, and affords information as to whether a given sample is a mixture or consists of a single compound only.

The spectra were examined by means of a Steinheil spectroscope with two large flint glass prisms, the measurements being made by means of a reflected photographic scale, which was so adjusted that the sodium line coincided with division 100. The dyes, for which I am indebted to Prof. J. J. Hummel, were dissolved in 10,000 parts of water, and the layer of liquid examined was 18·3mm. in thickness. The source of light was a Peebles governor burner No. 5, at a distance of about 4 inches from the tube containing the liquid. Fifteen samples of dyes were examined, and the position of the absorption band is given in the following table:—

Dye (1 : 10,000).	Absorption Band D=100
1. Eosin A (Badische-Anilin und Soda Fabrik) ..	140—285
2. Eosin JJ (Society of Chemical Industry)	141—285
3. Eosin SGF (L. Casella and Co.)	140—290
4. Eosin VE (Poirrier and Co.)	140—275
5. Phloxin (P. Monnet)	122—235

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* Photographic News, 1886, 803.

Dye (1: 10,000).	Absorption Band D = 100
6. Phloxin (Meister Lucius and Bruning)	128–255
7. Erythrosin B (Casella and Co.)	130–265
8. Erythrosin I (B. A. S. F.)	133–250
9. Erythrosin (Poirrier and Co.)	135–250
10. Erythrosin BE (Poirrier and Co.)	121–210
11. Erythrosin R E (Poirrier and Co.)	131–250
12. Erythrosin extra (Meister Lucius and Bruning)	133–250
13. Rose Bengal B (Meister Lucius and Bruning)	120–215
14. Rose Bengal (P. Monnet)	119–215
15. Cyanin	60–190

Since the examination was purely comparative, it was not necessary to calculate the wave-lengths of the bands, but the following reference lines will enable this to be done:—

Li α = 47; Sr α = 85—89; D = 100; Ba γ = 132; Tl α = 152·5; Ba α = 165; Ba β = 179; Mg* = 167—169; 191—193; 265; Sr δ 268.

The absorption spectra of the four eosins are evidently identical, and they were, in fact, found to exert equal effects when applied to the plates. The divergences in the extension of the band into the violet may be ascribed to differences in the proportion of water in the different samples, and partly to the difficulty of determining the exact point at which the band ceases, a difficulty which is increased by the very nebulous character of this end of the band. The differences may also be partly due to the fact that some are sodium salts, whilst others contain potassium. The two samples of phloxin are not identical, and it is not at all improbable that both are mixtures. Erythrosin B is not identical with the other erythrosins. It shows a decided fluorescence, and its absorption spectrum and behaviour with silver nitrate indicate that it is a mixture of eosin with erythrosin or rose Bengal, the former being probably present in the greater proportion. The spectrum of erythrosin BE shows that it is really a rose Bengal, and this conclusion is confirmed by the character of its sensitising action on gelatino-bromide plates. The remaining four samples of erythrosin, Nos. 8, 9, 11, 12, are identical so far as their absorption spectra are concerned, and Nos. 8, 9, and 12 exert a practically identical sensitising effect. The two samples of rose Bengal are likewise identical. It is worthy of note that the addition of ammonia has no effect on any of these absorption spectra.

The relation between the optical properties of the eosin dyes and their molecular weights is of considerable interest. The intensity of the fluorescence rapidly diminishes, and the tint of the dye becomes bluer as the molecular weight increases. Fluorescein itself gives a greenish-yellow solution, and its fluorescence is extremely brilliant. Eosin shows a strong fluorescence, whilst erythrosin and rose Bengal are not fluorescent, and the colour of the latter has a decidedly blue shade. Further, the absorption band becomes narrower, more intense, and less refrangible as the molecular weight increases. This is clearly shown by the measurements given in the table.

Effect of the Prismatic Spectrum on Dyed Plates.—The dyes were applied by the bath process exclusively, the plates used being those known as the Paget Prize Plates XXX. They are very sensitive, although not ranking with the most sensitive plates that are made.

In preparing the plates stock solutions were made (1) by dissolving one part of dye in 1000 parts of water, and (2) by diluting strong ammonia to ten times its volume.

When the dyes were applied without ammonia the plates were soaked in water for two or three minutes, and then, after slight draining, immersed for two minutes in a bath prepared by mixing *dye solution* (1 : 1000) one part, *water* nine parts. They were then allowed to drain with their edges on blotting paper, and were dried in complete darkness.

When ammonia and a dye were employed simultaneously the plates were soaked for two or three minutes in dilute ammonia, prepared by mixing one part of strong ammonia with 99 parts of water, and were then immersed for two minutes in

Dye solution (1 : 1000)	1 part,
Ammonia (1 : 10)	1 ,,
Water	8 parts,

drained and dried in the dark. Whilst the plates are soaking the dishes containing them should be rocked gently in order to promote regular action and uniform staining. It will be observed that in both cases the sensitising bath contains 1 part of dye in 10,000.

In the case of cyanin the solution was prepared according to Schumann's formula.† One part of iodocyanin is dissolved in 500 parts of absolute alcohol, and the bath is made up as follows:—

Cyanin solution (1 : 500)	10 parts.
Strong ammonia	2–4 ,,
Absolute alcohol	10 ,,
Water	200 ,,

The plates are soaked in dilute ammonia as above, immersed in the cyanin bath for two minutes, and dried in the dark. Plates thus treated must be used immediately after preparation, since they will not keep in good order for more than five or six days.

After exposure, the plates were developed with a solution which contained in each fluid ounce 1 grain of pyrogallol, 3 grains of ammonium bromide, and 6 minims of ammonia 0·880, and were fixed and washed in the usual manner.

In these experiments I employed, like previous observers, the prismatic spectrum. Such a spectrum is, however, as is well known, of an abnormal character, since the rays are not separated in proportion to their wave-lengths, but the less refrangible rays are crowded together, whilst the more refrangible are more widely separated than they ought to be. In a diffraction spectrum, on the contrary, the distances between the rays are proportional to their wave-lengths. If the length of the visible spectrum is divided into 1000 equal parts, the distance from A to D in the prismatic spectrum is 220 divisions, and from D to H 780 divisions, whilst in the normal or diffraction spectrum the distance between A and D is 468 divisions, and from D to H 532 divisions. It is obvious, therefore, that when a prismatic spectrum is employed, the relative effect of the less refrangible rays will be magnified, whilst that of the more refrangible rays will be diminished,‡ and consequently it is much to be desired that in experiments of this kind a diffraction spectrum should be used when possible. In these experiments I have endeavoured to select a source of light of such a character as to compensate, as far as possible, for the defects of the spectrum.

The spectroscope employed was kindly placed at my disposal by Professor Birch, by whom it had been arranged for photographic work. It is one of Hilger's construction, with an adjustable slit and one carbon bisulphide prism. The ordinary objective of the observing telescope was replaced by a lens with a focal distance of 21 inches. The eye piece was removed and the end of the telescope fitted into an ordinary camera, the back of which was provided with a horizontal swing, so that the whole length of the spectrum could be obtained in focus at once. The slit was used with an aperture of $\frac{1}{50}$ of an inch, and care was

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* Bands in the spectrum of burning magnesium.

† Year-book of Photography, 1887, p. 191.

‡ See Draper, Philosophical Magazine, 1872.

taken to protect the carbon bisulphide from changes of temperature during the exposures. It is scarcely necessary to point out that the carbon bisulphide used in experiments of this kind must be perfectly colourless.

Previous investigators have employed the solar spectrum, but the intensity of sunlight is so variable, especially in this climate, that it is practically impossible to obtain comparable exposures throughout a long series of observations. Moreover, sunlight not only varies in intensity, but also in character—that is, in the relative proportions of rays of high refrangibility and low refrangibility which it contains.[*] In order to obtain comparable results, I employed as a source of light burning magnesium ribbon, which was paid out at the rate of 2 feet 4 inches per minute, by means of an arrangement of clock-work. By burning a sufficient length of ribbon at a uniform rate the effects of inequalities are eliminated, and a unit of exposure sufficiently constant for all practical purposes is readily obtained. Moreover, as Bunsen and Roscoe pointed out several years ago, the light from burning magnesium is far superior to sunlight in its proportion of rays of high refrangibility, which are the chemically active rays so far as concerns the ordinary silver salts. The luminosity or optical activity of the sun's light at a certain zenith distance is 524·7 times as great as that of burning magnesium ribbon, whilst its chemical activity, which in this case depends on the proportion of rays of high refrangibility, is only 36·6 times as great.[†] By using a source of light containing such a very large proportion of rays of high refrangibility, the defects of the prismatic spectrum are to a certain extent neutralised, and the effects observed with a prismatic spectrum of the light from burning magnesium will approximate more or less closely to the effects produced by a diffraction spectrum of sunlight. The visible spectrum obtained was about 75mm. in length, the blue and violet regions being very bright. The exposure for each plate with the aperture of slit given above, was one minute, which corresponds with a length of ribbon of 2 feet 4 inches, or about 70 centimetres.

The dyes actually used as sensitisers were:—Eosin A; eosin SGF; eosin YE; erythrosin I; erythrosin extra; erythrosin (Porrier); erythrosin BE; phloxin (P. Monnet); phloxin (M, L and B); rose Bengal (P. Monnet); rose Bengal B; cyanin; crystal violet; ethyl purple; night blue (B.A.S.F.); violet 5BO. Unstained plates were exposed under similar conditions.

Crystal violet, night blue, ethyl purple and violet 5BO, although they completely absorb the orange, yellow and green, exert very little sensitising action on the plates, a result which confirms Eder's experiments with these dyes.

The results obtained with eosin and its allies and cyanin are represented by the curves in Fig. 3. The reference lines are D, B,[‡] and two other bands which are observed in the spectrum of burning magnesium. That next to B is a broad band composed of 5 or 6 lines,[§] and is situated very near F; the other is a much narrower band, close to the blue strontium line. The curves are not strictly comparable one with another. Each curve must be regarded separately and represents the relative actions of different parts of the spectrum. They are constructed from observations during the development of the plates and from comparisons of the densities of different parts of each negative. Each curve is the mean of several experiments. No increase in accuracy is gained by making elaborate measurements of the densities of the negatives, since the relative densities of different parts of the same negative vary with the time of exposure, and also with the time during which the developer has been allowed to act; moreover, the results will vary slightly with silver gelatino-bromide prepared in different ways.

In their general character my results agree with those of Eder, but there are some important differences of degree. The sensitiveness to ultra-violet and violet is somewhat diminished, but the sensitiveness to the less refrangible rays is very largely increased. Each curve has two maxima, separated by a region of minimum action. Eosin, in aqueous solution, exerts a comparatively slight, although distinct, sensitising action; with phloxin the effect is somewhat more strongly marked, but the results with this dye are not very definite owing to the uncertainty which exists as to the real nature of the substances sold commercially as phloxin. Eder found phloxin to be inferior to eosin as a sensitising agent. Erythrosin produces by far the greatest sensitising effect of the dyes of this group, whilst rose Bengal is inferior to erythrosin, but is far superior to eosin.

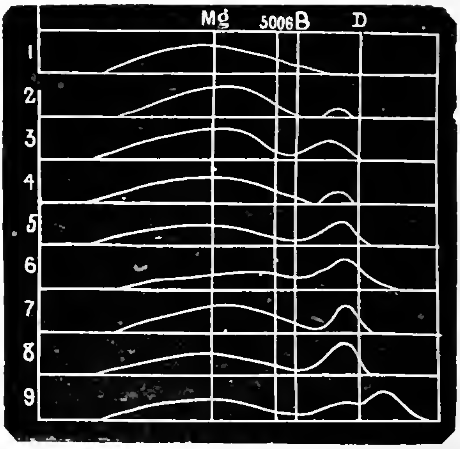

FIG. 3.

(1) Ordinary plate, (2) Aqueous Eosin, (3) Ammoniacal Eosin, (4) Aqueous Phloxin, (5) Aqueous Erythrosin, (6) Ammoniacal Erythrosin, (7) Aqueous Rose Bengal, (8) Ammoniacal Rose Bengal, (9) Ammoniacal Cyanin.

Cyanin differs from eosin, etc., in that it sensitises for yellow and orange and orange-red instead of for greenish yellow and yellow. It will be observed that with cyanin the second part of the curve shows two maxima, as Eder and Schumann have previously observed.

The simultaneous presence of ammonia increases the magnitude of the sensitising action, and by causing this action to extend to a greater distance on either side of the maximum tends to obliterate the region of minimum action. In the case of some of the plates treated with ammoniacal erythrosin it is even somewhat difficult to recognise the existence of the minimum at all. The difference between the action of aqueous and ammoniacal solutions is greatest in the case of eosin, but even in presence of ammonia this dye remains inferior as a sensitiser to aqueous erythrosin. Erythrosin in presence of ammonia exerts the greatest sensitising action of any dye with which I am acquainted.

The most remarkable result of these experiments, however, is that plates dyed with aqueous or ammoniacal erythrosin, ammoniacal rose Bengal, or ammo-

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[*] Ueber die Schwankungen in der Chemischen Wirkung des Sonnens specktrum. H. W. Vogel. Berichte, 1871, p. 88.

[†] Bunsen and Roscoe. Phil. Trans., 1859, p. 920.

[‡] λ 5184.

[§] λ 5005—4958.

niacal cyanin, are *more sensitive to the less refrangible rays of the spectrum (yellow, greenish yellow, or orange) than to the blue and violet*, and this even with a source of light which is extremely rich in chemically active rays of high refrangibility. Eder[*] found that silver gelatino chloride stained with eosin was as sensitive to yellowish green as to violet, and Vogel[†] states that the commercial Clayton and Attout plates are twice as sensitive to spectrum yellow as to the blue, but with these exceptions I am not acquainted with any published record of gelatin plates which are more sensitive to rays of low refrangibility than to those of high refrangibility. When burning magnesium is the source of light, plates dyed with aqueous erythrosin are about half as sensitive again to the yellow of the spectrum as to any part of the blue or violet; plates dyed with ammoniacal rose Bengal show a similar relative sensitiveness; plates dyed with ammoniacal erythrosin are somewhat more than twice as sensitive to the yellow as to any part of the blue or violet. Plates dyed with cyanin according to Schumann's formula are about half as sensitive again to orange as to blue or violet. With sunlight, which is relatively poorer in blue and violet, the relative sensitiveness to yellow would be still greater. Doubtless, too, the results will vary to a certain extent with different batches of plates.

The differences between my results and those obtained by Eder are probably due (1) to the use of plates which were not prepared in the same manner; (2) to the fact that in many of Eder's experiments the dyes were added to the emulsion, whilst in mine they were applied exclusively in the form of a bath; (3) to the fact that Eder's bath solutions were not so concentrated as those which I have employed. Comparative experiments showed that Eder's formula for the preparation of the dyed plates for general photographic purposes contained too small a proportion of the dye to give the maximum attainable result.

Why do these dyes produce such a remarkable effect when mixed with the silver bromide?

Eder found that all dyes which act as good sensitisers are substantive colours, and have the power of staining the granules of silver bromide. They also show a strong and well-defined absorption band in the solid condition (*i.e.*, in a dry gelatin film). When the dye is once associated with the silver bromide it cannot be entirely removed even by prolonged washing, just as the gelatin in the gelatino-bromide cannot be completely washed out. At the same time many dyes which fulfil these conditions exert very little sensitising action.

No definite connection has yet been traced between the sensitising action of the dyes and their general physical and chemical properties.[‡] Eosin is strongly fluorescent, erythrosin and rose Bengal are not. Aniline red and many others show anomalous dispersion, but some of the best sensitisers do not. Compounds of similar constitution as a rule behave similary, but to this there are many exceptions. Fluorescein and benzyl-fluorescein both sensitise for green, and the haloid derivatives of fluorescein sensitise for greenish-yellow or yellow, but the nitro-derivatives exert very little sensitising action. Phenol phthalein, orcein phthalein and their derivatives have very little sensitising effect. Benzaldehyde green and its sulphonic acid are both sensitisers, whilst rosaniline is a sensitiser, but its sulphonic acid is not. Further, isomerides such as orange R and acid orange, do not behave in a similar manner.

In order to determine the relation between the action of the dyes alone upon light, and their action as sensitisers, it is essential to examine the absorption spectra of the dyes in the solid condition, and associated with gelatin, since the absorption spectrum of one and the same substance varies greatly according to the conditions under which it is examined, and the substances with which it is associated.[§] The proper method of examination for this purpose is to dissolve the dye in a solution of gelatin, spread the liquid on a glass plate, and examine the film after drying.

When the absorption spectra thus observed are compared with the sensitising action of the particular dyes, it is found that in every case the absorption band and the band of sensitising effect correspond but do not coincide; the point of maximum sensitising effect is nearer to the red end of the spectrum than the point of maximum absorption. This is due to the association of the dye with the dense particles of silver bromide, the band being displaced towards the less refrangible end in accordance with Kundt's law.[‖] According to Eder's measurements the displacement of the band is equivalent to about 300 tenth-metres. When, however, the absorption spectrum of the dyed gelatino-bromide itself is examined, it is found that the absorption band and the sensitising effect are absolutely coincident, a result which affords further confimation of the fact first proved by Draper,[¶] and firmly established by the researches of Vogel[**] and others, that in order that light rays may produce any effect on a substance they must be absorbed by that substance.

How does the energy of the rays thus absorbed bring about the decomposition of the silver salt? Abney found that when cyanin alone is exposed to light it is decomposed, and the products of decomposition have the property of reducing silver bromide if the two are treated with a developer. It would seem, therefore, that the reduction of the silver bromide is a secondary phenomenon, conditioned by the preliminary decomposition of the dye. Vogel and Eder consider that this is only a special case, and that the explanation will not hold good generally, since many sensitisers are comparatively stable, and cannot undergo appreciable decomposition in the short time during which the plates are exposed to light. Many of the best sensitisers belong, however, to the class of fugitive dyes, and Abney has pointed out that in a dyed gelatino-bromide plate the dye is mixed with a large quantity of silver bromide, so that a very small quantity of dye is distributed over a very large surface, and the decomposition of only a very minute quantity would furnish sufficient nucleus for the commencement of development.

It has already been stated that the dye cannot be removed from the silver bromide by washing, and Eder considers that the dye unites with the silver bromide to form a molecular compound of the nature of a lake. The action of light on the dye and the silver bromide is simultaneous; the compound of the bromide and the dye absorbs the light rays, and the energy which existed as wave-motion is communicated to the molecules of the compound. The molecules are thereby thrown into such energetic vibration that their equilibrium is disturbed, and the silver bromide is either decomposed into bromine and silver sub-bromide, or is brought into that state of unstable equilibrium in which it is readily acted upon by a reducing agent such as constitutes an ordinary

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[*] *Loc. cit.* 1st paper, page 1129.

[†] Die Photographie farbiger Gegenstände in den richtigen Tonverhaltnissen. Berlin, 1885, page 87.

[‡] See Eder's three papers.

[§] Vogel; Ueber die Wandlung der Spektren verschiedener Farbstoffe; *Berichte*, 1878, p. 622. Ueber die Verschiedenheit der Absorptions-spektra eines und desselben Stoffs; *Berichte*, 1878, p. 913, 1363.

[‖] Poggendorff's Annalen. Jubelband, p. 615.

[¶] Philosophical Magazine, vol. 19, 1841, p. 195.

[**] Berichte, and Pogg. Annalen, 1873, 1874, 1875.

developer. When the light rays are absorbed by the dye alone the waves for the most part undergo *photo-thermal extinction*, and their energy is transformed into heat, a small proportion undergoing *photo-chemical extinction*, and being used up in producing chemical decomposition, since the majority of dyes are slightly altered by light. When, however, the rays are absorbed by the dyed silver bromide the greater part of the waves undergoes photo-chemical extinction, and their energy is used up in decomposing the silver bromide, whilst only a small proportion undergoes photo thermal extinction.

It is very difficult to understand why some dyes should exert such a great sensitising action, whilst others which are apparently very similar in constitution and properties have little or no effect. At present no explanation of the phenomenon can be given. I would point out, however, that the best sensitisers, erythrosin, rose Bengal, and cyanin, etc., have a very complex molecular constitution, a very high molecular weight, and contain a number of atoms of iodine or bromine, and it is very probable that the complex structure of the molecules, and their great weight, may confer upon them the power of entangling and arresting the ether waves to a greater extent than lighter and simpler molecules.

Dye.	Formula.	Mol. Wt.
Eosin.........	$-\begin{matrix}C_6H_4\\COO\end{matrix}>C<\begin{matrix}C_6HBr_2.ONa\\C_6HBr_2.ONa\end{matrix}>O$	692
Phloxin	$-\begin{matrix}C_6H_4\\COO\end{matrix}>C-\begin{matrix}C_6ClBr_2.ONa\\C_6ClBr_2.ONa\end{matrix}>O$	761
Erythrosin ..	$<\begin{matrix}C_6H_4\\COO\end{matrix}-C<\begin{matrix}C_6HI_2.ONa\\C_6HI_2.ONa\end{matrix}>O$	880
Rose Bengal.	$-\begin{matrix}C_6H_4\\COO\end{matrix}>C<\begin{matrix}C_6ClI_2.ONa\\C_6ClI_2.ONa\end{matrix}>O$	949
Cyanin	$C_{28}H_{35}N_2I$	526

Practical Applications.—The results obtained with the spectrum afford valuable information, but they must not be interpreted literally for practical purposes. The colour sensations produced by pigments, etc., are not always identical in origin with the similar colour sensations produced by the spectrum. Sometimes they are very different. It is well known, for instance, that the sensation of white may result from the simultaneous excitation of the sensations of red and greenish blue, purple and green, bright blue and yellow. The sensation of yellow may result from the simultaneous excitation of the sensations red and green, that is to say, may be produced by rays quite different from the yellow rays of the spectrum. Moreover, all coloured objects reflect a certain quantity of unaltered white light, which tends to reduce the contrasts resulting from differences in colour, and thus to produce truer gradations. The effect of this unaltered reflected light is greater the longer the time of exposure. The amount of light reflected without alteration, depends upon the brilliancy of the illumination, and the character of the surface of the object. If the surface is smooth and bright, the proportion of reflected white light will be comparatively large, and *vice versâ.* In ordinary landscapes the proportion of unaltered reflected light is very considerable, and hence the effect of making the plates sensitive to the less refrangible rays is not quite so strongly marked as in other cases.

Since the maximum sensitising action of different dyes is exerted for different rays, it is evident that the dye may be selected according to the colour which it is desired to bring into prominence; eosin for yellowish green, erythrosin for yellow, cyanin for orange. It will be seen that the curve for ammoniacal erythrosin (Fig. 3, No. 6) approximates somewhat closely to the curve of the optical effect of the spectrum (Fig. 1), and it follows that for general work erythrosin and ammonia will give the best results, whilst a little cyanin may be added to increase the sensitiveness to orange, but this is not usually necessary. No yellow pigment has the same relative luminosity as the yellow of the spectrum, and the difference between the relative brightness of blue and yellow pigments is much less than between the relative brightness of the blue and yellow of the spectrum. Moreover, as already explained, the crowding up of the less refrangible rays in the prismatic spectrum, magnifies the apparent effect of those rays. Hence, although a plate may be more sensitive to spectrum yellow than to spectrum blue, it does not follow that it is more sensitive to the light from a yellow pigment than to the light from a blue pigment. The curves show that the sensitiveness to blue and violet is still very great, and it is found that when photographing by daylight a yellow screen must be interposed between the object and the lens, in order to diminish the intensity of the blue and violet rays by absorbing the greater part of them. With gas or lamp light, a yellow screen is not necessary, since such light is comparatively poor in blue and violet rays, and relatively very rich in yellow rays. This applies equally to the light from ordinary incandescent electric lamps, provided that the current is not forced.

The yellow screen may consist of a piece of yellow glass, free from bubbles, etc., or of ordinary glass coated with collodion or gelatin stained with some yellow dye, such as *aurantia*. In any case the faces of the glass plate should be as perfectly parallel as possible, and the glass may be cut in the form of a circle, which fits inside the hood of the lens, and thus does not interfere with the use of the ordinary lens cap or shutter. A better method is to gum a film of dyed collodion or gelatin to the diaphragms of the lens. It is obvious that the deeper the tint of the yellow screen the greater will be the proportion of blue and violet rays absorbed, and consequently the greater the relative prominence of the yellow and orange, and *vice versa*. The proper selection of the yellow screen enables the photographer to control the character of the result to a very great extent. It is important not to cut off too much of the blue, since if this is done blue and violet will be relatively too dark, and the gradations will be incorrect. Vogel has pointed out* that not unfrequently the shadows of a painting owe whatever luminosity they possess to the presence of blue pigments, and hence if a yellow screen is used, and all the blue is cut off, the shadows are not rendered so well as on an ordinary plate. Again (*loc. cit.*), in the evening the shadows of landscapes, especially at the foot of a mountain, are illuminated almost exclusively by blue rays reflected from the sky, and hence when a yellow screen is used so much of the blue is cut off that the shadows appear far too dark. For certain subjects late in the evening, that is, with the yellow light of the setting sun, no yellow screen is required, and indeed is actually injurious. The use of a yellow screen increases the exposure from about 2 to 10 times the ordinary exposure, according to the tint and intensity of the screen

The plates used for photographing various coloured objects were treated with ammoniacal erythrosin. In the cases described Paget Prize Plate XXX. were employed, but equally good results have been obtained with Wratten & Wainwright's London plates of ordinary rapidity. The plates used in series A, B and C were immersed in a dye solution prepared according to Mallman and Scolik's formula,† which

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* Eder's Jahrbuch der Photographie, 1887, p. 272.

† Photographic Journal, 1886.

is as follows:—Soak the plate for 2 minutes in a 1 per cent. solution of ammonia, and then for 100 seconds in—

Aqueous erythrosin (1 : 1000)	25 parts.
Water	175 ,,
Strong ammonia	4 ,,

The plates used in the other series were prepared in in the same way as the plates used in the spectrum experiments.

After exposure, the dyed plates may be developed either with alkaline pyrogallol or with ferrous oxalate, but in either case care must be taken to keep the developer well restrained, since the dyed plates are much more liable to fog than ordinary plates. Since the plates are highly sensitive to yellow and orange, all the operations must be conducted in weak ruby light, and the plate must be protected as far as possible. A candle protected by the ordinary ruby glass, or by Edwards's ruby paper, answers very well. When, however, the plates are sensitive to red, it is best to use candle or lamp light filtered through several thicknesses of brown tissue paper (Seidepapier), since in this way the maximum amount of luminosity combined with the least chemical activity is obtained. At all times the intensity of the light must be kept as low as is compatible with visibility, and the plate must be carefully protected. After development has proceeded for some time the plate is much less sensitive to rays of low refrangibility. When the plate has been fixed and washed the dye can be more or less completely removed from the gelatin by soaking it in alcohol. It does not appreciably affect the printing qualities of the negatives.

In my own experiments the plates were developed with pyrogallol made alkaline with ammonia and restrained with ammonium bromide. The screen used was glass coated with collodion dyed with aurantia. In each series, except B and C, three exposures were made under the same conditions of lighting—namely, (1) a dyed plate, with a yellow screen fitted into the hood of the lens; (2) a dyed plate, without any screen; (3) an undyed plate, without any screen. In each case the exposure was the same, and hence it is evident that the differences in the results are not due to differences in the time of exposure. Undyed plates exposed behind the yellow screen for the same length of time gave no trace whatever of a developable image. Care was taken to give a full exposure even with the dyed plate and the yellow screen; and it follows that the plates exposed without the screen were very much overexposed. It is obvious that every chance was thus given for yellow, orange, etc,, to register themselves on the plate, and development was conducted in such a manner as to obtain the best possible result in each case, all the usual means being adopted to secure a good rendering of yellow and similar colours on the undyed plate.

A. Subject.—A series of seven bands of coloured paper with a matt surface; red, orange, yellow, green, blue, purple and violet.

1. Undyed Plate, no screen.—Violet, purple, and blue were practically identical, and almost equal to white; green darker; yellow darker still; orange darkest of all; red comparatively light, a result due to the fact that the red was not a pure red, but contained a certain proportion of admixed blue pigment.

2. Dyed Plate, no screen.—Violet, purple, blue, green, and yellow practically identical and almost equal to white: orange somewhat lighter than in 1; red somewhat darker than in 1.

3. Dyed Plate, yellow screen.—Yellow the brightest, green and orange darker and about equal; red, blue, purple, and violet comparately dark, the gradations approximating somewhat closely to the gradations of the colours.

B. Subject.—Bright yellow and brown plate with figures; dark blue and white vase, sage green background.

1. Undyed Plate, no screen.—Yellow plate almost black, the most prominent details only being obtained with great difficulty; vase almost white, the distinction between the white figures and the dark-blue ground being almost completely lost; background too light.

2. Dyed Plate, yellow screen.—Plate almost white, with all the details well rendered; ground of the vase dark, and the figures white; background darker than in 1.

C. Subject.—Various species of *Narcissi* in blue and white vases—viz., white narcissi, daffodils and jonquils.

1. Undyed Plate, no screen.—Jonquils very dark; daffodils almost as dark, though with a considerable amount of detail; white narcissi white; blue of the vases almost indistinguishable from the white.

(2) Dyed plate, yellow screen.—Daffodils full of detail and gradation, and almost as bright as the white narcissi; jonquils slightly darker than the narcissi (they are of a deeper yellow), and their orange centres somewhat darker still; blue of the vases very dark.

These results were exhibited when the paper was read; the following experiments have been made since.

D. Subject.—Dark blue and purple pansies with yellow centres, and bright yellow pansies with blue centres.

(1) Undyed plate, no screen.—The relative gradations are completely reversed, the blue being almost white, whilst the yellow is nearly black.

(2) Dyed plate, no screen.—Yellow and blue practically equal in brightness, and indistinguishable, the details and variations in shade being fairly well rendered.

(3) Dyed plate, yellow screen.—Blue dark, yellow almost white, the gradations being fairly correct, and the details and the variations in the shades of colour very well rendered.

E. Subject.—Primroses and violets in dark blue and white vase.

(1) Undyed plate, no screen.—Primroses well rendered in consequence of the long exposure, but the orange centres of the flowers very dark; violets much too light; vase white, and details almost completely lost.

(2) Dyed plate, no screen.—As No. 1, but centres of the primroses much lighter.

(3) Dyed plate, yellow screen.—Various colours in correct gradations, the violets and the dark blue of the vase being dark, the primroses white, but full of detail, with the orange centres somewhat darker.

F. Subject.—Single daffodils (orange) and hyacinths (white with a slight pink tinge); blue vase, not very dark.

(1) Undyed plate, no screen.—Hyacinths white; daffodils black, though full of detail; vase white.

(2) Dyed plate, no screen.—Hyacinths white; daffodils nearly white, and full of gradation and detail; vase still too light.

(3) Dyed plate, yellow screen.—As No. 2, but blue vase much darker; all the colours rendered in a very satisfactory manner.

G. Subject.—Painting: sun setting (white and orange) behind a church (dark olive grey). Sunset reflected in water, shadow parts of which are blue, like the outer parts of the sky.

(1) Undyed plate, no screen.—Orange much too dark; church and shadows of water too light.

(2) Dyed plate, no screen.—Orange of sunset much brighter, but church and the blue sky and water still too light.

(3) Dyed plate, yellow screen.—The sunset and its reflection bright, the orange being somewhat darker than

the white; the church dark; blue of water and sky darker than in 1 and 2; all gradations very good.

These results show that with dyed plates, even without a yellow screen, there is a very great improvement in the rendering of the yellow, orange, and green, but blue and similar colours are much too light. When the intensity of the blue, etc., is diminished by means of a suitable yellow screen, the gradations of the resulting photograph on a plate dyed with ammonical erythrosin are a very close approximation to the correct gradations. The chief defect is the very slight sensitiveness to reds, and this can, to some extent, be removed by adding a certain proportion of cyanin. An undyed plate exposed behind the yellow screen for the same length of time gave no trace of a developable image. The sensitiveness of ordinary plates to yellow, etc., is so small that if the blue and violet rays are cut off, an exposure of several hundred times the usual exposure would be required, and even then the gradations would not be correct, for the sensitiveness to green would be greater than to yellow, and still greater than to orange, whereas the sensitiveness to green and orange should be nearly equal, and the sensitiveness to yellow should be very much greater.

Note.—In landscape work Obernetter obtained very good results with plates dyed with azalin, and since this paper was read the author has been able to photograph landscapes under exactly the same conditions of lighting on both ordinary plates and plates dyed with ammoniacal erythrosin.[*] The difference is much greater than was anticipated, and is especially well marked in the case of yellowish green foliage, or indeed foliage of all kinds, and the distance. The first result is due to the sensitiveness of the plates to yellow and green; the second to the use of a yellow screen which cuts off the blue haze that usually interferes with the rendering of the distance. The "values" of photographic pictures obtained with the dyed plates and a yellow screen are very fairly correct, and are a very great improvement on the values obtained in the ordinary way.

Spectrum Photography.—Considerable use of dyed plates has been made by Dr. Hasselberg, of the Pulkowa Observatory, for photographing the less refrangible region of the spectrum, and he gives the following formulæ.[†]

From C to wave-length 5600.

Cyanin alcoholic solution (1:400)	2	parts.
Ammonia	1	,,
Distilled water........................	100	,,

From wave-length 5600 *to F.*

Chrysaniline solution (1:1000)	3	,,
Eosin solution (1:1000)	5	,,
Ammonia	1	,,
Distilled water	100	,,

The plates are steeped for about a minute in a weak solution of ammonia, and are then immersed in one of the above solutions for two or three minutes. The plates thus prepared are very sensitive, and the negatives obtained are highly satisfactory, the lines being sharp, dense, and well defined.

The effect of the dyes on the general sensitiveness of the plates is a point of considerable importance, but at present there is no very definite evidence. Some experiments by Eder[‡] indicate that the application of dilute aqueous solutions of the dyes to gelatin plates slightly diminishes the general sensitiveness to daylight, but increases the sensitiveness to gaslight to about twice its ordinary value. According to Mallman and Scolik (*loc. cit.*) the sensitiveness of plates treated with ammoniacal erythrosin is much greater than that of the same plates before treatment. The sensitiveness to daylight is about three times as great, and to gaslight about twenty times as great, this result being due partly to the action of the ammonia and partly to the sensitiveness for yellow rays which results from the presence of the dye. The effect of the sensitiveness for yellow is very marked in the case of gaslight, and it is found that with lamp or gaslight equal to 250—300 candles portraits can readily be taken with an exposure of 3—5 seconds; that is, more rapidly than with the wet collodion process in daylight.

Experiments made by the author show that plates dyed with aqueous erythrosin (1 : 10,000) are distinctly more sensitive to both gaslight and daylight than undyed plates, whilst with ammoniacal erythrosin the increase of sensitiveness is much more marked in both cases. Plates prepared as described above require only about one-third of the exposure of the undyed plates if used without any screen. These results are not in accordance with those of Eder, but the experiments just quoted must only be regarded as preliminary.

Reproduction of Pictures.—Ortho-chromatic plates have been and are being very largely used for the reproduction of paintings, and the numerous fine examples of this kind of work which have recently been produced by the Berlin Photographic Company, Braun & Co., Dixon & Co., and others, are evidence of the very great advance that has been made. In fact it is not too much to say that ortho-chromatic plates, together with the various methods of photogravure and collotype are the methods of the future for the accurate reproduction of paintings.

Vogel [§] has devised a process of photo-chromolithography, which is really an indirect process of photography in colour. It is a modified and improved form of the older process of Ducos du Hauron, who photographed the object through various coloured screens, and thus obtained negatives containing only those parts of the object which had certain colours. These fragmentary images were then transferred to stones, which were used as in ordinary chromolithography, each part of the image being printed in a pigment corresponding with the screen which had been used in taking that particular negative. Ducos du Hauron used only three screens and three pigments, and employed eosin only as a sensitiser. Vogel proposes to use at least six pigments, and to sensitise the plates for red with naphthol blue, for orange with cyanin, for yellow with eosin, for green with safranin, for green-blue with fluorescein, whilst for blue and violet the ordinary sensitiveness of the gelatinobromide plate is sufficient. In taking the various negatives the intensity of the blue and violet is diminished by using a yellow screen. It is evident that the greater the number of spectrum regions treated in this way, the nearer will the resulting chromo-lithograph approach the natural colours. The image on each negative is transferred to a separate stone, and the pigment used with each stone must be complementary to that part of the spectrum for which the plate was made sensitive. These complementary colours are, of course, furnished by the sensitising dyes themselves, and therefore each stone is printed with the dye which was used to produce the negative from which the stone was prepared. Most of the sensitising dyes are, however, of a fugitive character, and hence it is desirable to replace them in printing with permanent pigments which are of the same colour spectroscopically—*e.g.*, aniline blue in place of cyanin.

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[*] The results of these experiments were exhibited at the Royal Society's soirée on 8th June.

[†] Jahrbuch. f. Photographie, 1887, p. 146.

[‡] Monatsch. f. Chem, 7, p. 1—8.

[§] Annalen der Physik, 1885 [N.S.], 27, p. 130.

There are many points which have still to be settled by further researches, but the results obtained by the various investigators who have directed their attention to this question, together with the successes already achieved in the practical application of these processes, are sufficient to show that orthochromatic methods constitute an advance little, if at all, inferior in importance to the introduction of the gelatinobromide process itself. There can be no doubt that these methods will considerably modify the ordinary practice of photographers, and will increase the value of photography, not only as a method of reproduction, but also as a pictorial art.*

My best thanks are due to my friend, Prof. de Burgh Birch, not only for placing his spectrum-photographic apparatus at my disposal, but also for his kind assistance in the somewhat tedious work of making the exposures.

Journal and Patent† Literature.

IV.—COLOURING MATTERS AND DYES.

Formation of Barium Manganate (Manganese Green). Ed. Donath. Dingl. Polyt. J. **263**, 246—248.

THIS green pigment is one of the few harmless ones, and has the advantage of being unaltered by any basic colour ground, such as lime; it should therefore be useful for fresco painting. By igniting one part of pyrolusite containing 91 per cent. MnO_2, with three parts of commercial barium dioxide in a porcelain crucible, a very good product was obtained of a deep emerald colour with a slight bluish tone. At a higher temperature the colour was destroyed, and only a dark olive-green or grey-brown product resulted. Sulphuric acid or hot potash solution at once decomposed the colour obtained in the above way.—T. L. B.

Benzaldehyde Green Industry. Otto Mühlhäuser. Dingl. Polyt. J. **263**, 249—254 and 295—303.

I. *The Manufacture of Acid Green.*—The leuco-base of acid green is formed when 1mol. of benzaldehyde is condensed by anhydrous oxalic acid, with 2mols. of ethylbenzylaniline, $C_6H_5.COH + 2C_6H_5N.C_2H\ .CH_2.C_6H_5 = H_2O + C_6H_5.CH_2.C_2H_5 : N.C_6H_4.C_6H_5 : C : H.C_6H_4.N : C_2H_5.CH_2.C_6H_5$. This base on sulphonation with fuming sulphuric acid, yields a mixture of di- and tri-sulphonic acids of diethyldibenzyltriphenylmethane, which on oxidation with lead dioxide are converted into the corresponding acid greens.

For the daily production of 150kilos. of acid green are needed four cast-iron jacketed enamel pans, the stirring gear to make about 20 revolutions per minute; the covers to be provided with manhole, pressure-gauge, connections for air-pressure and with the blowing-off still; the jackets provided with both steam and cold water; one blowing-off still with steam coil and free steam pipe inside and a large tap at bottom to empty into a copper steam jacket; one cast-iron jacketed pan for the sulphonation; one liming-out cistern of about 3000 litres capacity; two "montejus," capacity 2000 litres each; one eighteen and one twelve-chambered filter-press; one iron cistern with copper steam coil, holding 6000 litres; one oxidising vat with stirring gear and a capacity of 3000 litres; a smaller reservoir with copper steam coil, holding 1800 litres; three copper evaporating pans provided with stirring scrapers; and lastly, one grinding mill.

The charge for each of the four enamel pans is 21kilos. of benzaldehyde and 80kilos. of benzylethylaniline. The stirrers being set in motion, 34kilos. of finely-sieved anhydrous oxalic acid are slowly added; this takes about one hour. The lid is then closed and the water in the jacket warmed during the first day to 60°, during the next two days to 80° and on the fourth day to the boil. The contents are then neutralised with about 100kilos. of caustic soda solution of 36° B. and, whilst still at 80° or thereabouts, blown over into the blowing-off still. By means of the steam coil the mass is raised to the boil and the excess of benzaldehyde blown off with free steam. The contents are then emptied into the copper jacket and cooled. The lye is removed from the solidified leuco-base and the base washed with water, the oxalic acid being recovered from the washings and lye. By fusing the base in the copper jacket and stirring all day, all the moisture is removed, and when cold the solid leuco-compound is chipped out and finely powdered. The yield averages 93kilos. The sulphonation is carried out in an apparatus similar to the melt pans, into which 200kilos. of 20 per cent. fuming sulphuric acid are placed and 50kilos. of the powdered base stirred in, care being taken to keep the temperature below 45°. When entirely dissolved, the mixture is heated to from 80 to 85°, avoiding a higher or lower temperature. When the product is quite soluble in ammonia the mass is allowed to cool down, and next day it is blown over into the liming-out vat into 1000 litres of water, where the acid is neutralised with about 150kilos. of quicklime, boiled up with free steam and then cooled to about 60—65° by the addition of cold water. The batch is introduced into the montejus and forced by air pressure into the filter-press, the cakes from the latter after boiling up with some 1000 litres water are again filtered and the united filtrates evaporated in the iron cistern down to 1200 litres. This solution is run through an open filter into the oxidation vat and cooled to below 20°. Whilst rapidly stirring, 10kilos. of 66° B. sulphuric acid are added and then as quickly as possible 56kilos. of lead dioxide paste ladled in. After ten minutes' stirring, about 25kilos. of sodium carbonate are thrown in, the temperature raised to 70°, and the solution passed, by air pressure, through the twelve-chambered filter-press which is provided with double filter-cloths. The filtrates are evaporated down to about 600 litres and then to dryness in the copper pans with the stirring scrapers, the drying being finished in the drying-room on zinc trays. The dried green is ground in the mill, forming a dark green powder, the average yield being 85·5kilos.

The above 56kilos. of lead dioxide are obtained by dissolving 22kilos. litharge in 40kilos. of 40 per cent. acetic acid and 100 litres of water, and oxidising with 27kilos. of bleaching powder made into a cream with 54 litres of water, which cream is added until a drop of the lead solution on filter paper no longer becomes yellow at the edge when brought in contact with a drop of the filtered bleach solution. The product is filtered off, well washed and made up with water to 56kilos.

II. *Manufacture of Malachite Green.*—The necessary apparatus for a daily production of 70kilos. green crystals are as follows:—Set of apparatus for production of the leuco-base, consisting of three cast-iron jacketed pans, blowing-off still and copper-drying jacket, as described for acid green. A system of vats for oxidation and precipitation of the colour, being a raised vat for solution of the leuco-base, three vats provided with stirring gear for the oxidation, a set of filters to filter into the three corresponding precipitating vats, and a further set of box filters to collect the colour when thrown down. The apparatus for purification consists of a horizontal boiler to hold 3500 litres provided with stirring gear, a tall dome with manhole, and a second manhole close to the bottom. The boiler is connected with the steam and water supply and also with a pressure filter. This is formed of an iron box divided by a diaphragm of strong

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* For a full treatment of the subject from a photographic point of view, with the various formulæ, etc., which have been recommended, the author would refer to his articles on "Orthochromatic Photography," in the Photographic News, 1887, pp. 65, 115, 116, 193, 211, *et seq.*

† Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.........	½d.
Above 8d., and not exceeding 1s. 6d...	1d.
" 1s. 6d., " " 2s. 4d...	1½d.
" 2s. 4d., " " 3s. 4d...	2d.

calico, through the lower half of which the liquor is forced and after passing through the calico run into three precipitating vats, each of which has a box filter for the colour underneath it. For the crystallisation, a vat of 2000 litres capacity is requred for the solution and six other vats of the same size provided with floating covers for the actual crystallisation.

Each charge consists of 100kilos. dimethylaniline and 40kilos. benzaldehyde, to which are slowly (in two hours) added 40kilos. dry powdered zinc chloride. The temperature is maintained the first day at 60°, the second at 80 and the third day raised to 100°. The melt is blown into the still, freed from excess of dimethylaniline with free steam and the base separated from the zinc solution, washed and dried in the manner described for the acid green. The fluid base is poured into zinc trays, each holding 33kilos. net. Average yield of base = 123kilos. The base on one such tray is removed from it by steaming in a vat to hold 400 litres, and then dissolved in about 200 litres of boiling water and 25kilos. of 21 B. hydrochloric acid. The clear solution is next run into one of the oxidation vats containing 1000 litres of water soured with 31kilos. of 40 per cent. acetic acid and there oxidised with 56kilos. of the above described lead dioxide paste. After the reaction is complete (in 5—10 minutes) the lead is thrown down by the addition of 24kilos. of sodium sulphate dissolved in 100 litres of water and the liquor allowed to settle during twelve hours, when it can be easily filtered through felt into the precipitating vat; there the colour is to be precipitated by the addition of 20kilos. of zinc chloride and about 180kilos. of common salt. The colour is collected in filter-boxes and the mother-liquor run to waste. This product from three vats is stirred up in the horizontal boiler with 2400 litres of hot water and boiled for about ten minutes, then some 500 litres of cold water are added, which causes the tar to settle out quickly, and after standing about ten minutes the solution is pressed through a filter into a large vat, where when cooled to 40° C. 100kilos. of ammonia are stirred in to precipitate the base. The filtrates from this precipitate are worked up for the ammonia, while the base is whizzed in a hydro-extractor, the yield of moist base being 85·5kilos. For the crystallisation, 120kilos. of oxalic acid are dissolved in 1200 litres water, raised to the boil and 100kilos. of the above base stirred in. This solution is diluted to 1800 litres and filtered into a slightly conical vat of 2000 litres capacity and when cooled to about 80°, 30kilos. of 20 per cent. ammonia is stirred in as a fine stream. This solution is almost entirely covered by a disc of boards and left to crystallise until the temperature of the vat has fallen to not lower than 18° C. The mother-liquor is filtered from the crystals, which are whizzed in wool bags and finally dried on frames covered with canvas at about 50—60° C. The yield of crystals is about 70kilos. The residual green is obtained as a tarry mass by basifying the filtrate from the crystals at 80° C. with caustic soda, and is worked up for green powder or mixed with violet, etc. The mother-liquors are worked up for the recovery of the oxalic acid. The lead residues from ten batches are boiled up with 2000 litres water, the sulphate of lead allowed to settle and from the clear liquor the green can be recovered as zinc double salt by adding salt and zinc chloride. After a second boil the lead sulphate is dried, ground and used as pigment. By boiling up 200kilos. at a time of the zinc double salt residues with 2000 litres of water and 20kilos. of hydrochloric acid, filtering and precipitating with caustic soda, a further quantity of green is obtained, which is used for making into "green solution," consisting of 50kilos. of green base, 40kilos. of hydrochloric acid and about 200 litres of water.

III. *Manufacture of Brilliant Green*—This is in almost all stages carried out exactly as described above under the head of malachite green, the proportions being: 60kilos. of diethylaniline, 22kilos. of benzaldehyde and 32kilos. of dry oxalic acid; the yield of leuco-base is about 77kilos. The crystallisation however is different, as the sulphate of this green is more insoluble in hot than in cold water. 280 litres of water are placed into an enamelled iron pan holding 600 litres, 120kilos. of sulphuric acid are added and 100kilos. of the base stirred into the warm mixture. When all is dissolved the pan is cooled to about 20°, 130kilos. of 16 per cent. ammonia carefully stirred in and the temperature raised to 55—60° until a slight precipitate is formed. The solution is then filtered into a similar enamelled pan and the temperature quickly raised to 85—90°, when the colour is thrown down in the form of brilliant metallic crystals. These are then filtered off, whizzed and dried, the yield from 114kilos. of green base being 94kilos. brilliant green.

—T. L. B.

The Manufacture of Methylviolet. Otto Mühlhäuser.
Dingl. Polyt. J. **264**, 37—45.

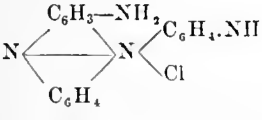
For the daily production of 85kilos. the following apparatus are necessary:—Five cast-iron cylinders, provided with strong stirrers and surrounded half their height by external jackets for steam or cold water. They rest horizontally on bearings and can be inverted for emptying; two large round iron boilers, 2metres broad and 2 metres deep, provided with stirring gear; two large manholes, one at the top and one at the bottom; two taps, one of which is fixed in the lower manhole; three box filters to hold 800 litres; a sulphuretted hydrogen apparatus; two large boiling vats, with stirring gear and a capacity of 3000 litres; six iron pans, with trough-shaped bottom and countersunk rivets, the capacity of each being about 5000 litres; a copper drying pan 120cm. wide and 40cm. deep; a grinding mill and a drying-room.

1st Day.—The Oxidation.—In each of the five iron cylinders 175kilos. of dry and well-ground common salt are placed, the stirrers set in motion and the water in the jackets raised to the boil. To the salt in each vessel 10kilos. of very finely ground sulphate of copper are added and well mixed; then 8kilos. of phenol and 2kilos. of water are poured in and, after about ten minutes mixing, 20kilos. of methylaniline are added. The contents of the drums are now heated up to 55°, the manhole closed and the oxidation allowed to go on for about 2½ hours, the stirrers being kept in motion all the time and the temperature at about 55—60°. The cover is next raised from the manhole and the heating and stirring continued for 5½ hours longer. The at first sticky mass will now have become bronzed and tough and will no longer adhere to the fingers, a sign that the reaction is complete. After a slight cooling the cylinders are inverted and the mass allowed to fall out into a truck, which is then emptied on to a stone floor, where the plastic mass is pressed out into a cake some 3 or 4 inches thick and left all night to cool. *2nd Day.*—This cake is broken up by blows of a wooden mallet into pieces about the size of a man's hand; at the same time 40kilos. of quicklime are slaked with 200 litres of water and the cream strained through a sieve. *3rd Day.*—In one of the large iron boilers 3000 litres of water are placed and the milk of lime added. This mixture is kept stirring by strong iron agitators, the crushed violet cake gradually added, until all the salt and phenol have become dissolved and the violet, hydrated oxide of copper and gypsum are precipitated. The whole is then left at rest over night. *4th Day.*—The clear supernatant liquor is drawn off through a tap near the bottom of the boiler and the precipitate finally washed out on to a woollen filter. This, when well drained, is stirred up with 3000 litres of water, allowed to settle, etc., when, after a repetition of this washing, the precipitate is left over night to drain on the woollen filter. *5th Day.*—The black precipitate is placed in a similar iron boiler, agitated with 3000 litres of water and saturated with hydrogen sulphide, obtained from "soda waste" and hydrochloric acid, and well washed. All the copper is thereby converted into CuS and the separation of the violet from it by means of HCl rendered possible. The bronze precipitate is allowed to settle, brought on to a woollen filter and allowed to drain over night. *6th Day.*—One of the large wooden vats is filled up with 1500 litres of water and the above precipitate stirred in, together with 40kilos. of hydrochloric acid of 21° B. The whole is then boiled up for ten minutes, allowed to settle and the violet solution siphoned off through a wool filter into one of the iron pans. A second boil is made with 800 litres of water and 10kilos. of HCl, the third and fourth boil (if necessary) with only 500 litres of water and 5kilos. of HCl. The residue is thrown away; the violet solution is thrown down by the addition of a filtered salt solution; and the colour forms a tarry green mass at the bottom of the pan. *7th Day.*—The salt mother-liquor is drawn off from the precipitated colour, which is then boiled up in the purification vat with 2000 litres of water and the solution filtered. A second and third extraction is made, the violet precipitated with salt solution and separated (*8th Day*) from the mother-liquor. The violet is then stirred well whilst being heated in the copper steam jacket for about six hours, when it is sufficiently dry to be poured upon zinc trays and allowed to cool. The steam pressure on the jacket must not exceed 20lbs. on the square inch, in order to avoid too high a temperature. *9th to 11th Day.*—The trays are freed from the cooled violet, which is then ground up in a mill and the powder spread on about 40 trays—that is, over a surface of some 15 square metres. This is then dried at about 60° for two days in the drying-room. *12th Day.*—The violet is allowed to cool and then again ground and made up into the various brands by the addition of the required amounts of benzylviolet. The yield of ground violet averages 86kilos. and it consists of a mixture of tetra- and pentamethylpararosaniline.

The raw materials used must fulfil the following requirements:—The methylaniline is dimethylaniline, containing monomethylaniline, as obtained by acting upon aniline with hydrochloric acid and wood spirit, without any fractional distillation. The common salt must be well dried and ground; the crystals of sulphate of copper must be well ground. The phenol need not be pure, a carbolic acid with 10 per cent. distilling below 180° and 97 per cent. below 200° being sufficiently good.
—T. L. B.

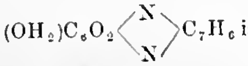
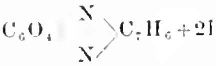
The Constitution of Safranines. A. Bernthsen. Ber. **20**, 179—180.

In a previous paper (compare this Journal, 1887, 212) the author endeavoured to show that the safranines are derived from the hypothetical body *phenyl-hydrophenazine* $C_6H_4 : (NH)(NC_6H_5) : C_6H_4$. This view had received much support from the light thrown later on the constitution of toluylene red. He considered that each amido-group of the safranines was combined with each of the benzene nuclei of the phenazine, the correctness of which idea was dependent upon the identity or otherwise of the two dimethylsafranines. Now, according to Nietzki and O. Lehmann (*Ber.* **19**, 3163), these two bodies are not identical; therefore, his theory requires modification and probably in the direction proposed by O. N. Witt and Nietzki (*Ber.* **19**, 3121 and 3163). Therefore, he considers phenosafranine to have the constitution expressed by the unsymmetrical formula:



which only differs in the position of the one amido-group from the one already proposed by him (this Journal, 1887, 213).—T. L. B.

Secondary and Tertiary Quinones. R. Nietzki and F. Kehrmann. Ber. **20**, 322—328.

When a salt of *o*-tolylenediamine is added to a solution of sodium rhodizonate (dihydroxydiquinoyl: this Journal, 1885, 671) in dilute hydrochloric acid, a gelatinous compound  $(OH_2)C_6O_2\left\langle\begin{matrix}N\\N\end{matrix}\right\rangle C_7H_6$ is formed which is soluble in alcohol, acetic acid, and slightly in water. It dissolves in alkaline solutions with a beautiful violet colouration. When made into a paste with water and nitric acid added until reaction commences, it is converted into a substance crystallising in yellow needles, nearly insoluble in cold water, ether, and alcohol; soluble in hot acetic acid. This is a derivative of triquinoyl of the formula  $C_6O_4\begin{matrix}N\\N\end{matrix}\rangle C_7H_6+2H_2O$. This *diquinoyltolazine*, when warmed with an excess of an aqueous solution of a salt of *o*-tolylenediamine, forms *benzotritolazine* $C_6(N_2C_7H_6)_3$, which is very soluble in alcohol and chloroform, and from the latter crystallises in long yellow crystals containing 1mol. of $CHCl_3$, which is only entirely given off at 160°. It is a weak base, soluble in strong acids with yellow colouration and insoluble in water and ether. When warmed with stannous chloride it takes up four atoms of hydrogen but re-oxidises very readily when exposed to the air.

When sodium rhodizonate is condensed with *o*-tolylenediamine in neutral solution (or made acid with a little acetic acid), it combines with three tolylenediamine groups, forming a greenish-grey substance, which oxidises to the above triazine $C_{27}H_{18}N_6$. From these experiments it is shown that triquinoyl contains six quinone oxygen-atoms, but they do not prove that the quinone and hydroxyl-groups in rhodizonic acid are in para position. But, taking this for granted, the fact that adjacent oxygen-atoms react like an orthoquinone group, and are independent of the para-oxygen, gives important support to the ketonic formulæ of quinones.
—T. L. B.

Substitution Products of Azobenzene. J. V. Janovsky and L. Erb. Ber. **20**, 357—362.

Para-bromazobenzene, $C_6H_5.N_2.C_6H_4Br$ [1 : 4], is the chief product of the bromination of azobenzene in acetic acid solution. It crystallises in orange-yellow plates, which melt at 82°. It can be sublimed, and is readily soluble in alcohol, ether, and acetone. On nitration, it gives *p*-nitro-*p*-bromazobenzene, [1:4] $C_6H_4(NO_2).N_2.C_6H_4Br$ [1 : 4]. Fuming sulphuric acid converts it into *p*-bromazobenzene-*p*-sulphonic acid, which is also obtained by bromination of azobenzene-*p*-sulphonic acid. This acid crystallises in flat needles and its sodium salt forms very sparingly-soluble silky needles; on reduction it gives *p*-sulphanilic acid and *p*-bromaniline.

Meta-bromazobenzene, $C_6H_5.N_2.C_6H_4Br$ [1 : 3], forms yellowish-green pearly plates melting at 53—56°, readily soluble in alcohol, ether and acetone, and more sparingly in petroleum ether. Fuming sulphuric acid converts it into *m*-bromazobenzene-*p*-sulphonic acid. It forms crystalline compounds with potassium and sodium salts, which are so insoluble that even 1 per cent. solutions of other potassium and sodium salts are precipitated by the free acid.

Ortho-nitroazobenzene, $C_6H_5.N_2.C_6H_4(NO_2)$ [1 : 2], appears to be the chief product of the nitration of azobenzene in acetic acid solution at 100°. It crystallises in orange-yellow microscopic needles, readily soluble in alcohol, ether, acetone and petroleum ether, and melts at 122—123°. By boiling its alcoholic solution with alkali, an olive-green colouration is produced. By bromination in acetic acid solution, it gives a nitrobromazobenzene, melting at 122—123°. Fuming sulphuric acid converts it into *o*-nitroazobenzene-sulphonic acid, which crystallises in hygroscopic needles and forms very characteristic salts.

Ortho-nitro-azoxybenzene, $C_6H_5.N_2O.C_6H_4(NO_2)$, is formed by the action of fuming nitric acid upon azobenzene in acetic acid when the temperature is kept at about 75°. It crystallises in red plates, which melt at 127°. Both this compound and the *o*-nitro-azobenzene are converted, by reduction with sodium amalgam or by long boiling with alcoholic KOH, into a complicated condensation product (hexazoxy-benzene), $C_{24}H_{18}N_6O$, which is very sparingly soluble in alcohol, ether and acetone, and crystallises from toluene in orange-yellow plates.
—A. G. G

Substitution Products of p-Azotoluene and of Hydrazobenzene. J. V. Janovsky and L. Erb. Ber. **20**, 362—364.

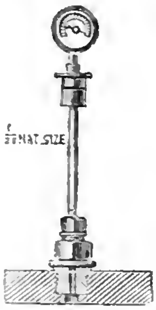
THE bromination of *p* azotoluene in acetic acid solution gives rise to two bromo-azo-toluenes, which melt at 138·5° and 115°. The bromo-azo-toluene, melting at 138·5°, gives on reduction a bromohydrazotoluene, which melts at 119°. By nitration of *p* azotoluene in acetic acid solution two nitro-derivatives are obtained. The one forms orange-yellow monoclinic crystals, which melt at 114°, the other small red tables. If *p*-azotoluene is treated with fuming HNO_3 in the cold, a dinitroazotoluene is formed, which crystallises from acetic acid in light yellow lustrous crystals, melting at 185—187°. By reduction of *p*-bromazobenzene with alcoholic ammonium sulphide, *p*-brom-hydrazobenzene $C_6H_5.N_2H_2.C_6H_4Br$ [1 : 4] is obtained, which crystallises in pearly scales or colourless tables and melts at 115°. By treating the alcoholic solution with H_2SO_4, it is converted into a bromodiamidodiphenyl (monobromobenzidine), crystallising in silvery plates.—A. G. G.

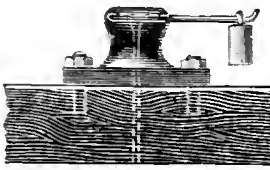
Action of Phenol upon Diazoamidobenzene. K. Heumann and L. Oeconomides. Ber. **20**, 372—373.

IF diazoamidobenzene is gently warmed with phenol (rather more than 1 molecule), *p*-oxy-azobenzene is formed, whilst aniline is liberated. The reaction is a general one; other phenols and other diazo-amides react in a similar manner.—A. G. G.

Manufacture of Dimethylaniline. P. Schoop. Chem. Zeit. **1887**, 253—254.

DIMETHYLANILINE is now no longer prepared by means of methyl chloride, but always, according to Bardy's method, from aniline, methyl alcohol and HCl or H_2SO_4. It is essential for this purpose that the materials should be as pure as possible. The aniline must be free from its homologues, which would give rise to dimethylated bases unsuitable to the preparation of malachite green. The methyl alcohol must be free from ethyl alcohol and acetone. The presence of the latter gives rise amongst other products to a base, $CH_2(C_6H_4.N[CH_3]_2)_2$, and the dimethylaniline thus contaminated is unsuitable for the preparation of either methyl violet or malachite green. The operation is performed in a thick-walled cast-iron autoclave, set in an oil-bath (see figures). A lining to the autoclave is not required when dry aniline salt is employed. The vessel is charged with 75kilos. of aniline, 75kilos. of wood-spirit and 25kilos. of aniline hydrochloride. Although the reaction does not require so high a temperature when more aniline hydrochloride is employed, yet the product is not so pure, since there is a greater tendency to form toluidine. The temperature of the oil-bath is regulated according to the pressure shown by the gauge, and varies between 270—230° C., being highest at the commencement. The maximum pressure is about 27 atmospheres. The operation, which requires about 15 hours, is completed when the pressure begins to decrease without the temperature having been lowered; the fire is then withdrawn. On the following morning, the remaining pressure is let off through the safety valve, the pressure-gauge unscrewed, a pump inserted and the contents pumped out into a separating funnel. The oil (A) is separated from the aqueous portion and the latter treated with NaOH; this gives a second quantity of oil (B). The alkaline liquors, on distillation, furnish a third portion (C). These portions are separately refined and form three qualities of dimethylaniline, of which A is the best and C the worst. The above proportions give on an average 90kilos. A, 19kilos. B, and 11¼kilos. C; thus 120¼kilos. in all from 93kilos. of aniline. For ascertaining the quality of the product, the following tests are employed:—

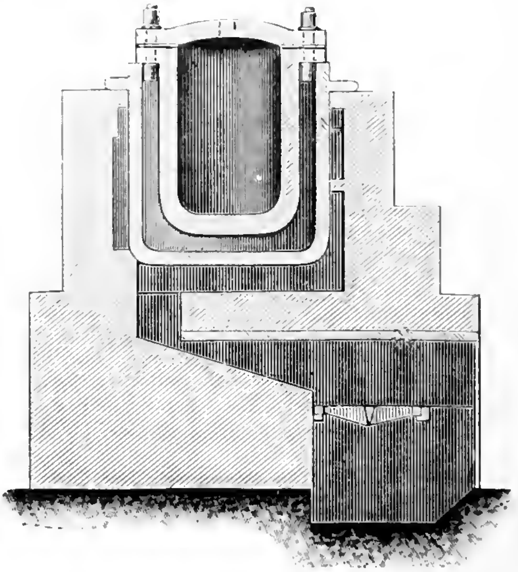




$\frac{1}{5}$ NAT. SIZE.

1. A few drops of the oil are mixed in a watch-glass with a few drops of ether and one drop of concentrated H_2SO_4; if aniline is present aniline sulphate will separate as a white precipitate.

2. The boiling-point gives an indication of the proportion of homologues present; the range should be as small as possible.



$\frac{1}{10}$ NAT. SIZE

3. 5cc. of the dry oil, and 5cc. of acetic anhydride, both at the same temperature, are mixed together with a thermometer; a rise of temperature indicates the presence of monomethylaniline.

4. For the quantitative determination of mono-methylaniline, 100grms. of the oil are treated with sufficient acetic anhydride (usually 5grms.) and the mixture fractionated; after distilling off the dimethylaniline and excess of acetic anhydride, the acetyl-mono-methylaniline remains.

The presence of mono-methylaniline is more objectionable in the preparation of green than of violet. Its quantity seldom exceeds 2% and the best qualities in the market are nearly or quite free from it. When present it can be removed by shaking the oil with a small quantity of dilute sulphuric acid or by boiling with acetic acid for two hours.—A. G. G.

A Process for Producing a new Sulpho-Acid and obtaining Azo-Dyes therefrom. J. Y. Johnson, London. From the "Farbenfabriken vormals Bayer and Co.," Elberfeld, Germany. Eng. Pat. 5846, April 29, 1886. 6d.

THE new acid is described as β-naphthylamine-δ-monosulphonic acid, and it is prepared by the action of an excess of sulphuric acid upon β-naphthylamine at 100—200° C. The acid does not dissolve readily in cold water but is freely soluble in hot water, crystallising out in needles on cooling. The colour obtained by the action of diazotised toluidine upon this acid is bluer in shade than that produced by the same tetrazo-salt with the β-monosulphonic acid. In order to prepare the δ-acid 50 parts of β-naphthylamine sulphate are mixed with 300 parts of sulphuric acid (66° B.) and maintained at 160—170° C. till a specimen withdrawn

gives a bluish-red product with tetrazoditolylchloride. The melt is poured on to ice and the separated acids collected on a filter. The residue is then boiled with water and filtered, in order to remove the insoluble β-acid which is produced with the δ-acid, the latter remaining in the solution and being purified by conversion into the barium or sodium salt and crystallisation. Instead of β-naphthylamine the α- or γ-monosulphonic acid may be employed, both these acids becoming converted into the δ-monosulphonic acid on heating with sulphuric acid above 100 C. The new acid forms a series of azo-dyes when diazotised and combined with phenols, amines, etc., in the usual way or when diazo- or tetrazo-salts act upon it. The patentees give as examples the preparation of the bluish-red colouring matter produced (1) by the action of the diazo-δ-acid upon α-naphthol-α-monosulphonic acid, and (2) by the action of tetrazoditolyl upon the δ-acid.
—R. M.

A Process for the Production of Pararosaniline and its Homologues, as well as mono-, di-, tri-alkylised phenylised or naphthylised Derivatives thereof. H. Baum, Mannheim, Germany. Eng. Pat. 6000, May 3, 1886. 6d.

As an illustration of this process the inventor gives the following:—A mixture is made of 129 parts aniline hydrochloride, 183 parts of paranitrobenzylaniline and 25 parts solid ferric chloride or the same quantity in concentrated aqueous solution. The mixture is heated to 135—140° C. for six hours and then for a short time to 140° C. The reaction is complete in from 10 to 12 hours and the melt is preferably dissolved in ten times the amount of hot water, mixed with 100 parts of hydrochloric acid and 100 parts common salt added. The solution is filtered when cold in order to remove a slight residual impurity. The homologues of pararosaniline are produced by substituting toluidine, xylidine, etc., for aniline, and naphthyl-rosaniline is obtained by the use of naphthylamine. By substituting secondary monamines such as methylaniline, diphenylamine, naphthylphenylamine, etc., for the aniline, mono-substituted rosanilines are obtained. By using paranitrobenzylmethylaniline and the salts of secondary monamines, di-substituted rosanilines can be prepared.—R. M.

The Preparation from Gallic Acid of a Yellow Colouring Matter suitable for Dyeing and Printing. J. H. Johnson, London. From the "Badische Anilin and Soda Fabrik," Ludwigshafen a/Rhine, Germany. Eng. Pat. 6413, May 12, 1886. 6d.

THE manufacture of this dyestuff, termed "galloflavine," is based upon the fact that whereas a solution of gallic acid containing an excess of alkali rapidly oxidises on exposure to the air with the formation of a brown colour which is of no use in the tinctorial industry, a useful yellow colouring matter is formed if the oxidation takes place in the presence of an amount of alkali insufficient to saturate all three hydroxyl groups of the gallic acid. The alkali used is preferably potash in the proportion of two or three molecules of the alkali to one of the acid. The oxidation is effected at a low temperature in dilute alcoholic solution by means of atmospheric air, and is stopped when the maximum of galloflavine is produced. The potassium salt of the colouring matter is insoluble in alcohol, and separates out as a crystalline deposit as fast as formed. As an example the following proportions are given:—5 parts by weight of gallic acid are dissolved in 80 parts of strong spirit and 100 parts of water, and the solution, after being cooled down to 5—10° C., is mixed with constant agitation with 17 parts of caustic potash lye of 1·26 sp. gr. The solution is then oxidised at 0—5° C. by means of a current of air. In order to ascertain the correct point at which to stop the oxidation, a specimen of the solution is filtered, shaken up with air and examined, to see if it contains a precipitate which is insoluble in dilute hydrochloric acid. If no such precipitate is formed the operation is complete, and the crystalline pulp is collected, pressed, dissolved in water at 50° C., the solution acidulated with hydrochloric acid and boiled till the flocculent precipitate becomes crystalline. The colouring matter, when collected and washed with tepid water, may be dried or sent into the market in the form of a paste. Galloflavine forms lakes with metallic oxides varying in shade from greenish-yellow to orange-yellow, and the colouring matter can accordingly be used in a similar manner to alizarin. The chrome lake is said to be particularly fast on cotton.—R. M.

Improvements in Preparing Printing Colours and Solutions of Colouring Matters suitable for Printing and Fixing Aniline Colours upon Cotton or similar Vegetable Fibre. J. H. Johnson, London. From the "Badische Anilin and Soda Fabrik," Ludwigshafen a/Rhine, Germany. Eng. Pat. 6631, May 17, 1886. 6d.

THE patentees commence this specification by pointing out the disadvantages attending the use of the ordinary solvents such as alcohol, wood spirit, methylated spirit, acetic, oxalic and tartaric acids, these disadvantages being volatility or corrosive action upon the fibre during the processes of printing and steaming. The solvent now claimed is a mixture of the acetins of glycerol prepared by cohobating 1 part of glycerol with 1½—2 parts of glacial acetic acid for 48 hours and then distilling off the excess of acid. The residue consists chiefly of a mixture of mono- and diacetin with a small quantity of triacetin. The mode of application is exemplified by the two following typical cases:—(1) For preparing a printing solution of induline, 10 parts by weight of the finely-ground colour (soluble in alcohol) are digested with 40 parts of the acetins at 80—90° C. for one hour. 12 parts of the foregoing solution are then mixed with 85 parts of starch thickening and 3 parts of tannin. The colour is printed and steamed at a low temperature. (2) 10 parts by weight of induline paste, containing 25 per cent. of dry colour (soluble in alcohol), are mixed with 77 parts of starch thickening and 3 parts of tannin, and then 10 parts of the acetin added. The colour is printed and steamed as before.—R. M.

A Process for the Production of Azo-Colours from the Paradiamines of Stilbene and Fluorene. C. A. Martius, Berlin, Germany. Eng. Pat. 7284, May 31, 1887. 6d.

THESE colouring matters are analogous to and are prepared in the same manner as the azo-colours derived from benzidine and its homologues. It is observed in this case, as in that of benzidine, etc., that the tetrazo-salt combines with the phenol, amine, etc., in two steps, so that mixed azo-compounds may be obtained. Seven examples are given:—(1) Diamidostilbene diazotised and the sodium salt of α-naphtholmonosulphonic acid. Dyes cotton bluish-violet. (2) The same tetrazo-salt and β-naphtholdisulphonate of sodium (R salt). Dyes cotton greenish-blue. (3) The same tetrazo-salt with one molecule of β-naphtholdisulphonate and then with one molecule of α-naphtholmonosulphonate of sodium. The intermediate compound is red; the final product dyes cotton bluish-violet. (4) Same as preceding, the α-naphtholmonosulphonate being replaced by α or β-naphthol, or by β-naphtholmonosulphonate of sodium (Schaeffer's acid). Dyes cotton blue or bluish-violet. (5) The same tetrazo-salt and salicylic acid (two molecules dissolved in soda) gives a yellow colouring matter. (6) Diamidofluorene (diazotised) and α-naphthylaminemonosulphonic acid (sodium salt). Dyes cotton a red shade. (7) Same tetrazo-salt and β-naphtholdisulphonate of sodium R. (Shade of colour not stated). All these colours dye cotton directly from a hot alkaline (soap) bath. Diamidostilbene is prepared by the methods of Strakosch (*Ber.* **16**, 328) and Klinger (*Ber.* **16**, 945). Diamidofluorene is prepared by the method described by Schultz (*Ann.* **203**, 100).—R. M.

VII.—ACIDS, ALKALIS AND SALTS.

Some Uses of Dioxide of Manganese. Ed. Donath, Dingl. Polyt. J. **263**, 248—249.

As is well known, manganese dioxide decomposes potassium iodide solution, liberating iodine; this reaction is not due to any ozonisation of the oxygen of the air, as some suppose, for the author found no trace of ozone in a current of air passed for hours over manganese dioxide. The formation of aldehyde, by passing alcohol vapour through tubes containing manganese dioxide (at 100° C.) is applicable for lecture demonstration; the presence of the aldehyde being shown by the reduction of an ammoniacal silver solution. If the dioxide be heated in the usual copper retort for the preparation of oxygen, and alcohol vapour be passed over it, a distillate is obtained, containing acetic acid, ethyl acetate, etc. Hydrogen sulphide is rapidly decomposed when passed over heated dioxide, all the oxygen of which is eventually replaced by sulphur, flesh-coloured manganese sulphide being formed. The author, therefore, again recommends its use for gas purification, and its addition to peat waste used for deodorising purposes. The dioxide is a powerful oxidiser in alkaline solutions, chromic oxide dissolved in potash being rapidly converted into chromate. The author proposes to recover in this way, instead of in the usual dry way, the waste chromium compounds from various technical processes.

—T. L. B.

Manufacture of Acetic Acid from Wood. W. Rudnew. Dingl. Polyt. J. **264**, 88—92 and 128—132.

The first part of the paper gives an account of a series of experiments made by Jakowlew at the author's instigation, the object being to determine the yield of acetic acid obtainable from different woods when subjected to dry distillation. Although similar experiments were conducted by Senff in 1885, the conditions of the working on a large scale being carefully observed, the results obtained were merely useful as a guide for practical work. Jakowlew has, however, determined the yield of acid from perfectly dry woods distilled at uniform temperatures. The experiments were performed in the following manner:—20 to 47grms. of wood in the form of sawdust was dried at 120° and distilled in a glass retort fitted with condenser, the heating being conducted in a bath of Wood's fusible metal. After reaching 150° in the bath, the temperature was raised 1° per minute to 300°. The distillation was now continued without a thermometer until liquid products ceased to come over. Steam was then passed through the apparatus to expel any acid which might have been retained by the residual charcoal. The distillate was filtered and the acid determined in the filtrate by titration with caustic baryta, phenolphthaleïn being used as indicator. The following numbers were obtained:—

	Acetic Acid. Per cent.	
	I.	II.
Linden	10·24	10·17
Birch	9·52	9·29
Aspen	8·06	8·37
Oak	7·92	8·21
Pine	5·65	6·12
Fir	5·24	5·09
Birch bark	2·20	2·38
Cellulose from birch	6·21	—
Cellulose from pine	5·07	—

The object of determining the yield of acid from the cellulose was to study the influence of the composition of different woods on the yield of acid. The cellulose was prepared by macerating the sawdust with a mixture of nitric and hydrochloric acids, boiling the residue with weak ammonia, washing with water and drying at 120°. The above results agree with the generally accepted fact that trees bearing foliage yield more acid than pines. In other respects, however, the numbers are essentially different from those obtained by other investigators, owing to the variation of the conditions under which these trials were made. The fact that the amount of acetic acid yielded by the cellulose is less than that obtainable from most woods would appear to indicate that by the dry distillation of wood the acetic acid is mostly formed from the *lignin*, so that hard woods should yield the largest proportion of acid. This supposition is not, however, substantiated by the above numbers, the linden tree, which is a very soft wood, yielding the largest percentage of acetic acid.

In the second part of the paper, the preparation of pure calcium acetate and pure acetic acid from wood vinegar is considered. The necessary experiments were made by Wienzkowsky in the author's laboratory and the practical conclusions arrived at furnished the foundation of a new process which is said to have the following advantages over the methods at present in use:—(1) An increase in the yield of acid; (2) the production of *pure* acid; (3) the more rapid treatment of wood vinegar. The process consists in distilling the wood vinegar in copper vessels and conducting the vapours through a cooler until methyl alcohol ceases to come over. The vapours are then passed without previous cooling into milk of lime which is kept at a boiling heat and agitated during the whole operation. After finishing the distillation, the mixture is allowed to settle. The supernatant fluid is then drawn off and evaporated to a crystalline consistency, from which the mother-liquor is separated by hydro-extractors, the residual salt being washed with a solution of pure calcium acetate or a small quantity of water. The salt is then decomposed with dilute sulphuric acid and the liquid, after removing the calcium sulphate, distilled. The acid thus obtained may be concentrated by re-distillation with a corresponding quantity of concentrated sulphuric acid. The residual sulphuric acid is employed for decomposing a further quantity of calcium acetate.—D. B.

Manufacture of Caustic Alkalis. W. L. Wise, London. From C. Löwig, Breslau, Germany. Eng. Pat. 4364, Sept. 14, 1882. 6d. Amended Specification.

If a perfect mixture of sodium carbonate with ferric oxide be exposed to a bright red heat, ferrate of soda is formed, which, if treated with hot water, is rapidly decomposed into sodium hydrate and ferric oxide. On this reaction a process for the manufacture of caustic alkalis is based. For the success of the process it is necessary to have a pure oxide of iron, particularly free from alumina and silica. Roasted iron pyrites may be used with advantage, although a loss of soda is hereby incurred in the first instance. But since the iron oxide is used over and over again, this loss will not recur. The iron oxide must not be in too fine a state but rather as a granulated powder, so as to allow of easy and perfect lixiviation. Owing to this circumstance the mixture to be causticised must contain an excess of iron oxide. In practice it has been found that the best results are obtained by dividing the heating process into two operations—viz., the fritting process, and the finishing process. The object of the first is to obtain a mass fused together by sodium carbonate, and which after cooling may be easily powdered, whereby the perfect mixture of the oxide and the soda is secured. The temperature in the first process must be raised up to cherry heat, and must be maintained for about three-quarters of an hour. In the second or finishing stage, the powdered fritted mass is uniformly filled into a muffle and there heated, without stirring, to the necessary temperature, until a sample drawn proves to be free from carbonic acid, which will require nearly the same time as the fritting process. Instead of a muffle, a reverberatory furnace may be employed, which for this purpose is preferably divided by a low bridge, so that the one part may be used for fritting, whereas the hotter part is used for finishing. When the finished mass is withdrawn, the mixture in the adjacent compartment in its first stage is removed to the finishing compartment, and the first compartment immediately re-charged with a fresh mixture. The finished melt has a dark greenish colour, and is heavy, hard and of sandy granulation. For the purpose of lixiviating, a large iron cylinder is used into which a second cylinder of smaller diameter is inserted, the latter being provided with a funnel-shaped exit pipe. The space between the two cylinders is filled with water which may be heated by steam. The bottom of the inner cylinder is covered with an iron sieve upon which a layer of coarsely-powdered iron oxide is spread, and upon this a second layer of oxide of iron finely powdered to cover the bottom uniformly like a filter-bed. The "ferrid" to be lixiviated is sifted through a coarse sieve, and the inner cylinder filled with it up to three-fourths of its bulk. Cold water is added simultaneously, so as to moisten the mass, which contains, besides some undecomposed sodium carbonate, all the impurities of the original soda ash, such as sodium sulphate, chloride, etc. These impurities are washed out by the cold water, which, however, does not act upon the "ferrid." The water in the outer cylinder is then raised 70 to 80° C., and after half-an-hour's time the "ferrid" is decomposed, and the lixiviation performed with hot water. The concentrated lye when first drawn off is perfectly clear, but on cooling it deposits a few flakes of iron. If it is required to produce solid sodium hydrate, the solution may be immediately evaporated. The iron oxide remaining after the lixiviation has a red colour and contains more or less sodium hydrate, according as the lixiviation has been more or less perfect. It is, of course, used over and over again. If potassium carbonate be treated in a like manner, potassium hydrate is produced.

The amendment consists in the deletion of the words *Caustic Baryta and Caustic Strontia* from the title of the original specification and the variation of the proportions of the iron oxide and sodium carbonate employed.—S. H.

Improvements in the Manufacture of Carbonate of Soda and of Carbonate of Potash, and in the Treatment of Residual Products obtained in such Manufacture. C. F. Claus, London. Eng. Pat. 4922, April 8, 1886. 6d.

ALKALI WASTE is decomposed by carbonic acid and the sulphuretted hydrogen evolved, mixed with a sufficient quantity of air, is passed through masses of heated brickwork, where it is burned to sulphurous acid and steam. This gas, after travelling through a heating apparatus, is then passed into a Hargreaves cylinder filled with sodium chloride, on which it acts in the well-known manner, forming sodium sulphate and hydrochloric acid. The latter is condensed, while the former is converted into sodium carbonate or hydrate by the Leblanc process, thus yielding again alkali waste. The Hargreaves process may be also modified in so far that instead of charging the decomposer with sodium chloride alone, it is filled with a mixture of small coke and sodium chloride. By the action of sulphurous acid the contents of the decomposer are converted into a mixture of coke and sodium sulphate. This mixture is then heated to a temperature at which the sodium sulphate is capable of being reduced to sodium sulphide. When this heat has been reached, water-gas—*i.e.*, a mixture of carbonic oxide and hydrogen, previously heated, is passed through the mass until the sodium sulphate is reduced to sulphide. The latter is then subjected to the combined action of carbonic acid and steam, whereby it is converted into sodium carbonate, whilst sulphuretted hydrogen is liberated. The former is lixiviated and the residual coke mixed again with fresh sodium chloride. The sulphuretted hydrogen is burned to sulphurous acid, which is made to act on further quantities of sodium chloride. When heated water-gas is passed through the mass of heated sodium sulphate and coke, the carbonic oxide in it becomes oxidised to carbonic acid, which latter is used for the decomposition of sodium sulphide.—S. H.

Improvements in Apparatus for Extracting and Subliming Sulphur. J. Y. Johnson, London. From C. Dubois, Marseilles. Eng. Pat. 7129, May 27, 1886. 8d.

THE apparatus relates to the extraction of sulphur from ores, and is also applicable for the sublimation of crude sulphur. It consists of a retort or chamber in which the materials are subjected to the action of superheated steam. The retort is mounted on hollow trunnions, one of which is used for the admission of steam, whilst the other serves for the escape of the sulphurous vapour. The retort has a rotary motion imparted to it by means of a worm and worm wheel, and is enclosed in a chamber of brickwork in which the products of combustion from a furnace are caused to circulate. Steam is supplied to the apparatus by a pipe which, after passing through the heating chamber surrounding the retort, enters the latter through one of the trunnions, and distributes the steam throughout the materials by means of perforated branch pipes with contracted orifices. The other trunnion communicates with a box in which the vapourous products can be examined, and whence they can be directed into different receptacles according to their quality.—S. H.

Improvements in the Manufacture of Carbonic Oxide Gas. A. Fritschi, Paris. Eng. Pat. 7192, May 28, 1886. 8d.

THIS invention relates to the manufacture of pure carbonic oxide, and is based upon the property cuprous chloride possesses, of dissolving at a temperature varying between 0° C. and 50° C. twenty times its own volume of carbonic oxide, and of allowing the gas to be disengaged if a partial vacuum is formed above the solution. The apparatus used consists of one or more gas producers worked at a high pressure for the purpose of producing carbonic oxide with a small quantity of carbonic acid, nitrogen and hydrogen. The gases are cooled in a column, into which cold water is injected. Thence they proceed to a leaden casing, forming a barometric tube and reservoir for the solution of cuprous chloride. This casing is traversed by two series of pipes, perforated with a number of small holes. One set of pipes communicates with the gas conduit leading from the cooling column, whilst the other forms the connection with the force pipe of a pump. The object of this pump is to constantly renew the surface by drawing the liquid deprived of carbonic oxide from the upper part of the barometric tube and forcing it through the other set of pipes. An exhauster continuously aspirates the carbonic oxide from the upper part of the barometric tube, and forces it into a pipe communicating with a gasometer. The operation of the apparatus is as follows:—The exhauster is started until the required vacuum is obtained, the pump is then worked, and the gas from the cooling column admitted to the reservoir holding the cuprous chloride solution. The carbonic oxide is quickly dissolved, and removed by the exhauster as fast as it is absorbed. Once started, the apparatus will continue to work for any length of time, as the cuprous solution is not altered in its chemical composition.—S. H.

New or Improved Means or Apparatus for Evaporating Waste Lyes and Recovering Soda from Black-Liquor. B. Dawson, Malvern Link. Eng. Pat. 7859, June 11, 1886. 8d.

FOR the recovery of soda in waste lyes, such as are obtained in the manufacture of paper, incinerators of various types have been used, with none of which it has been found practicable to effect evaporation by surface heating. In order to attain this end the inventor has devised an apparatus for the use of gaseous fuel, which is introduced with a due proportion of air into the furnace in such a manner that the flame may extend over practically the entire surface to be evaporated.

—S. H.

Improvements in obtaining Chlorine. L. Mond, London. Eng. Pat. 8308, June 23, 1886. 6d.

THE invention has for its object the production of chlorine from gaseous hydrochloric acid. The latter is brought into contact at an elevated temperature with nickel protoxide, when the chlorine combines with the base. By exposing this salt subsequently at a suitable temperature to dried and heated air, the original oxide is re-formed, whilst chlorine is given off. The two operations are carried out in one single apparatus, so that no expense is incurred in moving the solid substances used. Instead of nickel, the oxides and salts of those metals can be used which only form one oxide, such as magnesium, zinc, aluminium, and so forth. The compounds of these metals with silicic, phosphoric and boracic acids may also be employed. In order to increase the active surface for the action of the gaseous hydrochloric acid, pumice stone or any porous material is impregnated with the molten chloride or with a solution of the chloride, and after drying the mass is exposed to a current of heated air. The process is best carried out in retorts or cylinders made of earthenware or cast-iron, which latter is preferably enamelled. The gaseous acid and air before entering the cylinders or retorts, are heated so as to reduce the amount of heat which has to be passed through their walls, and by this means the cylinders can be made of a large diameter. A special feature of the process is the complete conversion of the hydrochloric acid into chlorine. Impure hydrochloric acid, which is unfit to be employed directly in the Deacon process, is quite suitable for this process.—S. H.

Improvements in obtaining Sulphide of Zinc from Solutions. J. H. Dennis, Liverpool; and N. Glendinning, St. Helens. Eng. Pat. 8217, June 22, 1886. 6d.

IT is intended to obtain pure zinc sulphide from the solutions which are produced in the manufacture of copper by the wet process, and other metallurgical operations. If the solution contains any metal which in the presence of free acid is precipitated by sulphuretted hydrogen, the solution is treated with this gas until these metals are precipitated, and the said gas is slightly in excess. The free acid is then nearly neutralised by passing the solution through a filter-bed of limestone. The neutralised solution is diluted with water, so that it contains no more than 10 or 11 ounces of zinc per cubic foot, and afterwards subjected to the action of sulphuretted hydrogen, until all the zinc is precipitated, when it is separated in any convenient manner. Instead of diluting with water, the action of sulphuretted hydrogen may be continued until as much zinc as can be is precipitated; the precipitate is then separated, the filtrate neutralised, and again subjected to the action of the gas, this process being repeated until all the zinc obtainable is precipitated. The zinc sulphide is washed with a little acid until all the foreign salts are removed, when the washing is completed with water.—S. H.

Improvements in Apparatus employed in the Ammonia-Soda Process. O. Imray. From La Société Anonyme pour l'Etude et la Création de Soudières, Paris, France. Eng. Pat. 9366, July 19, 1886. 8d.

THE first operation in the ammonia-soda process is the treatment of ammoniacal brine with carbonic acid. The carbonating apparatus according to this invention is shown in Fig. 1. It consists of an annular cylinder, having within the annulus numerous shelves p serrated at their edges, which project from the sides and nearly meet in the middle, and above each pair is a curved deflector p', supported on cross bars T. The vessel being filled up to A with the solution, carbonic acid, admitted at C, is first distributed by the deflector D, and further sub-divided as it ascends through the liquid by the serrations of the shelves p and plates p'. Portions of the liquid and its precipitate of sodium bicarbonate are from time to time withdrawn at R. For the recovery of the ammonia, two vessels are employed, an upper and a lower one, as shown in Fig. 2. The upper vessel A is divided into compartments by horizontal partitions F, having through them mouthpieces E covered by bells with serrated edges. Each compartment is charged with the liquid to a level determined by overflow pipes t from each compartment to the next below, a deflecting plate causing the liquid that enters to flow quite round before it reaches the overflow. The liquid to be distilled enters at D and proceeds downwards through the successive compartments. The gas and steam pass upwards through the mouthpieces E, and past the serrated edges of the bells by which their streams are sub-divided,

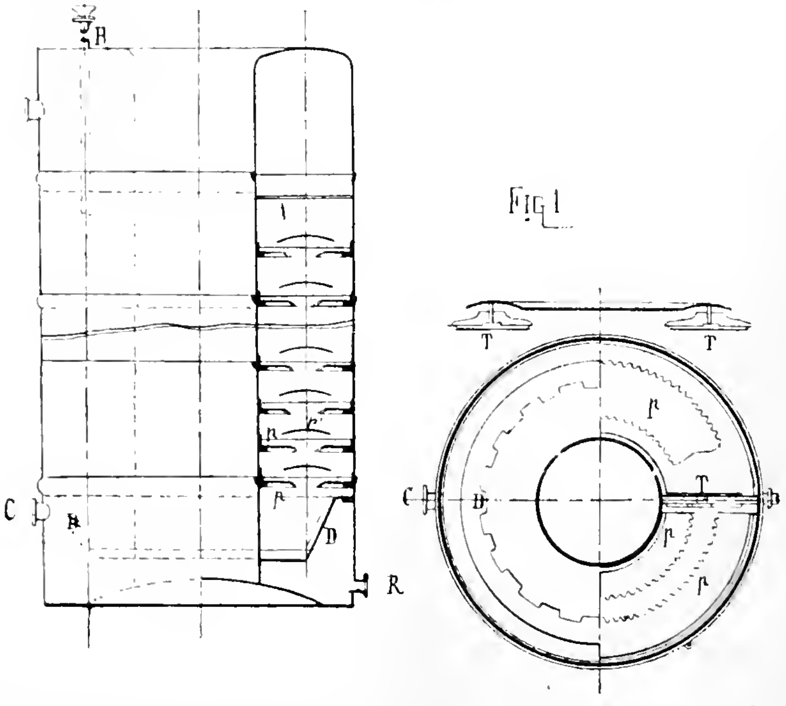


FIG. 1.

causing agitation. The disengaged gases pass away by the pipe H to be condensed. The liquid flows by the pipe N at the bottom of A to the lower vessel B, where the lime treatment is applied. This vessel is also divided into compartments by partitions, each having two mouthpieces with serrated bells K and an overflow pipe T. The latter being alternately at opposite sides, the liquid has in each compartment to pass across from the one bell K to the other. Milk of lime is continuously supplied by the pipe M to meet the liquor from A entering by the pipe N. Thus in the highest compartment the lime acts on the fixed ammonia salts. At the bottom are tubes S heated by steam around them, the steam being thus kept separate from the liquor so as not to dilute it. From time to time a portion of the liquor is run off at U.

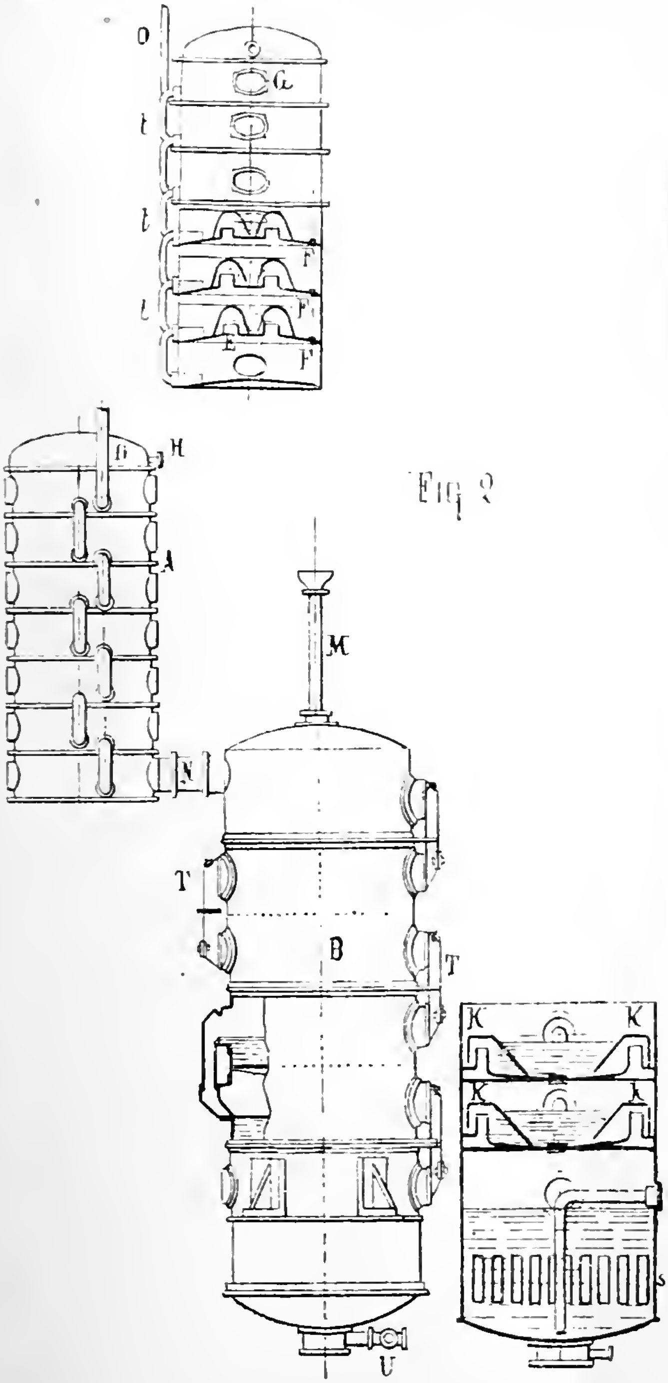


FIG. 2

The calcination of the sodium bicarbonate is effected by the apparatus shown in Fig. 3. C is a rotating cylinder, mounted on rollers G on shafts A, within a furnace chamber heated by a fire on one side. Along the axis of the cylinder extends a shaft B which is driven in a direction opposite to that of the cylinder. One end of the shaft B works on a bearing formed by a pipe T, from which a branch M is directed upwards to serve as an outlet for the gases and vapours liberated during the calcination. To the shaft B are hinged arms carrying two scraper blades L which have indented edges, the projecting teeth of the one blade corresponding in position with the intervals between the teeth of the other blade. P is a manhole for charging and discharging.

—S. H.

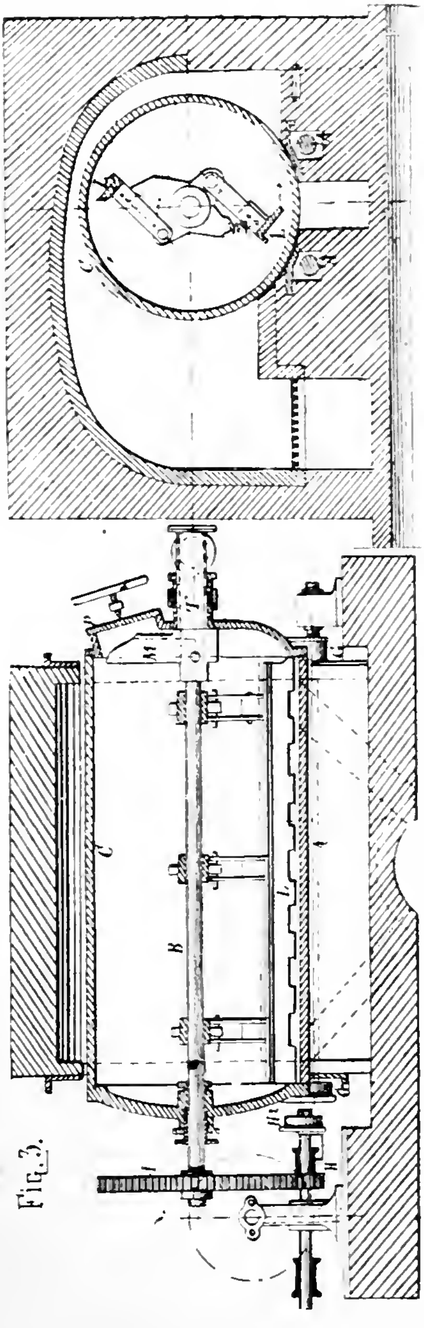


Fig. 3.

Improvements in the Manufacture of Bichromate of Ammonia. J. Park, Glasgow. Eng. Pat. 8602, July 1, 1886. 6d.

Calcium chromate is converted into calcium bichromate by the addition of the requisite quantity of sulphuric acid. Ammonium sulphate either in solid form or in solution is then added, when calcium sulphate is precipitated, from which the solution of ammonium bichromate is separated by filtration. The latter is then boiled down to the point of crystallisation.—S. H.

A Process for Manufacturing the Double Sulphate and Phosphate of Ammonium or Potassium. O. v. Gruber, Viennenburg, Germany. Eng. Pat. 329, Jan. 8, 1887. 4d.

The compound is obtained by heating phosphoric acid, containing from 50 to 54 per cent. phosphoric acid anhydride, to its boiling point (about 150° C.) and adding to it, powdered neutral ammonium or potassium sulphate in molecular proportion. The heating is kept up until the fluid shows an inclination to solidify. It is then poured upon plates, and forms dry cakes, which are readily pulverised.—S. H.

Improvements in Apparatus for Producing Sulphurous Acid in Solution. P. Thomas, Manchester. Eng. Pat. 872, Jan. 20, 1887. 8d.

The apparatus is particularly designed for the manufacture of sulphurous acid in solution, applicable to the same inventor's bleaching process (Eng. Pat. 549, 1882; this Journal, 1882, 406). Sulphurous acid gas from a sulphur burner or a pyrites kiln is passed into a box, which acts as a dust catcher, and has a series of leaden sheets suspended from hooks in an inclined position, so that the gas travelling in a downward direction may leave the solid matter behind. The gas then enters a series of coke scrubbers, in which it meets with a descending current of the sulphurous acid solution, partially exhausted and weakened by use in connection with the bleaching process. Behind the coke scrubbers a steam jet exhauster is arranged, so that the gas in its further progress is forced. At the same time the gas is thoroughly mixed up with the steam, which being immediately condensed by passing through an externally cooled coil pipe, absorbs the greater part of the remaining sulphurous acid. The gas is lastly conducted to a washer, which is continuously replenished with pure water, and extracts the last traces of the sulphurous acid. This washer consists of two boxes bolted together by vertical flanges, one box being destined for the inlet of the gas, the other for the outlet of the liquor on the one hand, and of the pure air on the other hand. The inlet box has a number of perforated tubes fixed to one of its faces. The gas has free access to the inside of these tubes, and on depressing the liquid in the inlet box, is caused to bubble up through the perforations and the liquor in the outlet box.—S. H.

Improvements in Condensing Chambers for Sublimed Sulphur. J. Y. Johnson, London. From C. Dubois, Marseilles, France. Eng. Pat. 4133, March 18, 1887. 4d.

In a previous specification (Eng. Pat. 7129, 1886; see abstract, p. 439), an apparatus was described for the sublimation of sulphur. The sublimed article, however, is obtained in a very moist condition, and requires to be dried before it can be placed in the market. In order to dispense with this necessity, the receiving chamber in which the sulphur is collected is provided with a cloth stretched at a suitable height above the floor. The sulphur is deposited on this cloth, but the water of condensation filters through it, and is drained off along suitable inclines. The whole or part of the sides and roof may be made of cloth, thus providing for the escape of uncondensed steam, which causes back pressure, and is liable to retard the sublimation of the sulphur in the retort.
—S. H.

An Improved Furnace for Recovering in an inodorous manner the Salts contained in the Lyes used in the Manufacture of Wood Fibre. C. F. Dahl, Danzig, Germany. Eng. Pat. 4600, March 28, 1887. 11d.

The alkaline lyes, resulting from the manufacture of wood fibre, contain the incrusting substances of the wood, straw, etc., which are destroyed by a fusion process, in order to recover the alkali. In this fusion process, as well as during the concentration of the liquors, very offensive gases are given off, which cannot be led away through chimneys into the open air on account of their penetrating smell. The object of this invention is to prevent a nuisance being created by these gases, and this end is attained by a particular process of evaporation, and by the complete combustion of the smouldering gases. The recovery of the alkali takes place in three stages. 1. The liquors are evaporated to a strength of 40° B., by surface heating; the vapours given off not being offensive, are led away through the chimney. 2. The concentrated lyes are boiled down to the consistency of mud, in a fire-proof vat, by an open fire. The smouldering gases which are liberated flow into an auxiliary fire arranged beside the vat, and are thus intimately mixed with heated air and completely burnt, whereupon they are led underneath the pans for the concentration of the dilute liquors. 3. The mud is fused in a retort-shaped furnace, where the incrusting matter is converted into gas. This gas, mixed with hot air, enters the main fire of the inspissation vat, where it is burnt, thus aiding the evaporation. The specification contains a large number of drawings of furnaces, in which these principles are applied.—S. H.

VIII.—GLASS POTTERY AND EARTHENWARE.

Notes on the Analysis of Clay. Meineke. Rep. Anal. Chem. **7**, 214—217.

The proportion between silica and alumina in clay is of the greatest importance for ceramic purposes. Nevertheless, the usual process of analysing clay contains two sources of error which are mostly lost sight of. The silica separated in the usual manner, not only always contains alumina, but is also soluble after drying at 110° C. to an appreciable extent. It is true these two errors sometimes equalise each other, but it is shown by a series of analyses that this is often not the case. It may be especially pointed out that in well-burnt samples of clay the silica may contain as much as 2¼ per cent. of alumina.—S. H.

IX.—BUILDING MATERIALS, CLAYS, MORTARS AND CEMENTS.

On the Behaviour of Sand containing Peat and Humus in the Preparation of Mortar. O. Lieven. Dingl. Polyt. J. **263**, 342—343.

The author shows that sand containing peat or humus cannot be used in the preparation of cement, as the cement does not set. Experiments are described in support of this statement.—S. G. R.

XI.—FATS, OILS AND SOAP MANUFACTURE.

Improvements in Treating and Purifying Paraffin Wax, and in Apparatus therefor. R. Tervet and F. Alison, Renfrew. Eng. Pat. 8756, July 5, 1886. 1s. 1d. Complete Specification accepted, May 6, 1887.

The apparatus described here, with the aid of several sheets of drawings, is intended to lessen the manual labour and the cost of the apparatus employed in purifying paraffin wax by the process technically known as "sweating." Blocks of paraffin, moulded in external stationary vessels, are slowly drawn through the sweating stove, while supported on canvas bands; or the vessels themselves, containing blocks of paraffin, are arranged on carriages and run through the stove. In both cases, gutters, pipes, etc., are provided to carry off the liquid drainings.—W. L. C.

Means for Bleaching and Disinfecting Animal, Vegetable, or Mineral Oils and Fatty Matters. A. Brin, London; and L. Q. Brin, Paris, France. Eng. Pat. 10,968, August 27, 1886. 8d.

THE material to be operated upon is subjected to the action of oxygen exactly as described in the following abstract. When bleaching is desired, the oxygen may be electrically converted into ozone, according to Eng. Pat. 11,846 of September 17, 1886. Chlorine gas may be similarly used in the same apparatus.—W. L. C.

Improvements in the Oxidation of Oils for Use in the Manufacture of Paints or Varnishes, or for other Purposes to which Oxidised Oils are applicable. A. Brin, London; and L. Q. Brin, Paris, France. Eng. Pat. 12,652, Oct. 5, 1886. 8d.

GASEOUS OXYGEN is made to pass in a finely-divided stream through the oil to be oxidised, which is placed in a close vessel provided with a steam jacket and a mechanical agitator, a drawing of which vessel is given. —W. L. C.

Improved Apparatus and Means for Extracting, Washing, and Condensing Fat, Grease, Glue, Oil, or other Substances from Bones, etc. W. Büttner, Gummersbach, Germany; and J. G. Haller and J. Magnus, London. Eng. Pat. 2615, Feb. 19, 1887. 8d.

THREE separate modifications of very complete apparatus for extraction by volatile solvents are described and figured in detail, viz:—(1) For use when the solvent is lighter than the extract; (2) when it is heavier; (3) specially for "de-greasing" woollen and other fabrics. In this last, a revolving cage is used to contain the fabrics. Special precautions are taken to ensure the complete recovery of the solvent.—W. L. C.

An Improved Lubricant. A. G. Wass, Bermondsey. Eng. Pat. 3832, March 14, 1887. 4d.

ASPHALTUM is dissolved in shale oil, tar oil or other medium; to the solution may be added glycerin and litharge or ashes of zinc, lead, or tin.—W. L. C.

An Improved Lubricant. A. G. Wass, Bermondsey. Eng. Pat. 3833, March 14, 1887.

RESIN is dissolved in any convenient oil, and litharge or ashes of lead, zinc or tin is incorporated with the solution, and sometimes any suitable animal, vegetable or mineral greases.—W. L. C.

An Improved Arrangement of Apparatus for Expressing Oil from Oil-yielding Vegetable Substances, and Converting the Residue into Oil-cake. H. Lambert and G. Greenwood, Leeds. Eng. Pat. 5277, April 15, 1886. 11d. Complete Specification accepted April 15, 1887.

THIS patent, illustrated by twelve figures on four sheets of drawings, describes a complete and compact arrangement of portable mechanism specially suited for the requirements of landowners, manufacturers and others using or dealing in oil or oil-cake in the colonies and India. It is designed to enable one attendant to crush all the seed of a moderate-sized holding, and to produce at once a marketable commodity. The engine and boiler, the crushing rolls and kettle, the consolidating or moulding press and the force-pumps for the oil-extracting press, are all mounted on one and the same cast-iron bed; the oil-extracting press and the cake-parer each have their own separate cast-iron beds, but all the machinery is worked from the same source of power.—W. L. C.

XII.—PAINTS, VARNISHES AND RESINS.

On the Varieties of Caoutchouc and Estimation of their Value. Franz v. Hohnel. Dingl. Polyt. J. **263**, 236—240.

THE various sorts of rubber, of which there are some hundreds in the market, may be divided into eight classes, according to their mode of preparation. I. In the first method the milk is poured in thin layers in a mould and dried slowly in hot smoke. The best "Para" rubber belongs to this class. For the finest quality the layers, often over 100 in number, should not exceed 0.5mm. in thickness, and they appear white or greyish, being divided by black smoke lines; the presence of air bubbles or thick layers are signs of poor quality. II. The milk is allowed to flow from the plant into little hollows dug in the soil and is allowed to dry there. This is a very rough method and can only be used in dry seasons. The product is very impure and contains much water. III. Some water is added to the fresh milk and the mixture allowed to stand a few days, when the precipitated rubber is kneaded, pressed free from the excess of moisture and dried in the sun or smoked. IV. The milk is caused to coagulate quickly by the addition of alum, brine or an acid, etc., and the coagulum pressed and dried. The rubber obtained by either of these two processes is of poor quality, and contains much water. The drying is often effected at too high a temperature, the product being rendered "tarry." Such sorts are of the least value. These processes are much used in the north of South America, also in parts of India, Central America, West Africa and the Sunda Islands. Sections of fresh samples of these sorts show a dry rind and a large soft opaque spongy kernel of a whitish-violet, yellow-red or flesh colour; they are generally free from bark or wood chips. V. To the milk is added from four to eight times its volume of water, which causes the rubber to rise as a cream to the surface. This cream is repeatedly washed and then dried. The product is good; certain Central American sorts come in this class. VI. The milk is simply allowed to evaporate in shallow vessels. The quality is good. VII. The milk, being very concentrated, is allowed to flow out on the arm of the collector, where it quickly dries and is rolled off in the form of a ring or—VIII. It runs over the bark of the tree or falls on the ground, being afterwards made up into balls or spindles. Rubber thus obtained is usually very dry and hard, but often contains as much as 30 per cent. of wood chips and bark; the colour varies from yellowish-red to brown. To this class belong the "Thimbles," "Rings," "Spindles," "Niggers," "Scraps," etc. Of course the amount of water a sample contains is an important point to be considered in its valuation, as some varieties contain over 50 per cent.—T. L. B.

XIV.—AGRICULTURE, MANURES, Etc.

On the Slow Enrichment of the Ground in Iron by the Employment of Artificial Manures. E. Jensch. Chem. Zeit. **11**, 136—137.

MANY farmers have feared that the use of Thomas phosphates and other fertilisers containing much iron, might in time cause such an accumulation of iron in the soil as to prove injurious to the crops. The author shows that this fear is groundless. If the depth ploughed is taken at 25cm., the volume of earth employed for cultivation will be 2500cm. per hect., equal (sp. gr. = 2—3) to a weight of 5750 tons. If 400kilos. of phosphate is used annually per hect. and its average value of iron is taken at 9 per cent., the weight of iron annually added will be 36kilos. Hence, even if no allowance is made for the removal of iron by crops, 597 years will be required to raise the iron-value of the soil 1 per cent. —A. G. G.

Ammonium Phosphate as a Manure. K. H. Neuffer. Chem. Zeit. **11**, 137.

THE author claims to have been the first to introduce this substance into commerce. It is now manufactured cheaply by three German firms. The commercial product consists chiefly of the mono-ammonium phosphate $(NH_4)H_2PO_4$.—A. G. G.

Injurious Action of Sodium Nitrate. K. H. Neufler. Chem. Zeit. **11**, 399.

BARLEY grown on a soil that has been manured with sodium nitrate is unfit for brewing purposes in consequence of the barley being too rich in proteids (albuminoids).—S. H.

Analysis of Freshly-fallen Leaves. Loges and Emeis. Bied. Centr. **16**, 135.

THE percentages of the ash are calculated on the dry substance :—

	Willow. (Salix caprea.)	Aspen. (Populus tremula.)	Pine. (Pinus silvestris.)	Fir. (Abeis excelsa.)
Ash	7·46	7·79	2·12	4·91
Containing:—				
Potash................	27·66	5·17	18·01	1·33
Soda..................	4·40	4·91	5·95	1·10
Lime..................	33·00	47·69	26·66	20·04
Magnesia	9·06	9·76	6·73	4·37
Ferric oxide..........	2·27	2·08	10·08	3·19
Manganese oxide	0 90	1 64	3·60	10·03
Phosphoric acid	5·57	3·68	10·24	2·70
Sulphuric Acid	5·45	2·88	4·93	2·65
Silica	6·27	20·07	11·88	54·46
Chlorine	7·59	2·78	2·34	0·23
	102·17	100·69	100·42	100·10
Oxygen equivalent for the chlorine..... ...	1·71	0·62	0·52	0 05
	100·46	100·07	99·90	100·05

The dry substance of the leaves contained :—

	Willow. (Salix caprea.)	Aspen. (Populus tremula.)	Pine. (Pinus silvestris.)	Fir. (Abeis excelsa.)
Nitrogen	1·46	0·97	0·95	0·81
Protein	9·13	6·07	5·95	5·07
Fat	4·08	9·49	8·72	12·01
Carbohydrates	57·92	45·14	44·36	46·23
Woody fibre	22·97	33·19	39·16	32·30
Mineral matter	5·90	6·11	1·81	4·39
Potash	1·60	0·31	0·33	0·06
Soda..................	0·25	0·30	0·11	0·05
Lime	1·94	2·89	0·48	0·88
Magnesia	0·52	0·59	0·12	0·19
Ferric oxide..........	0·13	0·13	0·18	0·14
Manganese oxide	0·95	0·10	0·07	0·44
Phosphoric acid......	0·32	0·22	0·10	0·12
Sulphuric Acid	0·32	0·18	0·09	0·12
Silica	0·36	1·23	0·21	2·39
Chlorine..............	0·44	0·17	0·04	0·01

Calculation of the manurial value of the foregoing. (The per cent. H_2O is taken as 17·5.) :—

	Willow. (Salix caprea.)	Aspen. (Populus tremula.)	Pine. (Pinus silvestris.)	Fir. (Abeis excelsa.)
% of Nitrogen........	1·21	0·80	0·79	0·67
,, Phosphoric acid	0·27	0·19	0·15	0·10
,, Potash..........	1·35	0·26	0·27	0·05
	7·92	4·65	4·50	3 66
Manurial value in marks per centner	0·79	0·17	0·45	0·37

—J. W. L.

Influence of the Sp. Gr. of the Seed on the Production of Cultivated Plants. E. Wollny. Forsch. auf d. Gebiet d. Agrikultur Physik, **9**, 207—216.

IN investigating this subject the author took into account, not merely the sp. gr. of the seed, but also their absolute weight. He set potatoes of different sp. gr., but of as nearly as possible the same size, in distances of 60cm. from each other, and from the results obtained at the time of ripeness of the crop the author concludes that the difference in sp. gr. of the seeds has no perceptible influence on the quantity and quality of the crop.
—J. W. L.

The Russian Black Earth. E. Brückner. Der Naturforscher **19**, 313—315.

THIS earth, which is found in South and West Russia, contains from 2—19 per cent. of humus substance. It appears to be in two layers of about 0·5 metre each, the upper one of which consists of a homogenous light loam, containing a close network of fine grass roots, while the lower one is completely undermined with mole holes. According to Dokutschajef, this black earth is formed from the remains of charred roots. The author suggests that the accumulation of dust has also taken part in the formation. The subsoil is in general loess, besides slate, limestone, sand, etc. The influence of the climate on the formation of this earth appears to be considerable; great heat and drought hindering the growth of the steppe grasses, followed by cold and lasting snow, which limit the period of vegetation to several months only, must be unfavourable to it.—J. W. L.

Analysis of a Description of Maize from Cameroon. B. Schulze. Der Landwirt. **22**, 543.

.	Per Cent.	Per Cent.
Water..........................	9·00	—
Protein	8·13	8·94
Fat	5·46	6·00
Starch, mucilage, etc..........	75·15	82·60
Woody fibre....................	1·04	1·14
Mineral matter	1·20	1·32

This corn is long, of a very light yellow colour, somewhat large and has an average weight of 0·209grm.
—J. W. L.

Methods of Storing Potatoes. G. Neuhaus. Deut. Landwirtsch. Presse, 1886, No. 80.

As it is difficult to control the temperature, moisture, etc., of a large quantity of potatoes when put together in one heap, the author suggests keeping them in pits 1—1½ft. deep and 5—6ft. wide. They should be at first covered with only a few inches of loose earth, with good ventilating shafts, and the temperature regularly noted. If it rises to 10° C., they should be uncovered on the first dry day, taken out, riddled from sand and again replaced. When the temperature of the atmosphere has sunk to 7 or 8° C. on the approach of winter, they should for the first time receive the winter covering.—J. W. L.

On the Examination of Barley. W. Hoffmeister. Landw. Jahrbücher. **15**, 865—871.

THE author having now examined a large quantity of barley as he examined the oats (this Journal, 1887, 45), especially with regard to the proportions of nitrogen and P_2O_5, he arrives at the following with regard to the development of barley on well-manured ground :—

1. The average weight of the seed varies in inverse proportion to the proteïn.
2. The size of the seed varies indirectly with the per cent. of proteïn.
3. Seeds of the same size do not necessarily contain the same per cent. of nitrogen ; this depends rather on the manure.

Proportion of P_2O_5 to Nitrogen.—The figures in the table refer to the dry substance. In comparing the small seeds with the largest ones, the latter are represented by 100 :—

DESCRIPTION OF SEED.	Proportion of smallest to largest.	Ash, per Cent.			P_2O_5, per Cent.			N, per Cent.			P_2O_5 : N.		
		Large.	Medium.	Small.	Large.	Medium.	Small.	Large.	Medium.	Small.	Large.	Medium.	Small.
Chevalier Barley	62·3	2·650	—	2·720	1·192	—	1·200	1·597	—	1·571	1 : 1·124	—	1 : 1·310
Scotch Barley	55·2	2·635	2·605	2·683	1·033	1·024	1·004	1·541	1·577	1·626	1 : 1·495	1 : 1·577	1 : 1·626
Sheep Barley	51·2	1·588	1·585	1·639	0·969	0·953	0·976	1·590	1·582	1·610	1 : 1·610	1 : 1·660	1 : 1·680
Sample Barley........	—	3·060	—	3·210	1·252	—	1·301	2·324	—	2·369	1 : 1·856	—	1 : 1·817
Imperial Barley	41·8	2·718	2·656	3·082	1·564	1·278	1·483	2·920	3·121	3·233	1 : 1·870	1 : 2·442	1 : 2·180

According to these results the P_2O_5 is just as high in the least, as in the most nitrogenous.—J. W. L.

XV.—SUGAR, GUMS, STARCHES, Etc.

The Amount of Sugar in Certain Descriptions of Oil Cakes. G. Burkhard. Neue Zeits. für d. Rübenzucker Ind. **17**, 206.

THE author finds that most oil cakes contain but a very small quantity of sugar, but earth-nut cake contains 4 per cent. of cane sugar.—J. W. L.

On the Quantity of Juice in the Sugar Beet. Bied. Centr. **16**, 197.

IN a series of papers on this subject, Petermann, Pellett, Scheibler and Sidersky have given the results of experiments, and have discussed the conclusions which may be drawn therefrom. Petermann's results give 95 as the percentage of juice. On the other hand, the results obtained by Scheibler by extracting with alcohol for the sugar determination, led Petermann to deduct 0·5 per cent. from the per cent. of sugar obtained by multiplying the per cent. found in the juice by 0·95. Sidersky has come to the conclusion that in pressing the juice from the sugar beet for analysis, it becomes more concentrated by diffusion.

Pagnoul deducts not only the 0·5 per cent. as suggested by Petermann, but also 0·17 per cent. as a correction for the volume occupied in the flask by the precipitate formed when clarifying with acetate of lead. He has compared the percentage figures obtained by using these corrections in a large number of analyses with those obtained by the alcohol method, and finds them to agree. The same author believes, however, that the alcohol method is the only reliable one.

—J. W. L.

Detection and Estimation of Melitriose (Raffinose). C. Scheibler. Ber. **19**, 2868—2874.

THE author was the first who detected raffinose in the beetroot molasses (this Journal, 1885, 607).

In 1876 Loiseau detected Raffinose in beetroot molasses and wrote its formula $C_{18}H_{32}O_{16}.5H_2O$ (*Ber.* **9**, 732). In 1883 Böhm detected gossypose in cotton-seed (*J. Prakt. Chem.* **30**, 37), and soon after Ritthausen proved that it was identical with the melitose obtained by Johnson and Berthelot from the Eucalyptus mannia, the formula being $C_{12}H_{22}O_{11}.3H_2O$. (*J. Prakt. Chem.* 29, 351 ; also this Journ. 1886, 386).

In 1885 Tollens showed that Loiseau's raffinose, and Ritthausen's melitose were identical, and the results of his analysis of the sugar itself, and of a sodium salt, agreed with the formula $C_{12}H_{22}O_{11}.3H_2O$ (this Journ. 1885, 607, and 1886, 243).

About the same time the author, in conjunction with Tollens, discovered a method by which this sugar could be obtained from beetroot molasses and other beetroot sugar products, and von Lippmann showed that it existed ready formed in the beet itself (this Journ. 1886, 104). The author's own experiments, especially the estimation of the water of crystallisation, seemed to leave no doubt that the right formula was that assigned to it by Loiseau, $C_{18}H_{32}O_{16}.5H_2O$.

Having regard to his nomenclature for the sugars (this Journ. 1885, 541), the author suggests that the various names under which this sugar has been known, up to the present, should be substituted by that of melitose.

Melitriose thus freed from water melts at 118—119° and is very hygroscopic. On account of its great solubility in water it is found in the beetroot molasses, and also in the sugars recovered from these. It seems to form a compound with cane-sugar, possessing a peculiar crystalline form, and cannot command the highest prices. This is, indeed, but right, for if the sugar be estimated with the polariscope it will rotate the ray to a greater extent than pure cane-sugar, and in the refinery give a larger amount of molasses. Of the various processes used to recover cane-sugar from molasses, the strontium one alone separates it from the melitriose, this sugar forming no insoluble compound with strontium. The other sugars recovered from molasses containing, therefore, melitriose, the want of a simple method for the estimation of the melitriose has been much felt, and for some months experiments to this end have been in process in the author's laboratory. It was found that 100cc. absolute methyl alcohol dissolves 9½grms. melitriose, whereas it only dissolves 0·4grm cane sugar. From three different commercial sugars obtained from molasses the author separated very considerable quantities of melitriose by means of wood spirit, and purification by crystallisation out of ethyl alcohol. But the difference in the solubility of melitriose and the saccharoses in absolute methyl alcohol may enable the amount of the former to be determined quantitatively. The author desires to reserve the subject for further investigation.—J. W. L.

Formose. O. Loew. Ber. **20**, 141—144.

THE author criticises Tollens' statement* that formose $(C_6H_{12}O_6)$, the product of the action of an excess of milk of lime on a 3·5–4 per cent. solution of formaldehyde,† does not belong to the glucoses, because it does not yield levulinic acid on treatment with hydrochloric acid. Formose possesses the sweet taste and reducing properties of the glucoses; it also forms a compound with phenylhydrazine. With yeast, however, it does not ferment, nor is it optically active; but the author does not consider the possession of these properties as essential to its being classed among the glucoses. As is the case with levulose, both dilute nitric acid and bromine cause the chain of carbon atoms to break up. With both these reagents, trihydroxybutyric acid is among the products of the reactions. With hydrochloric acid a large quantity of humus substances result and as a by-product, probably a ketonic acid, which does not yield the characteristic silver salt of levulinic acid.—C. A. K.

The Action of Aromatic Diamines on Carbohydrates. P. Griess and G. Harrow. Ber. **20**, 281—282.

THE authors have found that certain diamidobenzenes and their carboxylic acids combine with carbohydrates. If a conc. aqueous solution of one part by weight of diamidobenzene [1 : 2] be mixed with two parts of grape sugar, a few drops of HCl added, and the mixture kept in a warm place for about eight days, a weak base is formed, which is somewhat soluble in hot water and alcohol, from which it crystallises almost completely on cooling, in beautiful white shining needles. It is readily soluble in dilute HCl, from which it may be again precipitated, unchanged, by addition of ammonia. It has a bitter taste, and reduces Fehling's solution. If instead of the diamidobenzene, the diamidobenzoic acid $[CO_2H : NH_2 : NH_2 = 1 : 2 : 3]$ be used, a compound, having the character of an amido-acid, is formed. It is but slightly soluble in boiling water or alcohol, and crystallises out of the former in white shining leaves, which do not reduce Fehling's solution but behave similarly to the sugars on heating in a test tube. The authors have obtained a similar acid to the last by substituting maltose for grape sugar. (See this Journal, 1885, 331.)—J. W. L.

Preliminary Communication. H. Kiliani. Ber. **20**, 282.

THE action of HI on arabinose carboxylic acid produced a dehydro-acid, and a small quantity of caproic acid (this Journal, 1887, 219). Accordingly, this dehydro acid has the formula $C_6H_{10}O_6$. Since further the analyses of the phenylhydrazine compound of arabinose agreed with the formula $C_{17}H_{20}O_3N_4$, it is very probable that the arabinose molecule contains only five carbon atoms.

—J. W. L.

Paragalactin. E. Schulze and E. Steiger. Ber. **20**, 290—294.

THE authors have recently noticed that lupin seeds contain a substance which is insoluble in water, alcohol and ether, and from which galactose may be obtained in large quantities by boiling with dilute acids. In order to investigate the character of the sugar obtained when this substance is heated with dilute H_2SO_4, they prepared a quantity as follows:—1kilo. of finely-ground lupin seeds were extracted first with ether, then several times with cold, very dilute (about 1 per cent.) KHO and finally with water until free from alkali. This residue, which possesses a gelatinous appearance, was next heated half-an-hour with 10 per cent. H_2SO_4, the solution filtered from the undissolved woody fibre, diluted with an equal volume of water and finally boiled for another two hours in order to complete the reaction. After cooling, the H_2SO_4 was precipitated with $BaCO_3$, and the solution then concentrated to a syrup on the water bath at a low temperature. This syrup was boiled with absolute alcohol, and the extract, after concentration on the water bath, was again boiled with absolute alcohol. The alcohol dissolved only a part of the residue, and after allowing the solution to stand for some time, a sugar crystallised out, which was purified by recrystallisation from dilute alcohol. The residue, insoluble in absolute alcohol, was dissolved in 90 per cent. alcohol, the solution concentrated, the residue taken up with water, and the solution, after decolourisation with animal charcoal and subsequent concentration, crystallised completely on standing. The crystalline mass was purified by recrystallisation from alcohol. Both the crystalline products, although prepared from different parts of the principal residue, proved to be one and the same substance—viz., galactose. The specific rotatory power, the melting points, both of the pure substances, and also those of their phenylhydrazine derivatives, the product of oxidation with HNO_3, which was principally mucic acid, and lastly, an examination of the product of the oxidation with Br., proved their identity. There was no other sugar found with the galactose. The constituent of the lupins producing galactose in the manner just described, the authors have named paragalactin. They calculate that the seeds contain about 20 per cent. of this substance. Paragalactin is insoluble in water, even at the boiling point; it is slightly soluble in tartaric acid, which solution reduces Fehling's solution. It produces no sugar when treated with diastase solution. The gelatinous extract obtained by treating the lupins with very dilute KHO, was heated for two hours on the water bath with 10 per cent. KHO. A yellow coloured solution was formed, from which alcohol produced a gelatinous precipitate, soluble in water and again reprecipitated by alcohol. The precipitate was filtered off, freed from water by means of absolute alcohol, and standing over H_2SO_4. Ignition showed it to contain a considerable quantity of K_2O. By treating it with anhydrous acetic acid, an acetic ether was formed, the analysis of which agreed with the formula $C_6H_7O_3(C_2H_3O)_3$. This ether is insoluble in water, alcohol, ether and in a mixture of alcohol and acetic acid. On heating, it commences to decompose at about 225° without previous fusion; it is, therefore, quite distinct from the acetic ether of β-galactan. Although the authors have not been able to prepare the paragalactin in the pure state, they conclude from the above reactions that it may be represented by the formula $C_6H_{10}O_5$.—J. W. L.

Composition of the Seeds of Panicum Miliaceum. A. Beutell and F. W. Dafert. Chem. Zeit. **11**, 136.

THE long-known varieties of this plant, "klebreis" and "klebhirse," are much used in Japan and China as a gum and as a cheap article of food. The seeds owe their glutinous character to a new form of starch—viz., erythroamylum. The latter is starch in which the granulose is replaced by erythrogranulose (probably identical with erythrodextrin). The authors give the following analysis of a specimen of "klebreis":—

	Decorticated Grain.	Cortex.
Protein	12·99%	11·98%
Fat	4·28	6·85
Dextrin	0·26	0·96
Glucose	5·13	4·68
Starch	76·18	60·31
Fibre	0·15	4·98
Ash	1·01	10·21

—A. G. G.

The Real Nature of Starch Cellulose. Griessmayer. Allgem. Bauer- und Hopfenzeit. **26**, 147.

IN order to prove by macro-chemical means that the skeleton-like substance, obtained from starch by treat-

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* Ber. 19, 2134. † J. Prakt. Chem. 1886, 321–351.

ment with dilute acid, consists of amylodextrose, Nagelli treated 1000grms. of potato-starch with 6 litres of 12 per cent. HCl for 100 days in the cold. A large quantity of the skeleton-like substance was thus formed. It was washed free from acid, sugar, dextrose etc. In the dry state it weighed 300grms. On boiling with water it almost completely dissolved, the small undissolved residue consisting of impurities, fat etc. On freezing the solution, the amylodextrose crystallised out in spheroid crystals.

J. W. L.

Imitation Gum Arabic. Brit. and Col. Drug. 1887.

THIS is a substance said to be offered in the market in three classes, designated as white, light yellow, and yellow. The first two are, it is stated, in appearance a close imitation of the genuine article, the white being in fragments about the size of those in gum mastic, but as light in colour as good picked gum arabic, angular, with conchoidal faces but without the fissures of gum arabic. The light yellow variety is like the above as to size and general appearance, excepting in colour; the masses in this look like "sorts" gum arabic. The yellow appears in masses somewhat larger, cubical, and in colour resemble translucent pix burgundica. They all are said to behave nearly alike, and the described reactions with water (in which no solution, but only intumescence takes place, becoming clear when boiled), iodine (giving no starch reaction), alcohol (with which the solution remains clear, showing absence of arabin) and lead acetate (by which it is not precipitated), should readily establish their fictitious nature. The substance is said to be carrageein obtained from Irish moss, but this mucilage *is* precipitated by lead acetate solution, so that there must be some error.

XVI.—BREWING, WINES, SPIRITS, Etc.

Composition of By-products from a Porter Brewery. By Sir Charles A. Cameron. Brit. and Col. Drug. 1887, 348.

THE following analyses relate to some of the by-products from the largest brewery in the world, namely, Messrs. Arthur Guinness & Sons, Dublin. They are, no doubt, similar to by-products obtained in other breweries, and which might be converted into artificial manures, or constituents of manures, especially where waste heat for evaporating purposes were required.

Residue from vats to which gelatine had been added: 100 parts contain—

Water	87·800
Dry matter	12·200
	100·000

The dry matter yields—

Ammonia	1·244
Ash	1·150

Including—

Phosphoric anhydride	0·381
(Equal to calcium phosphate 0·838)	
Potash	0·040
Soda	0·050
Chlorine	0·100
Calcium sulphate	0·036

The residue, if nearly dried, would therefore yield about of—

Ammonia	8·000
Calcium phosphate	6·000
Potash	0·600

Residue from vats containing no gelatine; 100 parts contain—

Water	77·500
Dry matter	22·500
	100·000

The dry matter yields—

Ammonia	1·836
Ash	2·055

Including—

Phosphoric anhydride	0·320
(Equal to calcium phosphate 0·700)	
Potash	0·100
Soda	0·110
Calcium sulphate	0·080

This residue nearly dried would contain about 2·8 per cent. of calcium phosphate and 0·4 per cent. of potash, and yield 7 per cent. of ammonia. Compressed yeast, 100 parts, contain—

Water	62·30
Dry matter	37·70
	100·00

The dry matter yields by combustion with soda-lime—

Ammonia	3·204

And leaves on combustion—

Ash	2·800

Including—

Phosphoric anhydride	1·690
(Equal to calcium phosphate 3·380)	
Potash (chiefly in union with phosphoric acid)	0·500
Soda	0·230

If converted into a moderately dry substance the compressed yeast would yield fully—

Ammonia	8·000
And of calcium phosphate	4·000
And potash	1·500

EXHAUSTED HOPS.

100 parts contain—

Water	93·840
*Dry matter	6·160
	100·000

*Yielding—

Ammonia	0·314
Ash	0·308

Including—

Calcium phosphate	0·140
Potash	0·035

The amount of water is very large, and the drying of this waste product would be rather costly. This by-product largely exceeds in quantity all the others above described.

Diastase. O. Loew. Ber. **20.** 58.

THE method of obtaining pure diastase by treating the crude substance with lead acetate, was first proposed by Wurtz and not by the author, as stated by Lintner (this Journal, 1887, 296—297). The method works well, provided due precautions are observed. To show the relation of diastase in its chemical composition to other ferments, Lintner compares it with invertin which Kiliani has proved to contain a considerable amount of hop resin. The author stands by his statement (*Ber.* **15**, 1583), that the pancreatic ferments are albuminous bodies closely related, both as regards composition and properties, to the peptones.—C. A. K.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(*A*) CHEMISTRY OF FOODS.

Sp. Gr. of Butter, Artificial Butter and other Fats. Sell. Milchzeit. **15**, 460—461.

THE author gives the following densities, determined by König's method at 100° C.

Pure butter never less than	0·866
Other fats and oleomargarine	0·859
75% butter. 25% artificial butter	0·865
50% butter. 50% ditto	0·863—864

and he suggests that 0·866 should be the limit for the sp. gr. of pure butter.—J. W. L.

On the Formation of the Skin on Heating Milk. P. Sembritzky. Milchzeit. **15,** 462.

THE author removed the skin, which forms on the surface of milk when heated, until it no longer formed, and found it to be about 1 per cent. of the milk. It was, therefore, not merely albumen, of which there is only about 0·4 per cent., but he found it to contain casein. This skin forms at temperatures above 50° and may be removed 50 or more times; when it ceases to form any longer, the milk contains no albumen and but little casein.—J. W. L.

The Action on the Milk of Cows fed on the Residuary Liquors of Sugar Refiners. Kirchner. Centr. Blatt. für d. med. Wissensch. 1885, No. 2.

AFTER closely examining the results of an extensive experiment, the author concludes that, provided the cow does not lose her appetite for ordinary foods, the addition of the maize residuary liquors has a decidedly beneficial effect on the milk, both with regard to quantity and quality; whereas the addition of vinasse has, on account of its purgative properties, a prejudicial effect. The author finds, further, that the very greatest cleanliness should be observed in connection with all the various utensils used in the dairy, when using these foods. These liquors, vinasse, etc., especially in a partially fermented condition, contain not only considerable quantities of yeast but are also a very suitable bed for supporting the development of all the lower germs and bacteria, which exert a very detrimental influence on the health of the cow and on the rate at which the milk becomes sour. These germs, which do not pass through the cow into the milk but become transmitted through carelessness into it, have also a serious influence on the keeping qualities of the butter and cheese.—J. W. L.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

The Perennial Scented Grass Anthroxanthum Odoratum. Nobbe. Der Landwirt, **22,** 523.

THE seeds of this grass are being replaced by the small annual grass, *Anthroxanthum Puelii, lec. and lam.*, which also contains cumarin, the valuable essence of the scented grass. This annual grass, *A. Puelii*, grows as a weed and has latterly spread very rapidly in Hanover. It has a less value than the *A. odoratum*, is an annual plant, forms no turf and produces much less hay. The seed ripens the summer after being sown and produces no more than a quarter to one-third the quantity that the *A. odoratum* does, besides possessing a much weaker odour.—J. W. L.

The Polariscope as a Revealer of Adulterations in Essential Oils. A. M. Todd. Amer. Journ. Pharm. April, 1887.

IN examining some spurious oils of peppermint in behalf of the State, observations were made with a Mitscherlich polariscope upon their polarisation. In authentic samples of several peppermint oils prepared by the author, it was found that, though these different pure samples varied slightly in the angle of polarisation, there were found to be *limits* beyond which pure samples did not go. It was found that if a certain essential oil polarising within a certain limit was mixed with another polarising within entirely different limits, the difference in the polarising angle would enable the amount of adulteration to be readily determined. The angles exhibited by five samples of pure oil of peppermint when polarised were: −55°, −46°, −46°, −52°, −52°, averaging −50·2°. Five samples of natural oil of camphor were also examined, exhibiting an average angle of +65°. Five samples of adulterated peppermint oil averaged −9°, showing a deficit of 40·8°. The variation of the last five samples was at first thought to be due to the dementholisation of the respective oils; but from the fact that oil of camphor (which is dextro-rotatory) is known to be a common adulterant of essential oils, and from his polariscopic observations the author arrived at the conclusion that the impure samples contained an admixture of oil of camphor, the exact proportions in which the polariscope, in skilled hands, was capable of accurately determining. A description of the polariscope recommended by the author for the examination of essential oils may be found in Tucker's work on "Sugar Analysis."

No great progress can be made in this mode of examining essential oils until the indices of refraction of the numerous *pure* oils have been accurately determined; the majority of essential oils in commerce cannot for this purpose be depended upon. The author is now engaged upon special investigations with the oils of fireweed and erigeron.—W. E.

Specific Gravity of some Essential Oils of Commerce as taken from Pure and Normal Samples. From the Report of Messrs. Schimmel & Co., Leipzig.

Name of the Oil.	Temperature of the Oil.			Remarks.
	10° C. (50° F.)	15° C. (59° F.)	20° C. (68° F.)	
Oleum Anisi	—	0·985	0·980	On an Average.
" Valerianæ ..	0·947	0·915	0·940	
" Bergamotæ La Reggio	0·887	0·883	0·880	
" Amygdal essent.	1·063	1·060	1·055	1·060
" Cajuputa (green)	0·927	0·925	0·922	1·05–1·06
" Cassiæ rect. ..	1·058	1·055	1·052	
" Cedri ligni ..	0·918	0·945	0·940	
" Citronellæ ..	0·900	0·896	0·893	
" Cymini . ..	0·925	0·922	0·918	
" Cubebæ	0·918	0·915	0·912	
" Coriandri ..	0·872	0·867	0·861	0·860–0·870
" Eucalypti globul	0·925	0·922	0·918	
" Anethi	0·905	0·900	0·896	
" Fœniculi dulcis I. rectif ..	0·975	0·970	0·965	0·965–0·975
" Zingiberis ..	0·885	0·882	0·878	
" Carui (from Dutch fruits)..	0·911	0·908	0·905	
" Macis	0·858	0·855	0·852	
" Caryophylli ..	1·065	1·062	1·059	1·060–1·065
" Menth. pip (Mitcham) ..	0·905	0·900	0·898	0·900–0·905
" Aurantii dulce..	0·851	0·850	—	
" Sassafras ..	1·068	1·065	1·060	1·05–1·07
" Sinapis essent. (from seeds) ..	1·030	1·025	1·020	
" Sinapis (artificial)	1·025	1·020	1·016	
" Santali (East Ind.)	0·978	0·975	0·973	
" Juniperi dupl. rectif. e baccis	0·863	0·858	0·855	
" Wintergreen (natural) ..	1·189	1·185	1·182	
" Wintergreen (artificial) ..	1·192	1·187	1·183	
" Cinnamoni, Ceylon	1·035	1·030	1·027	1·03–1·035

A variation in the above numbers, not exceeding the third decimal figure, would not necessarily imply adulteration, but more considerable discrepancies are not permissible.

Saccharine. Chem. Zeit. **11**, 195.

MAUMENÉ criticises the properties of Fahlberg's saccharine, which he pronounces to be a mixture, since crystals can be obtained from the solution in weak alcohol which contain 13 per cent. of sulphur, whereas the substance remaining in the mother-liquor contains 15 per cent. of sulphur.—S. H.

Hydrastine. M. Freund and W. Will. Ber. **20**, 89—95.

HYDRASTINE is decomposed by dilute nitric acid similarly to narcotine, opianic acid and a base resembling cotarnine being formed (this Journal, 1886, 677). This base, to which the name "hydrastinine" is given, has the formula $C_{11}H_{11}NO_2+H_2O$, whence the formula for hydrastine would be $C_{21}H_{2}\ NO_6$, and not $C_{22}H_{23}NO_6$, as given by Mahla (*Sill. Amer. Journ.* (2), **36**, 57) and Power (*Archiv. d. Pharm.* 1884, 910), unless carbon dioxide is evolved on treating it with dilute nitric acid, which is not the case.

$$\underset{\text{Hydrastine.}}{C_{21}H_{21}NO_6}+O=\underset{\text{Opianic Acid.}}{C_{10}H_{10}O_5}+\underset{\text{Hydrastinine.}}{C_{1}\ H_{11}NO_3}$$

This formula for hydrastine agrees with analyses both of the free base and of its platinum double salt, and has been confirmed by Eykman (this Journal, 1887, 380).

Hydrastinine is a white crystalline body melting at 116—117°, and dissolving in petroleum ether and hot ether. It is precipitated from an acid solution by caustic potash or soda, but not by ammonia or sodium carbonate. Like cotarnine, it contains a molecule of water of crystallisation, which is not present, however, in its salts. Of these the hydrochloride and acid sulphate are readily soluble in water. The former is optically inactive and shows a slight fluorescence in solution, while the crystals of the latter show a green fluorescence. The bichromate and ferricyanide are very characteristic, as well as the gold and platinum double salts. The methiodide is a yellow crystalline body. On reduction with zinc and hydrochloric acid, hydrohydrastinine is formed, $C_{11}H_{13}NO_2$, a base readily soluble in ether, alcohol, etc., and melting at 66°. Its hydrochloride is a crystalline powder, while its hydrobromide forms white needles. When oxidised with dilute nitric acid until caustic potash ceases to produce a precipitate in the solution, hydrastine forms an acid having the formula $C_8H_7NO_4$, isomeric if not identical with apophyllenic acid. Its melting point is 232°, 10° above that of apophyllenic acid.

—C. A. K.

Carveol, Borneol, and Menthol. R. Leuckart. Ber. **20**, 114—116.

CARVOL is reduced to the corresponding alcohol—"carveol"—by means of sodium and alcohol, just as ordinary camphor is converted into borneol.

Carveol boils without decomposition at 218—220° and is characterised by a smell quite distinct from that of carvol. The presence of the hydroxyl-group is shown by the action of acid chlorides and by the formation of acetic and benzoyl ethers, both of which are liquids. Further, when treated with phenylcyanate, phenylcarvylurethane is formed, a crystalline body soluble in hot alcohol and melting at 84°.

$$C_{10}H_{15}.OH+CO.N.C_6H_5=CO{<}\begin{matrix}NH.C_6H_5\\O.C_{10}H_{15}\end{matrix}$$

Borneol and menthol form analogous crystalline compounds, melting at 133° and 111° respectively. The formation of these compounds appears characteristic of the presence of an hydroxyl-group (Leuckart and Bach; *Ber.* **20**, 104) and the author finds that phenylcyanate gives no urethane with either carvol, camphor or monobromocamphor, the sole product of the reaction being diphenylcarbamide, formed from the phenylcyanate by assimilation of a molecule of water and loss of carbon dioxide.—C. A. K.

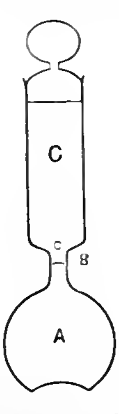
Naringin. W. Will. Ber. **20**, 294—304.

THE author now gives fuller details of the research partially published in *Ber.* **18**, 1311. From 30kilos. of dried *Citrus decumana* blossoms he obtained 600grms. or 2 per cent. of naringin. To this glucoside the formula $C_{21}H_{26}O_{11}$ is assigned. It is a white substance, which dissolves in alcohol and in warm water, crystallising from the latter with 4 molecules of H_2O. The specific rotatory power in H_2O was found to be $[\alpha]_D = 84{\cdot}5°$; in alcohol solution $[\alpha]_D = 87{\cdot}6°$. It decomposes readily when heated with dilute acids. Heated on the water-bath for 6—8 hours with a 2 per cent. solution of H_2SO_4, it is split up into iso-dulcite and naringenin, the latter being precipitated from the solution as a white crystalline mass. Purified by recrystallisation out of alcohol, naringenin melts at 248°, when decomposition sets in. It possesses the weak acid properties of a phenol, dissolves readily in solutions of the alkalis but forms no salts with alkaline carbonates. With ferric chloride it forms a deep red-brown coloured solution and it dissolves readily in alcohol, ether and benzene. The analyses agree with the formula $C_{15}H_{12}O_5$. The iso-dulcite obtained by the decomposition of naringin agreed in all its properties with the published descriptions of it. The specific rotatory power was found to be $[\alpha]_D = 8{\cdot}2°$.

Naringenin is readily decomposed when boiled with concentrated KHO, the products being phloroglucinol and naringeninic acid. The phloroglucinol agreed in properties with descriptions already published. It melted at 209° and crystallised in the prismatic system. The naringeninic acid was separated from the phloroglucinol by precipitation with dilute H_2SO_4, filtered, dissolved in $NaHCO_3$ solution, again filtered and precipitated with H_2SO_4. Thus obtained it is crystalline and may be purified by recrystallisation from hot water. The analytical data agree with the formula $C_9H_8O_3$. From hot water it crystallises anhydrous, while from cold water it crystallises in long shining needles containing 1 molecule of H_2O. It melts at 207° and gives a red-brown coloured solution with ferric chloride. If the aqueous solution be treated with sodium amalgam, hydronaringeninic acid ($C_9H_{10}O_3$) is formed, melting at 126°. To naringin may be assigned the formula $HO.C_6H_4.CH{:}CH.CO.O.C_6H_3(OH)_2[HO{:}CH=1{:}4$ and $O{:}OH{:}OH=1{:}3{:}5]$. Naringin must be considered to be a glucoside composed of naringenin in combination with iso-dulcite.—J. W. L.

Optical Behaviour of Cocaïne and a Method for Proving its Purity. O. Antrick. Ber. **20**, 310—322.

IN order to place in the hands of chemists a method for the accurate estimation of cocaïne hydrochloride, the author has determined the specific rotation of solutions of this salt obtained from different sources in as pure a state as possible. All the specimens which the author examined dissolved in water with a slight turbidity, and he therefore used diluted alcohol as the solvent. The instrument he used for the determination of the power of rotation was a Landolt's polaristrobometer (*Zeits. f. Instrumentenkunde*, 1883, 121). For the determination of the sp. gr., as well as the strength of the solution, the author used a flask of the form in the accompanying wood-cut. The bulb A has a capacity of about 25cc., and



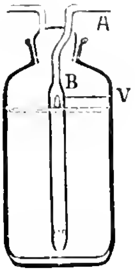
in preparing a solution it is filled up to the mark *b*, the diameter of the neck here being 5mm. The sp. gr. was taken at 20°, water at 4° being the unit of comparison. For the calculation of the constants A and B in the formula $[\alpha]_D = A + Bq$, and $[\alpha]_D = A - Bc$, a specimen of cocaine hydrochloride obtained from Messrs. Jaffé and Darmstaedter was taken as the standard. This specimen not only answered all the requirements of the Pharmaceutical Commission of the Society of Apothecaries, but the analytical data also agreed with those obtained by other authors. It melted at 181·5°. Tables are given with details of results obtained.

In using this method for the examination of any specimen of cocaine hydrochloride, the author suggests that the flask he used will be found very useful, and advises that 100cc. of the solution shall contain 10 or 20grms. of the salt, and further that more than one determination shall be made, and a mean of the results taken.—J. W. L.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

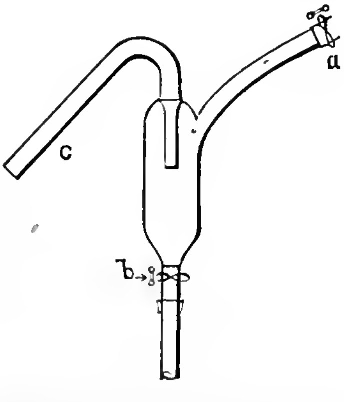
Drechsel's Absorption Bottle with Valve. Chem. Zeit. **11**, 224.

The bottle has inside the gas-inlet tube A a small valve light enough to float upon liquors. If gas be passed into A, the valve will allow it to enter, but as soon as the pressure diminishes the valve will rise, close tube A at B and thus prevent the flowing back of the liquor. —S. H.



A New Siphon. A. Jolles. Rep. Anal. Chem. **7**, 151.

By sucking slightly at *a*, and then closing the pinch-cock, a partial vacuum is created in the body of the apparatus, which is at once filled with the liquid rising through the tube *c*. On opening the pinch-cock *b*, the apparatus acts like any ordinary siphon. It is extremely easy to set the siphon in action and none of the liquid can be drawn into the mouth of the operator, so the apparatus is specially recommended for siphoning poisonous liquids.—E. E. B.



A Method of Maintaining Water-baths, Spirit-lamps, etc., at a Constant Level. R. Bensemann. Rep. Anal. Chem. **7**, 3 and 4.

Fig. 1 shows the arrangement recommended. F is the bottle from which the liquid is supplied. The level of the liquid in the spirit lamp or water-bath B is determined by the regulator A, which is a cylindrical vessel, provided with a doubly-bored cork and two tubes. A is partly filled with mercury, into which the longer of the two tubes dips; and the level of the liquid in B can be altered by changing the depth to which the tube dips into the mercury. In order to start the apparatus, the tube is raised out of the mercury until the liquid begins to flow out of F, and when it has reached the desired level, the tube is again pushed down into the mercury until the flow is checked. The level in B then remains constant, the condition for equilibrium being $h = q \pm s$, where *h*, *q*, and *s* denote the respective pressures due to the columns of liquid so marked in the figure. A still simpler arrangement is to omit A altogether, and connect B directly with F, as in Fig. 2. The level of the liquid in B is then regulated by varying the depth to which the vertical tube dips into the liquid in F. The apparatus is put into working order by blowing air in through this tube until the liquid has reached the proper level in B. The cork shown in the neck of B need not be air-tight, as it only serves to support the tube which conveys the liquid.—D. E. J.

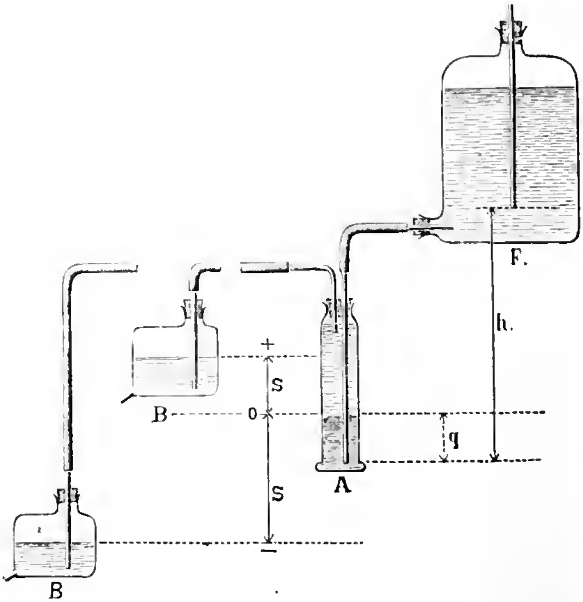


Fig. 1.

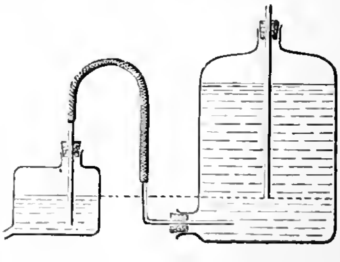
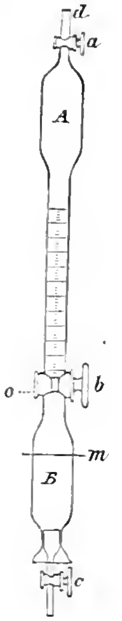


Fig. 2.

A New Gas Burette. B. Franke. J. Prakt. Chem. **35**, 1887, 259—262.

The burette consists of a measuring tube A and the bulb B for holding the reagents, connected by a tap *b*. The other end of B can be closed by a stopper with a tap c. The measuring tube A holds exactly 100cc., the zero of the scale lying in the bore of the tap *b*. The burette is filled with the gas to be examined either by passing it through the apparatus for some time or by filling the burette with water and aspirating the gas through *d* until the level of the water has sunk to *m*. The tap *a* is then closed, and the burette placed vertically in water, so that the water inside and outside is on the same level. On closing *b*, the gas in the burette is under the ordinary atmospheric pressure.



The vessel B is filled with any absorbing agent for treating the gas, and the stopper inserted afterwards. The tap *c* is closed and *b* opened, so that the liquid may enter the measuring tube to be thoroughly mixed with the gas by shaking. After the absorption has taken place, the liquid is again collected in B, *b* is closed, and after rinsing and filling B with water, the burette is placed in water. The tap *b* is then opened in order to measure the gas under the same conditions as before. It will be seen that the burette is of general application, like Bunte's, and can also replace the more expensive Orsat's apparatus.—S. H.

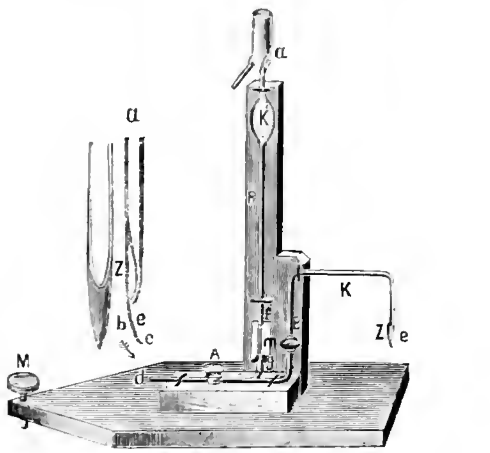
Pipettes without Graduations. A. Beutel and F. W. Dafert. Rep. Anal. Chem. **7**, 186—190.

THE advantages claimed for this form of pipette, which consists of a siphon arrangement by means of which a constant volume of liquid is allowed to pass from one part of the apparatus to another, are, that it requires no manipulative skill, while it is, at the same time, quite as accurate as any of the ordinary measuring instruments employed in volumetric work. Indeed, a comparison made with both pipettes and burettes, by weighing the amounts of water delivered, seems to show that this new form is more accurate than burettes and quite as accurate as any form of pipette.

The liquid to be measured enters the apparatus by the tube *d* (Fig. 2) which is connected with the supply vessel (not shown in the figure). The pipette is filled by opening the stopcocks A and B, and allowing the liquid to flow in until the siphon K is full. B is now closed, and then A. Any liquid rising in the tube *f* K′ above the level of *a* is carried away by the overflow pipe (see Fig. 2). The tube *f* K′ is 5—6mm. wide, and by making it of considerable length and having the bulb K′ at the top, the liquid in K is under sufficient pressure to enable it to flow out rapidly. The portion of the tube *fg* is narrowed (internal diameter 2—2½mm.) in order to reduce the fluctuations of the meniscus of the fluid to a minimum. There is a mark at *m*, and the pipette is in the correct position, when on emptying the siphon the meniscus of the fluid rests at this point. The pipette is fixed on a wooden board, and all corrections for position are made by the screw M. By means of this screw any difference in the capillarity of the liquids used, is readily allowed for: the meniscus must be at *m* when the siphon is empty.

The pipette having been filled as described, the mode of operations is as follows:—The stopcock B is opened and the liquid in *f* K′ sinks to *m*. To avoid any inaccuracy in the manner in which the contents of the siphon are delivered, a glass tongue *z* is fixed on to *e* (Fig. 1), and as soon as more liquid drops from Z, B is closed, and the vessel receiving the liquid moved along the tongue Z in the direction indicated by the arrow (Fig. 1). The pipette is refilled on opening A, and is again ready for use. It is necessary to pay particular attention to closing B at the right moment, and also to the manner in which the last drops of liquid are removed from *z*. With these points duly observed, and provided there is no change in temperature, the volume of liquid flowing from *e* is constant.

FIG. 1. FIG. 2.



The glass stopcocks A and B may be replaced by indiarubber tubing connections and pinchcocks. The tubing used must be as near as possible of the same bore as the tubes, and some arrangement must be introduced for fixing the siphon K securely.—C. A. K.

Pesier's Natrometer. E. Pfeiffer. Chem. Zeit. **11**, 443.

PESIER'S natrometer was first introduced in 1846 for the valuation of potash in the residues obtained from the calcination of beetroot molasses, and it was soon abandoned for the better method of determining potash by platinum chloride. The author states that in the hands of a careful analyst, the natrometer gives with little trouble results well agreeing with those obtained by the platinum method. The apparatus consists of a hydrometer, the scale of which is based on the fact that the density of a potassium sulphate solution increases proportionately with the amount of solid matter in solution. If the solution contains sodium sulphate, the density rises considerably, potassium sulphate being more soluble in the presence of sodium sulphate. For further details as to the precautions to be observed, the original paper should be consulted.—S. H.

Scheme for the Detection of Artificial Colouring Matters. E. Weingärtner. Chem. Zeit. 1887, 135—137 and 165—169.

IT is of considerable importance to the dyer or printer to be able to identify by readily performed tests, the dyestuffs he is using, as colouring matters that have been long known, and mixtures of these, are often sold under new names. Upon the scheme proposed by Witt (this Journal, 1886, 249) the author has based a complete system of qualitative analysis for all the dyestuffs at present occurring in the market. This has been successfully used for six months in the laboratory of the Ecole de Chemiè, at Mülhausen. Before proceeding to the analysis it is necessary to first determine whether the substance is a simple compound or a mixture of dyestuffs, since the presence of more than a small quantity of a second colouring matter would obscure the reactions and lead to erroneous conclusions. In the case of mechanical mixtures this can usually be ascertained by sprinkling a little of the powder upon filter-paper and moistening with water or alcohol, when streaks of the constituent colours will be seen. Mixtures of azo-

DYESTUFFS SOLUBLE IN WATER.

A. *Precipitated by Tannin Basic Colours.*—The aqueous solution is reduced with zinc-dust and HCl, neutralised and a drop put on filter-paper:—

THE ORIGINAL COLOUR REAPPEARS					THE ORIGINAL COLOUR DOES NOT APPEAR.
Red.	Yellow and Orange.	Green.	Blue.	Violet.	Yellow, Brown, and Blue.
Magenta	Phosphine	Malachite green	Methylene blue	Methyl violet	Chrysoidine
Toluylene red	Flavoaniline	Brilliant green	New blue	Hofmann violet	Bismarck brown
Safranine		Methyl green	Muscarine	Mauveine	Auramine
				Amethyst	Victoria blue
				Crystal violet.	

B. *Not Precipitated by Tannin—Acid Colours.*—Reduced with zinc-dust and HCl (or zinc-dust and ammonia).

On Paper the original Colour reappears. The Aqueous Solution is acidified with HCl and extracted with Ether.		The original Colour does not reappear. The Dyestuff is heated on Platinum Foil.			The Colour is changed to a Brownish-red. On Paper the original Colour of the Ammoniacal Solution is restored.
The Ether dissolves the Dyestuff and the Aqueous Solution is left nearly colourless.	The Ether remains uncoloured.	Deflagrates without production of Coloured Vapours.	Burns with production of Coloured Vapours. A piece of unmordanted Cotton is heated in the Aqueous Solution.		
			The Colour on the Cotton resists a warm Soap-bath.	The Colour is stripped by a warm Soap-bath.	
Phthaleïns	Sulphonated rosaniline derivatives	Nitro-colouring matters	Benzidine colours	Azo-colouring matters	Alizarin S
	Sulphonated indulines		Erythrosine		Alizarin blue S
					Cœruleïn S

DYESTUFFS INSOLUBLE IN WATER.

The colouring matter is treated with water and a few drops of 5% caustic soda.

It dissolves. The Alkaline Solution is heated with zinc-dust and a drop put on filter-paper.		It remains undissolved. The Dyestuff is heated with 70% Alcohol.				
The Colour reappears.	The Colour does not reappear of the same shade, or the original Colour remains unaltered.	Soluble.				Not soluble.
		Solution not Fluorescent.		Solution Fluorescent.		
		Caustic Soda (33%) is added.				
		Colour becomes reddish brown.	No alteration in Colour.	The Fluorescence is destroyed.	The Fluorescence remains.	
Cœruleïn	Canarine	Induline	Indophenol	Magdala red	Primrose	Indigo.
Galleïn	Alizarin	Nigrosine			Cyanosine	
Gallocyanine	Anthrapurpurine	Rosaniline blue (opal)				
Galloflavine	Nitro-alizarin	Diphenylamine blue (opal)				
	Alizarin brown					
	Alizarin blue					
	Chrysamine					
	Solid green					

colours which do not differ widely in shade and hence are not readily seen by the above test, are rendered apparent by scattering a few particles of the colour upon the surface of concentrated H_2SO_4 contained in a white porcelain dish.

When the constituents of the mixture have been precipitated together, fractional dyeing must be resorted to; a bath of the colour is prepared and a number of pieces of wool or silk are dyed from it in succession until exhausted; if a great difference in shade is apparent between the first and last dyeings the substance is not a single compound.

The commonest impurities are salt, sodium sulphate, sodium carbonate, and dextrin. *Salt* is detected by igniting and testing the residue for chlorine. *Sodium sulphate* remains in the filtrate after precipitating the colour with pure sodium chloride, and is indicated by barium chloride. *Dextrin* is readily recognised by its smell and by its remaining undissolved when the colouring matter is extracted with alcohol.

The author employs a solution of tannin to distinguish acid from basic colours, the two groups being further subdivided by their behaviour on reduction with zinc dust and HCl. The tannin reagent is made by dissolving 25grms. of tannin and 25grms. of sodium acetate in 250cc. of water. If a few drops of this reagent (an excess must be avoided) is added to the solution of the dyestuff and the solution heated, all basic colours are precipitated; acid colours are not precipitated (if the solution is hot).

BASIC COLOURS.

Red.

(*a*) Bluish red in aqueous solution turned yellowish brown by HCl or H_2SO_4.—*Magenta* (roseine, fuchsine, etc).

(*b*) Bluish red in aqueous solution; ammonia precipitated brown flocks soluble in ether with a greenish yellow fluorescence. Dissolves in HCl with a blue colour, in concentrated H_2SO_4 with a green; on dilution the colour changes through blue and violet to red.—*Neutral red.*

(*c*) Addition of alcohol to the aqueous solution causes an orange fluorescence. Dissolves in concentrated H_2SO_4 with a green colour, which on dilution changes through blue and violet into red.—*Safranine.*

Yellow.

(*a*) Alkalis give a flocculent yellow precipitate, which is soluble in ether with a yellow colour and strong green fluorescence.—*Phosphine.*

(*b*) Alkalis give a yellowish white precipitate, soluble in ether, without colouration, with a splendid blue fluorescence.—*Flavaniline.*

Green.

(*a*) Turned yellow by acid. Alkalis throw down a pink or grey precipitate.—*Malachite green.*

(*b*) Ammonia gives no precipitate. Dissolves in H_2SO_4 with a yellow colour, becoming green on dilution.—*Brilliant green.*

(*c*) The aqueous solution has a blue or greenish blue colour; turned yellow by acids; discolourised by alkalis without forming a precipitate.—*Methyl green.*

Violet.

(*a*) Very soluble in water; alkalis produce a violet brown precipitate. The solution is turned yellow by H_2SO_4 and on dilution the colour changes through green into bluish violet.—*Methyl violet* and *Hofmann violet.*

(*b*) Highly soluble in cold water; HCl changes the colour to blue; alkalis give a brown precipitate. H_2SO_4 gives a dirty violet colour, which becomes blue and finally violet on dilution.—*Neutral violet.*

(*c*) Moderately soluble in water; alkalis give a violet precipitate; H_2SO_4 changes the colour to grey, on dilution the colour passes through sky blue into reddish violet.—*Mauvein.*

(*d*) Soluble in water with a reddish violet colour; addition of alcohol produces a red fluorescence, H_2SO_4 produces a green colour, which on dilution changes through blue into violet.—*Amethyst.*

(*e*) Caustic soda gives a yellow precipitate; addition of HCl or H_2SO_4 changes the colour to orange. Long six-sided crystals.—*Crystal violet.*

Blue.

(*a*) The concentrated solution gives a violet black precipitate with NaOH. Coloured grass-green by H_2SO_4. Contains zinc.—*Methylene blue.*

(*b*) The aqueous solution is bluish violet; NaOH gives a brownish black precipitate. Concentrated H_2SO_4 gives a green colour, on dilution passing through blue into violet.—*Neublau* (Casella).

(*c*) Sparingly soluble in cold water, easily in hot, with a violet colour; NaOH gives a reddish brown precipitate. Tannin gives an indigo blue precipitate. Dissolves in concentrated H_2SO_4 with a bluish green colour, on dilution becoming blue and then violet.—*Muscarine.*

Brown, Yellow and Blue.

(*a*) Soluble with a yellow colour; alkalis give a white precipitate, which is soluble in ether without fluorescence; boiling with dilute H_2SO_4 slowly decolourises the solution. Reduction with zinc-dust and acetic acid gives an evanescent green colouration.—*Auramine.*

(*b*) Dyes wool orange yellow. Dissolves in concentrated H_2SO_4 with a yellowish brown colour.—*Chrysoidine.*

(*c*) Dyes wool orange brown. Dissolves in concentrated H_2SO_4 with a brown colour.—*Bismarck brown.*

(*d*) Acids turn the solution yellowish brown; alkalis give a brownish red precipitate. Dissolves in H_2SO_4 with a reddish brown colour, which becomes greenish blue on dilution.—*Victoria blue.*

ACID COLOURS.

Phthaleins.

(*a*) The aqueous solution is red with a greenish fluorescence; acids produce an orange precipitate which is soluble in ether with a yellow colour. Dissolves in concentrated H_2SO_4 yellow; on heating, fumes of HBr are evolved; if manganese dioxide is added bromine is liberated.—*Eosin.*

(*b*) The aqueous solution is more bluish-red than eosin; acids produce a yellowish brown precipitate, which is soluble in ether with a yellow colour. Reacts with H_2SO_4 same as eosin. Heated on platinum foil it burns with production of "Pharaoh's serpents."—*Safrosin* (Eosin scarlet).

(*c*) Bluish red solution with slight greenish fluorescence; acids produce a flesh-coloured precipitate soluble in ether with a brownish yellow colour. Reactions with H_2SO_4 same as eosin.—*Phloxin.*

(*d*) The aqueous solution is dark bluish red without fluorescence; acids give a red precipitate soluble in ether with an orange colour. The alcoholic solution has a golden-yellow fluorescence. Dissolves in concentrated H_2SO_4 with an orange colour; on heating, iodine is liberated.—*Rose Bengal.*

(*e*) Brownish yellow solution with strong green fluorescence; acids give a yellow precipitate.—*Uranin* and *Chrysolin.*

(*f*) Red solution smelling of phenol; acids give a yellow precipitate.—*Corallin* and *Aurin.*

Sulphonated Rosaniline Derivatives and Indulines.

(*a*) The aqueous solution is bluish-red; on heating with NaOH the colour vanishes but is restored by acetic acid. Dissolves in H_2SO_4 with a yellow colour, becoming red on dilution.—*Acid magenta.*

(*b*) Easily soluble in water with a slight greenish colouration; addition of a little acid intensifies the colour but an excess turns it yellow. Alkalis decolourise it.—*Helvetia green* (acid green).

(*c*) Alkalis decolourise it. Wool extracts the colour from the ammoniacal solution, and after washing and developing in dilute acid, becomes deep blue.—*Alkali blue.*

(*d*) Easily soluble and crystallises in metallic glistening flakes. Wool is only dyed from an acid bath.—*Soluble blue (China blue).*

(*e*) The violet aqueous solution is decolourised by ammonia without precipitation. Coloured orange by H_2SO_4, on dilution changing through green and blue to violet.—*Acid violet.*

(*f*) The colour of the aqueous solution varies between bluish grey and reddish grey; alkalis redden it; acids give a bluish or violet precipitate. Not decolourised by heating with dilute nitric acid.—*Indulines* and *nigrosines.*

Nitro Colouring Matters.

(*a*) Greenish-yellow solution. Bitter taste. The alkaline solution is not precipitated by HCl. The alkaline salts deflagrate.—*Picric acid.*

(*b*) Golden-yellow solution; HCl gives a light yellow precipitate, soluble in ether.—*Naphthol yellow* (primrose).

(*c*) Golden-yellow solution; HCl gives no precipitate.—*Naphthol yellow S.*

(*d*) The concentrated aqueous solution is red, the dilute solution is yellow; excess of alkalis gives a dark-red precipitate; acids give a milky precipitate—*Aurantia.*

Benzidine Colours.

(*a*) The red aqueous solution is coloured blue by a trace of HCl. Dissolves in concentrated H_2SO_4 with a slate-blue colour not changed by dilution.—*Congo red.*

(*b*) The aqueous solution is orange-red; when concentrated, a brown precipitate is produced by concentrated H_2SO_4 or HCl, which, on dilution, dissolves to a brown solution.—*Benzopurpurin.*

(*c*) The bluish-violet solution is turned red by alkalis; when concentrated, HCl gives a violet precipitate. Dissolves in concentrated H_2SO_4 with a violet colour.—*Azo blue.*

Bluish-red solution; HCl and H_2SO_4 produce an orange precipitate. On heating, the solid iodine sublimes.—*Erythrosin.*

Azo Colouring Matters.

(*a*) The yellow aqueous solution gives a precipitate with $BaCl_2$ but not with $CaCl_2$. Dissolves in H_2SO_4 with a yellow colour, which, on dilution, becomes brownish-red and finally orange.—*Fast yellow.*

(*b*) The yellow aqueous solution deposits the dyestuff, on cooling, in crystals; with $BaCl_2$ and $CaCl_2$ it gives crystalline precipitates. Dissolves in H_2SO_4 with a violet colour, reddish-violet on dilution.—*Diphenylamine yellow* (Tropæoline O O).

(*c*) Deflagrates on heating with formation of "Pharaoh's serpent" and evolution of yellow vapours. Dissolves in H_2SO_4 with a carmine-red colour, becoming yellow on dilution. The reduced dyestuff put on filter-paper forms brown spots.—*Indian yellow* (citronine).

(*d*) The orange aqueous solution is coloured violet by HCl; $BaCl_2$ gives a precipitate but not $CaCl_2$. Dissolves in H_2SO_4 with a violet-red colour, which becomes red on dilution.—*Azoflavine.*

(*e*) The yellow aqueous solution, on cooling, deposits the dyestuff in yellow plates; dilute acids precipitate reddish-violet plates. Dissolves in concentrated H_2SO_4 with a yellow colour, becoming red on dilution.—*Methyl or Ethyl orange.*

(*f*) The aqueous solution is yellow; on cooling, the dyestuff crystallises out. Sulphuric acid changes the colour to bluish-green, on dilution becoming violet and forming a slate-blue precipitate. Barium chloride gives a yellow precipitate.—*Yellow N* (Poirrier).

(*g*) The aqueous solution is yellow: on cooling, the dyestuff crystallises out. Dissolves in H_2SO_4 with a yellowish-green colour, on dilution becoming violet with a grey precipitate. Calcium chloride gives an orange precipitate, which, on heating, becomes red and crystalline.—*Luteoline.*

(*h*) Forms a well crystallised calcium salt. Dissolves in H_2SO_4 with a dark orange colour, not changed on dilution.—*Orange G.*

(*i*) The addition of a trace of HCl to the yellow solution produces a crystallisation of yellow plates; a larger quantity precipitates grey needles. The solution in H_2SO_4 is brownish-orange, not changed by dilution.—*Tropæoline O* (chrysoïne).

(*j*) The reddish-orange solution gives precipitates with $BaCl_2$ and $CaCl_2$: the calcium salt crystallises from a large quantity of water in red needles. Dissolves in H_2SO_4 with a carmine-red colour, giving an orange precipitate on dilution.—*Orange II.* (Mandarine).

(*k*) The aqueous solution is reddish-orange, turned carmine-red by NaOH. Dissolves in H_2SO_4 with a violet colour, giving, on dilution, a brown precipitate and then an orange solution.—*Orange I.* (tropæoline OOO).

(*l*) The orange aqueous solution deposits on cooling a yellow precipitate; $BaCl_2$ gives a precipitate, but not $CaCl_2$. The H_2SO_4 solution is yellow.—*Tartrazine.*

(*m*) The orange aqueous solution gives a precipitate with $BaCl_2$. The H_2SO_4 solution is dull violet, becoming red on dilution.—*Metanil yellow.*

(*n*) The concentrated aqueous solution gelatinises on cooling. Dissolves in concentrated H_2SO_4 with a green colour, which becomes bluish-violet on dilution.—*Biebrich scarlet.*

(*o*) Calcium chloride gives a red precipitate. Solution in H_2SO_4 blue, on dilution passing through violet into red.—*Croceine scarlet.*

(*p*) The aqueous solution deposits bronzy crystals on cooling. Solution in H_2SO_4 violet, on dilution a brown precipitate.—*Ponceau from xylidine and α-naphthol-sulphonic acid.*

(*q*) The red aqueous solution is turned reddish-brown by NH_3; $BaCl_2$ gives a brown precipitate. Solution in H_2SO_4 magenta-red, red on dilution.—*Coccine* and *Coccinine.*

(*r*) The aqueous solution is brownish-red; when concentrated, the addition of a few drops of Na_2CO_3 causes the separation of brown glistening plates. The solution in H_2SO_4 is violet, becoming red on dilution.—*Roccelline.*

(*s*) The red aqueous solution gives a precipitate with $BaCl_2$. Solution in H_2SO_4 indigo-blue, red on dilution.—*Bordeaux G and R.*

(*t*) The aqueous solution is turned dark violet-red by NH_3. Solution in H_2SO_4 blue, on dilution passing through violet to red.—*Ponceau S.*

Anthracene Colours.

(*a*) The aqueous solution is brownish-yellow; with HCl, pure yellow; strong solutions give a violet precipitate with NaOH, a red precipitate with $CaCl_2$. Solution in concentrated H_2SO_4, yellow.—*Alizarin S.*

(*b*) The olive-brown aqueous solution is turned green by NH_3. The solution, obtained by reduction with zinc dust and NH_3, quickly oxidises in the air with production of a green precipitate.—*Cœrulein S.*

(*c*) The brownish-red aqueous solution is turned greenish-blue by NH_3, green by NaOH. The HCl solution is yellowish-orange. The reduced solution quickly oxidises with production of a blue precipitate.—*Alizarin blue S.*

COLOURING MATTERS INSOLUBLE IN WATER.

(*a*) The NaOH solution is violet. Solution in H_2SO_4 is blue.—*Gallocyanine.*

(*b*) The solution in strong aqueous NaOH is indigo-blue, on dilution violet-red. The H_2SO_4 solution is orange.—*Galleïn.*

(*c*) The NaOH and concentrated H_2SO_4 solutions are green.—*Cœruleïn.*

(*d*) The NaOH solution is dull yellow. Dissolves in concentrated H_2SO_4 with a yellow colour.—*Galloflavin.*

(*e*) The NaOH solution is yellow. Unmordanted cotton is dyed a fast yellow from an alkaline bath. Insoluble in concentrated H_2SO_4.—*Canarine.*

(*f*) The NaOH solution is bluish-violet; addition of zinc-dust to the cold bath changes the colour to red.—*Alizarin.*

(*g*) The NaOH solution is magenta-red. Reactions like alizarin.—*Anthrapurpurin* and *flavopurpurin.*

(*h*) The NaOH solution is orange. Dissolves in H_2SO_4 with a magenta-red colour, brown precipitate on dilution. Dyes unmordanted cotton.—*Chrysamine.*

(*i*) The NaOH solution is red: on reduction with zinc-dust it gives, on filter paper, indigo-blue spots. *Nitro-alizarin.*

(*j*) The NaOH solution is olive: after reduction it forms dull violet spots on filter-paper. Solution in H_2SO_4 brownish-red. *Alizarin maroon.*

(*k*) Sparingly soluble in NaOH with a green colour: the reduced solution forms dark blue spots on filter paper. *Alizarin blue.*

(*l*) The alcoholic solution is bluish-grey to reddish-grey.—*Indulines* and *nigrosines.*

(*m*) The alcoholic solution is deep blue: addition of NaOH turns it brown, HCl turns it greener. The H_2SO_4 solution is reddish-brown.—*Rosaniline* or *diphenylamine blue.*

(*n*) The blue alcoholic solution is turned brownish-red by HCl.—*Indophenol.*

(*o*) The alcoholic solution is bluish-red with red fluorescence.—*Magdala red.*

(*p*) The alcoholic solution is bluish-red with greenish-yellow fluorescence; addition of HCl turns it yellow and the fluorescence vanishes.—*Methyleosin.*

(*q*) The alcoholic solution is bluish-red with a red fluorescence; addition of HCl turns it orange and the fluorescence vanishes.—*Cyanosin.*

(*r*) The powder, reduced with zinc-dust and NH gives a yellow solution, which forms blue spots on filter-paper.—*Indigo.*—A. G. G.

Colour Reactions of Beetroot Sugar. A. Ihl. Chem. Zeit. **11**, 2.

SUGAR treated with dilute sulphuric or hydrochloric acid yields ulmous substances, which give very characteristic reactions with phenols. If a rather concentrated solution of beetroot sugar be boiled with a small quantity of hydrochloric or sulphuric acid, a solution of resorcinol added to the cooled liquid and afterwards gradually plenty of hydrochloric acid, an eosin-red colouration is produced, which soon increases, until at last a precipitate of red flakes is obtained. Concentrated sulphuric acid has a similar effect if the temperature does not rise too high. Caramel solutions give the same reactions with resorcinol and hydrochloric or sulphuric acid, and it may be concluded that caramel splits up into the same compounds as beetroot sugar. The ulmous substances also react with all the other phenols. Pyrogallic acid acts similarly to resorcinol, but the precipitate is brown-red. Orcinol requires the presence of alcohol for a characteristic reaction. If a sugar solution be boiled with an alcoholic orcinol solution and concentrated hydrochloric acid, a dark-yellow liquid is obtained, which, poured into water, yields a brilliant green precipitate. α-Naphthol in alcoholic solution gives, with sugar and acid, a violet-red colouration, which, according to Molisch, allows of the detection of 0.00001 per cent. of sugar. If a piece of sugar be moistened with an aqueous solution of resorcinol, and then with concentrated sulphuric acid, the sugar is coloured dark-red; an alcoholic solution of α-naphthol colours the sugar, in a similar manner, blue-violet. White thymol, cresol and guaiacol produce a red colouration. If sugar be treated with alcohol, diphenylamine and sulphuric acid, a blue dyestuff is obtained.—S. H.

Estimation of Organic Matter in Spring Water. A. Köbrich. Chem. Zeit. **11**, 4.

THE detailed statement of every analysis of water contains an item for organic matter, to which little practical value can be given, so long as no uniform method of testing is adopted. The author recommends the following process, which gives very concordant results. It is based upon the decomposition of organic matter by potassium permanganate and sulphuric acid at an elevated temperature. 0.5grm. of the permanganate is dissolved in 1 litre of water, to which 150grms. of pure concentrated sulphuric acid are added. This mixture is heated at 90° C. for three hours in a flask with a long neck, without replacing the water which evaporates, and then titrated with a standard oxalic acid solution containing 0.5grm. of oxalic acid per litre. 100cc. of the water to be tested are then mixed with 50cc. of the permanganate solution and 15cc. sulphuric acid, and the mixture is heated at 90° C. for three hours in a covered flask, which allows of the escape of steam. The unreduced permanganate is titrated back with the standard oxalic acid. The author suggests, for analytical purposes, that the amount of organic matter thus found should be calculated in equivalents of oxalic acid. If chlorine be present in the water, it must be removed with silver before treating with permanganate. If nitrous acid is also present, the filtrate from the silver chloride precipitate is acidified with sulphuric acid, and permanganate added drop by drop until the pink colour remains permanent for at least five minutes. More sulphuric acid is then added, and the organic matter determined as previously mentioned. Nitrous acid reduces a permanganate solution at once and in the cold, whereas organic matter requires both time and heat for the reduction.—S. H.

Estimation of the Amount of Cinchonidine in Officinal Quinine Sulphate. F. Jobst. Chem. Zeit. **10**, 1617—1618.

THE author contends that De Vrij's "bisulphate test" is not suited as a means of testing the proportion of cinchonidine in quinine sulphate, the results being about 61 per cent. above the truth. This is due to the fact that in this test ether fails to separate cinchonidine as such, a compound of cinchonidine and quinine of the constitution $C_{20}H_{24}N_2O_2.2C_{19}H_{22}N_2O$ being obtained. The author is of opinion that the existing apprehensions concerning the high amount of cinchonidine in officinal quinine sulphate are largely exaggerated, as they are based on imperfect tests.—D. B.

Valuation of Commercial Indigo. T. Manoley. Romen's Journal, 1887, 16.

THE author employs the method of Fritzsche in the following way:—About 1grm. of the finely-powdered indigo is moistened with a little strong alcohol in a half-litre cylinder. 2—3grms. of clear glucose syrup diluted with a little water is poured into 100cc. of strong alcohol and treated with a few centimetres of NaOH. The fine emulsion thus obtained is added to the indigo, the cylinder filled up with boiling strong alcohol and closed with a stopper provided with two tubes like a wash-bottle. After standing for 24 hours with repeated shaking, the fluid is blown into dilute H_2SO_4, left standing for two days, filtered through a weighed filter, dried and weighed. The employment of hydrogen peroxide as an oxidising agent is recommended, as the tendency of the precipitate to stick to the walls of the vessel is thereby avoided (this Journal, 1884, 319 and 516; *Dingl. Polyt. J.* **256**, 175; **258**, 364).—A. G. G.

Estimation of Indigo on the Fabric. A. Renard. Bull. Soc. Chim., 1887, [47], 41.

THE material is warmed in a flask at 60°—70° C. with a solution containing sodium hydrosulphite and lime. This is prepared by adding 100cc. of milk of lime to 100cc. of a solution of sodium hydrosulphite, obtained by reducing sodium bisulphite solution of 30° B., the mixture being diluted to two litres. A stream of coal-gas is led through the liquid in the flask and when the reduction of the indigo is complete, the solution is decanted into a graduated cylinder also filled with coal-gas; the volume should amount to about 100cc. The solution is precipitated with HCl and allowed to stand in the air for 12 hours. The filtered, washed and dried precipitate is then dissolved in 100cc. of fuming H_2SO_4 and the indigo titrated according to the method of A. Müller (*Jahresbericht f. Chem.* 1874, 1019).
—A. G. G.

Catalytic Actions. O. Loew. Ber. **20**, 144—145.

A 15 per cent. solution of formaldehyde treated with a concentrated solution of caustic soda yields formic acid (sodium formate) and methyl alcohol, there being only a very slight evolution of gas on warming the mixture and none at all in the cold. But if cuprous oxide be added a violent evolution of hydrogen ensues after 1–2 minutes, the solution becomes slightly warm and sodium formate is formed,

$$H.COH + NaOH = H.CO.ONa + H_2.$$

This result is not obtained with any other metallic oxides. In this reaction, according to the author, metallic copper in an extremely finely divided state is first formed, which owing to a "specific vibratory condition," modifies the reaction between caustic soda and formaldehyde. Copper dust and platinum black have a similar though far weaker action. A further catalytic action is that of platinum black on a caustic-soda solution of hydroxylamine, when the decomposition into nitrogen, ammonia and water takes place very readily. In absence of platinum black it is only slowly effected.—C. A. K.

The Action of Hydrogen Peroxide on Bismuth Oxyhydrate and Bismuthic Acid—A new Colour Reaction for Bismuth. K. Hasebroek. Ber. **20**, 213.

By the addition of a weak alkaline solution of hydrogen peroxide to bismuth subnitrate the white nitrate is converted, on warming, into a yellow-brown body; a rapid evolution of oxygen from the decomposed hydrogen peroxide taking place. The product is prepared on the large scale by adding commercial hydrogen peroxide to a dilute nitric acid solution of "magisterium bismuthii," and filtering into concentrated solution of ammonia, when the orange-yellow precipitate forms at once. The precipitate is then washed first with ammonia and then water, and dried in vacuo over sulphuric acid. It is light orange-yellow in colour, amorphous, and melts on heating to form crystalline bismuth oxide. It is insoluble in water, becomes brown on boiling with alkalis, and is soluble in dilute mineral acids. The body seems to be a higher oxide of bismuth, as it evolves oxygen on treatment with sulphuric acid, and chlorine when acted upon by hydrochloric acid. The analyses differ among themselves, but from these and the fact that hydrogen determinations show presence of hydroxyl groups, it is probable that the product is in reality a mixture of bismuth pentoxide and the carbonate; this latter being derived from the carbon dioxide of the air. By excluding the air during the preparation almost pure bismuth pentoxide, containing only traces of carbon dioxide, is obtained. As prepared by the Arppe-Hoffmann process—*i.e.*, oxidation by chlorine of an alkaline solution of bismuth trioxide—the pentoxide always contains potassium hydrate. The reaction also serves as a very delicate test for bismuth, and conversely for hydrogen peroxide; 1 part in 100,000 may be thus detected.—S. G. R.

Simple Method for the Generation of Chlorine from Bleach. C. Winkler. Ber. **20**, 184.

Dry bleach is intimately mixed with one-fourth its weight of burnt gypsum, moistened with cold water and ground in a mortar. The mixture is then placed in a shallow iron vessel and pressed to form a cake about half an inch in thickness. This is then cut up into cubes and dried at 20° C. It is used in an ordinary Kipp's apparatus. HCl of sp. gr. 1·124 mixed with an equal volume of water is employed to liberate the gas.—S. G. R.

On Weil's Method for the Volumetric Determination of Sulphuretted Hydrogen in Sulphides decomposable by Hydrochloric and Sulphuric Acids. C. Friedheim. Ber. **20**, 59.

In Weil's method the H_2S is passed into an excess of a standard ammoniacal copper solution and the excess of copper estimated by titration with stannous chloride. Pelouze and Raschig have, however, shown that, short of complete saturation, the copper sulphide always retains varying amounts of copper oxide, and their results are now confirmed by the author. By digesting the solution for a quarter of an hour at 90° C., both cuprous chloride and sulphuric acid were detected, formed probably according to the equation $CuS + 7\ CuCl_2 + 4\ H_2O = 4\ Cu_2\ Cl_2 + H_2SO_4 + 6HCl$. Another source of error lies in the fact that strong ammoniacal solutions dissolve varying quantities of copper sulphide. The method, therefore, is altogether unreliable.—S. G. R.

Decomposition of Stannous Chloride Solutions. E. Donath. Rep. Anal. Chem. **7**, 77.

It is well known that standard stannous chloride solutions will not keep, oxygen being absorbed with separation of a precipitate even in strongly acid solutions. The author recently analysed the precipitate, which in this particular case was transparent and gelatinous. He found it to contain 2·65 per cent. of chlorine, and he believes it to consist of a mixture of stannic hydrate with the chloro-stannic compound SnO.Cl.OH, described by Mallet (*Chem. News.* **26**, 262).—E. E. B.

Gravimetric Determination of Manganese. C. Meineke. Chem. Zeit. 1887, 137.

In the estimation of manganese by chlorate precipitation as MnO_2, it is essential in order to obtain accurate results that *cold* water should be used for dilution. If warm water is employed a certain amount of the manganese remains in solution at MnO, and the results obtained are too low.—A. G. G.

Determination of Manganese by Precipitation with Mercuric Oxide and Bromine. C. Meineke. Rep. Anal. Chem. **7**, 54—58 and 67—76.

Volhard has described a process for estimating manganese by adding nitric acid and mercuric oxide, boiling and then adding chlorine or bromine water. Manganese peroxide is thrown down and the manganese, after purification and ignition, is weighed as Mn_3O_4. The results are very accurate, but the author finds that the process is not available for the very dilute solutions obtained by him in the separation of iron and manganese. The addition of zinc nitrate to the solution, however, rendered the precipitation by the above treatment complete, but the resulting Mn_3O_4 was found to contain a small quantity of iron oxide and a trace of zinc oxide, even after boiling the precipitate with dilute nitric acid. The manganese can be determined volumetrically in the precipitated oxide, after boiling it with nitric acid and washing, by titration with a standard oxalic acid solution containing a certain proportion of hydrochloric acid. An excess of the oxalate should be added and the solution titrated back with standard permanganate after the addition of sulphuric acid and of some manganous sulphate. The hydrochloric acid is necessary to avoid precipitation of oxalate of mercury. Details are given of the method adopted for ascertaining the amount of manganese in iron, and it is pointed out however little nickel the iron may contain, it will be precipitated with the manganese peroxide, together with some zinc oxide. Hence, after weighing the impure Mn_3O_4, it must be re-dissolved in hydrochloric acid, and the amount of nickel and zinc determined by precipitation with sulphuretted hydrogen in an acetic acid solution in the usual way. The weight of the oxides of these two metals, together with any iron oxide, must be deducted from the total weight, the difference being pure Mn_3O_4. To avoid this tedious separation of nickel and zinc the author prefers to multiply by 0·95 the weight of the impure Mn_3O_4 after deduction of the iron oxide, as the proportion of impurity is practically constant.—E. E. B.

Estimation of Chromium in Chrome Ironstone. Ed. Donath. Dingl. Polyt. J. **263**, 245—246.

Chrome ironstone mixed with 5 parts of barium dioxide and most finely ground, is ignited for half-an-hour in a porcelain crucible over a Bunsen burner. The yellowish-green semi-fused mass thus obtained dissolves in dilute HCl and contains all the chromium, as chromic acid; if the fusion is made in a platinum crucible at a higher temperature, the product, although still quite soluble, contains some chromic oxide. The barium is thrown down with a very slight excess of sulphuric acid, the filtrate neutralised with sodium carbonate, and then run into a boiling solution of potassium permanganate and sodium carbonate. The excess of permanganate is next carefully removed by a little ferrous or manganous sulphate, the alkaline chromate solution filtered off and the chromic acid determined with iron in the usual way. —T. L. B.

A Volumetric Determination of Phosphoric Acid, especially suitable for the Analysis of Thomas-slag. Chem. Zeit. **11**, 193–195 and 223–224.

THE molybdic precipitate being soluble in ammonia, E. Thilo has based upon this fact a method from which the weight of the phosphoric acid can be calculated. The precipitate is dissolved in a known quantity of standard ammonia and the excess of the latter is titrated back with standard sulphuric acid until the blue colour of litmus is suddenly turned violet. Although the contrast between blue and violet is not very great, the change is said to be very distinct. The ammonia is empirically standardised upon a weighed quantity of pure and dry molybdic precipitate. In this method, silicic acid need not be removed before the precipitation of the phosphoric acid, as it does not influence the result. A. Isbert rejects Thilo's process, as he could not obtain results agreeing with each other. The "neutral" point is very indistinct both with litmus and other indicators, and the composition of the molybdic precipitate is variable, since it nearly always contains more or less uncombined molybdic acid which acts on ammonia. He therefore devised another process—viz., the determination of the ammonia in the molybdic precipitate by distillation with sodium hydrate and the calculation of the phosphoric acid therefrom. This process is said to give very satisfactory results.—S. H.

Presence of the Calcium Salt of Tetrobasic Phosphoric Acid in Thomas-slag. H. Otto. Chem. Zeit. **11**, 255.

THE ready extraction of the phosphoric acid from Thomas-slag by dilute acid, whilst the ordinary phosphates of calcium, aluminium and iron after ignition are nearly insoluble in dilute acids, would seem to indicate that the phosphoric acid is present in some new form. Hilgenstock was the first to suggest that it occurs as a tetrabasic calcium phosphate, $Ca_4P_2O_9$. The author has confirmed this supposition by the analysis of crystals of this compound which can be isolated from the slag. These were nearly colourless thin tubes which did not absorb CO_2. The numbers obtained on analysis closely correspond to the above formula. The compound is easily soluble in dilute sulphuric, hydrochloric, nitric, citric and acetic acids. Although the pure compound is readily soluble in alkaline and neutral ammonium citrate solution, it cannot be completely extracted from the slag by these solvents, since the presence of the other constituents prevents complete solution. The extraction, however, can be effected by the employment of 1000cc. of the slightly acid dilute ammonium citrate solution of P. Wagner to 2½—3 grains of finely-ground slag. The following is an analysis of a sample of Thomas-slag:—

$Ca_4P_2O_9$	49·02 p. c.	FeO	8·06 p. c.
$CaSiO_3$	15·85 „	F_2O_3	5·14 „
CaO (free)	11·00 „	MgO	3·4 „
CaS	1·35 „	Al_2O_3	1·1 „
MnO	5·25 „		

—A. G. G.

Determination of the Phosphoric Acid in Basic Slags. G. Loges. Rep. Anal. Chem. **7**, 85—88.

THE solution of the phosphates in basic slags is usually effected by treating the slags with oxidising agents—*e.g.*, nitric acid, etc.—or with hydrochloric acid. Neither process is satisfactory, as in the former the whole of the phosphorus as iron phosphide is oxidised to phosphoric acid and afterwards estimated as such; and in the latter all the hydrochloric acid must be subsequently removed by evaporation with nitric acid before the phosphoric acid can be precipitated by the nitro-molybdate solution. Both the objections are overcome by the use of *concentrated sulphuric acid* as the solvent. The powdered sample is first mixed with enough dilute sulphuric acid (1 : 1) to combine with the calcium oxide and decompose the sulphides and carbonates, and then a large excess of concentrated sulphuric acid (50cc. to 10grms. of the slag) is slowly stirred in. The mixture is subsequently heated on a sand-bath until it has the consistency of a thin paste, the phosphoric acid being finally determined by the molybdate method. It is not necessary to oxidise the ferrous compounds before addition of the molybdate solution. The results obtained by the author with this process are slightly higher (about 0·05 per cent.) than those obtained by digestion with hydrochloric acid, thus proving that more complete solution of the phosphates is effected by the concentrated sulphuric acid.—E. E. B.

The Estimation of Ammonia in Soils. W. Knop. Zeits. Anal. Chem. **26**, 1.

THE method proposed by the author in conjunction with Wolf, in 1859, for the estimation of ammonia in soils, by the decomposition of the ammonia by a strongly alkaline Javelle solution (sodium hypochlorite solution) and sodium hypobromite, and measurement of the nitrogen liberated, was liable to yield fallacious results on account of the contraction which many soils suffer when shaken up with strongly alkaline liquids. This contraction appears to be due to a reaction between the water, some of the mineral constituents of the soil (especially ferruginous clays), and the alkali, new compounds being formed, and this formation being attended by condensation. Of course, it is well known that when peaty soils and soils rich in humus are shaken up in a closed flask with an alkaline solution, a contraction in bulk of the air above the liquid takes place, but this is due to the absorption of oxygen, and the reaction is similar to the absorption of oxygen by an alkaline solution of pyrogallic acid. The contraction of the soil which has hitherto led to the vitiation of the ammonia estimations must therefore not be confounded with the absorption of oxygen, and it is to be remarked that contraction also takes place when the flask is filled with hydrogen in place of air. The author now finds it possible to avoid this contraction by employing a solution of sodium hypobromite saturated with borax, care being taken that the amount of free sodium hydrate is not more than 0·5grm per 200cc. borax solution; but although with this proportion of free alkali, few soils will show any contraction, it is advisable to determine with every sample of soil the proportion of alkali with which contraction begins to occur and also the amount of such contraction, if any. As it is not easy to prepare a solution of hypobromite with the desired proportion of caustic soda, a solution prepared according to the following plan is employed and this whilst sufficiently alkaline to decompose ammonia is not liable to cause any contraction. To an excess of calcium hydrate are added 200cc. of water and 15cc. of bromine, the mixture is allowed to stand several days to become saturated with lime, then filtered and mixed with a saturated solution of borax before use. In the actual performance of the test it is not advisable to employ more than 100grms. of the sample of soil, and the flask should be provided with a thermometer inserted through a tubulus, so that precautions may be taken against changes of temperature. Prolonged shaking is not necessary, as the decomposition of the ammonia appears to proceed readily and easily.—W. D. B.

On the Determination of Nitrogen in Manures containing Saltpetre. A. Stutzer and O. Reitmer. Rep. Anal. Chem. **7**, 4—6.

THE well-known method of estimating nitrogen in manures by ignition with soda-lime, has been to a large extent abandoned in favour of the process proposed by Kjeldahl. This method, which may be named the "sulphate method" has been considerably modified since its introduction; concentrated sulphuric acid and metallic mercury alone being now employed, instead of the fuming sulphuric acid, phosphoric acid and permanganate originally used. The sulphate method, like the soda lime process, is not applicable to nitro compounds, and in order to remedy this defect, Jodlbaur has suggested the employment of phenolsulphonic acid, instead of sulphuric acid. The nitro phenol can be converted by means of zinc-dust into amido-phenol, the nitrogen in which can be estimated by the sulphate method. The authors find that the method (this Journal, 1886, 510) does not give good results when the manure contains much saltpetre, or when the substance examined is sodium or potassium nitrate; but, by a slight modification, satisfactory results can be obtained even with the nitrates themselves. It is of great importance that the phenolsulphonic acid should *not* be allowed to act upon compact masses of the substance: for when this occurs, the nitration does not proceed quantitatively. 1grm. of the manure should be taken, 25cc. of water added and the whole evaporated down to dryness. If the solution to be analysed is a nitrate, it is best to take 10grms. and dissolve in 500cc. of water; 25cc. of the solution are evaporated down in a dish of about 350cc. capacity, the evaporation being best conducted in an air bath at 100—110. The substance is now in a finely-divided state, and, after cooling, 50cc. of sulphuric acid containing 20grms. of phenol per litre, are poured in. After standing for a few minutes, 2—3grms. of dry pure zinc-dust and one or two drops of mercury are added and the mixture boiled. The conversion into ammonium sulphate is complete in 1½ hours when the ammonia is distilled off.—D. E. J.

Detection and Estimation of Small Quantities of Chromium. E. Donath and R. Jeller. Rep. Anal. Chem. **7**, 33—34.

In order to separate traces of chromium from large quantities of iron, alumina and manganese, the solution containing these substances together with the bases of the alkaline earths, is poured into a hot solution of sodium carbonate, to which some permanganate has been added. The liquid is boiled for a few minutes, a few drops of alcohol are added, to reduce the excess of permanganate to manganese peroxide and the whole is filtered; the metals and alkaline earths are thus precipitated, while the chromium oxide is converted by the hot alkaline permanganate into chromate and thus passes into the filtrate. When a considerable quantity is present, it can be recognised by the yellow colour of the filtrate; otherwise it should be evaporated down, acidified, and tested with a small piece of starch moistened with a freshly-prepared solution of KI, the chromic acid, even in very dilute solutions, decomposing the hydriodic acid. For quantitative work, the filtrate containing the chromate is acidified with HCl and a little alcohol added; the chromium oxide is precipitated in the usual way by ammonium sulphide.—D. E. J.

Valuation of Rich Copper Ores. E. Donath and R. Jeller. Rep. Anal. Chem. **7**, 34—35.

In estimating copper volumetrically by potassium cyanide, a previous precipitation of the copper by zinc is necessary in order to separate it from iron contained in the ore (Steinbeck's process). The solution of the copper-ore and the separation of the copper from iron, etc., can be expedited as follows:—The finely-powdered ore is mixed with twice its volume of zinc-dust and heated in a porcelain crucible for ten minutes; the sulphur of the metallic sulphides combines with the zinc, forming zinc sulphide. On treatment with dilute acid (1 of H_2SO_4 to 3—4 of water), the iron, zinc sulphide and excess of zinc are dissolved out, leaving the copper and insoluble matter behind. After washing by decantation with hot water, the copper can be dissolved by dilute nitric acid and the titration carried out in the usual manner.—D. E. J.

Separation of Alumina from Iron by Chancel's Method. E. Donath and R. Jeller. Rep. Anal. Chem. **7**, 35—36.

This method consists in boiling the neutral solution with sodium thiosulphate, the alumina being thus precipitated together with sulphur. The writers have tested the method, using solutions of alum of known strength, and they find that the precipitation of the alumina is not complete (in five examples given, the mean deficiency was 4). But on boiling down the filtrate and wash-waters, a further precipitate is obtained, and the sum of the two is found to be in excess of the quantity of alumina contained in the original solution; the explanation being that the alumina obstinately retains a portion of the co-precipitated sulphur. In this state it takes a yellow colour on heating (just like ZnO), becoming white again when cold; it can be freed from sulphur by strong ignition and does not then become yellow when hot.

The method gives satisfactory results under the following conditions:—The solution containing the oxides should be very dilute and must be boiled down to half its volume; the filtrate and wash-waters being again boiled down and the second precipitate collected. The alumina must be ignited over a blow-pipe until it no longer shows a yellow colour when hot.—D. E. J.

ABSTRACT FROM A LECTURE AT THE ROYAL INSTITUTION "ON THE WORK OF THE IMPERIAL INSTITUTE," ON 22ND APRIL, 1887.

BY SIR F. A. ABEL, C.B., D.C.L., F.R.S.

After generally indicating the scope and design of the Imperial Institute, Sir Frederick proceeded:—

"In 1852 Sir Lyon Playfair, in one of a course of most interesting lectures on some of the results of the preceding year's great Exhibition, was impelled by the teaching of that great world's display to point out that 'the raw material, formerly our capital advantage, was gradually being equalised in price and made available to all by the improvements in locomotion,' and 'that industry must in future be supported not by a competition of local advantages, but by a competition of intellect.' If this was already felt to be the state of the case six-and-thirty years ago, how much more must we be convinced of the full truth of this at the present day by the conditions under which the British merchant and manufacturer have to compete with their rivals on the Continent and in the United States.

"It is still within the recollection of many that almost the whole world was in very great measure dependent upon Great Britain for its supplies of ordinary cast-iron. Even as lately as 1871 the United States of America received from Great Britain nearly one-fifth of its total produce of pig-iron; but from 1875 all importation of British iron ceased for over three years, and it was only in consequence of requirements in the States exceeding the capabilities of production that some small demands arose in 1879, which were for some time maintained.

"But while, in 1879, the pig-iron produced in the United States amounted to little over 3,000,000 tons, to 1882 the make had increased by 70 per cent.—viz., in over 5,100,000 tons. Since that time the actual make has not increased (in 1885 it amounted to 4,529,869 tons of 2000lb.), but the *capacity of production*, which vitally interests the iron trade of this country, has risen enormously, the present capacity of all the American pig-iron works being estimated at over 8,900,000 tons, or nearly 300 per cent. greater than it was in 1879. So much regarding the United States. Looking nearer home, we find that the iron of France, Belgium, and Germany not only competes with ours in the open market, but that Belgian and German iron is actually imported into this country to a moderate extent.

"As an instructive illustration of the advance and influence of the improvements which have been made in intercommunication upon the value of our natural products and their importance even in our own industries, I

AREA, POPULATION, TRADE, ETC., OF THE BRITISH EMPIRE.

(Compiled in the Spring of 1886.)

	How and When Acquired.		Area.		Population.		Imports.		Exports.	
			Square Miles.				Total. £390,018,569	From Colonies. £95,812,911	Total. £295,967,583	To Colonies. £88,303,634
British Isles	....	..		120,832		35,241,482				
							Total. £68,156,654	From British Isles. £49,711,562	Total. £89,098,427	To British Isles. £36,984,031
Indian Empire (including Burmah)	....	1757—1858		1,574,516		253,982,595				
Dominion of Canada:—				3,170,392		4,324,810	23,917,200	8,921,510	18,782,156	8,986,897
Quebec Ontario	Conquest, Treaty Cession	1759—63								
New Brunswick	Treaty Cession	1763								
Nova Scotia	Conquest, Treaty Cession	1627—1713								
British Columbia	Transfer to Crown	1858								
Manitoba	Settlement	1813								
North-West Territories	Charter to Company	1670								
Prince Edward's Island	Conquest	1756—63								
Newfoundland	Settlement, Treaty Cession	1550—1713		40,200		179,509	1,682,457	612,528	1,368,153	322,527
Australasia:—										
New South Wales	Settlement	1787	311,098		921,268		22,826,985	11,423,017	18,251,506	7,683,886
Victoria	Settlement	1834	87,884		961,276		19,201,633	9,149,076	16,050,465	7,715,115
South Australia	Settlement	1836	903,690		312,781		5,749,353	2,983,296	6,623,704	4,081,864
Queensland	Settlement	1824	668,497		309,913		6,381,976	2,520,863	1,673,861	1,715,391
Western Australia	Settlement	1826	1,060,000		31,700		521,167	222,940	105,693	279,650
Tasmania	Settlement	1803	26,215		130,541		1,656,118	612,102	1,475,857	359,708
New Zealand	Purchase	1840	104,458		564,304		7,663,888	1,931,193	7,091,667	5,158,078
Fiji	Cession from Natives	1874	7,740		128,614		134,522		315,344	35,512
New Guinea	Annexation	1884	86,360		135,000			...		
				3,255,942		3,495,397				
South Africa:—										
Cape of Good Hope	Treaty Cession (finally)	1815	219,700		1,249,824		5,260,697	1,023,849	7,031,744	6,602,193
Bechuanaland	....	1885	185,000							
Natal	Annexation	1843	18,750		421,495		1,675,850	1,310,452	957,918	721,190
				423,450		1,674,319				
St. Helena	Conquest	1673		45		5,024	63,786	27,931	23,406	1,164
Ascension	Annexation	1815		37		200				
Ceylon	Treaty Cession	1801		25,365		2,763,984	4,811,451	1,315,315	3,161,262	1,852,829
Mauritius	Conquest and Cession	1810—14		713		377,373	2,963,152	692,130	3,914,757	508,331
Straits Settlements	Treaty Cession	1785—1824		1,472		510,000	18,676,766	1,282,920	17,260,138	3,845,362
Hong Kong	Treaty Cession	1841		30		160,402	4,000,000	3,218,946	2,000,000	1,052,302
Port Hamilton	....	1884		5		2,000	...		...	
British North Borneo	Cession to Company	1877		30,000		150,000	96,282	...	52,551	
Labuan	Treaty Cession	1847		30		6,298	84,869	1,554	85,741	
British Guiana	Conquest and Cession	1803—14		109,000		264,061	1,999,448	1,099,504	2,322,032	1,777,376
West Indies:—										
Jamaica	Conquest	1655	4,362		585,536		1,595,262	910,491	1,518,024	631,974
Trinidad	Conquest	1797	1,754		153,128		3,083,870	887,014	2,769,727	863,290
Windward Islands	Cession	1783	784		311,413		1,611,183	670,955	1,831,388	797,194
Leeward Islands	....		665		119,546		476,157	207,637	166,759	160,903
Bahamas	Settlement	1629	5,390		43,521		181,494	37,329	122,351	35,771
				12,955		1,213,144				
Bermudas	Settlement	1612		19		13,948	283,410	75,116	88,622	2,557
British Honduras	Conquest	1798		6,400		27,452	237,538	127,602	317,119	205,032
West Africa:—										
Sierra Leone	Transfer from Company	1807	468		60,546		455,424	323,572	377,055	156,730
Gambia	....	..	69		14,150		232,122	87,089	199,483	18,753
Gold Coast	Conquest and Cession	1663—1871	18,784		408,070		537,339	403,788	467,228	130,997
Lagos	Cession	1861	1,069		75,270		538,221	338,318	672,474	249,791
				20,390		558,036				
Gibraltar	Conquest	1704		2		18,381		..		
Malta	Treaty Cession	1814		119		149,782	13,313,789	122,899	12,908,492	3,120,319
Cyprus	Convention with Turkey	1878		3,584		186,173	304,375		287,521	
Heligoland	Treaty Cession	1814		1		2,001				
Falkland Islands	Treaty Cession	1770		6,500		1,553	67,818	60,962	104,338	98,468
				9,101,999		305,337,924	£220,752,916	£111,577,100	£223,131,236	£96,397,528

may, on the authority of Sir Lowthian Bell, state the astounding fact that, in the opinion of competent authorities, the ore (hæmatite) especially suitable for steel manufacture by the Bessemer process can be brought over sea a distance of 1000 miles, landed close to mines furnishing the cheapest made pig-iron of Great Britain, and converted into *steel* rails at a lower cost than the native ironstone of Cleveland can furnish similar rails in *iron*.

"From time to time the ground which we have lost through the development of the resources of other countries has been more than retrieved temporarily by improvements effected through the more thorough comprehension and consequent better application of the scientific principles underlying processes of manufacture. Thus the quantity of fuel consumed in producing wrought-iron rails has been gradually reduced by improvements in the construction and working of furnaces, until less than one-half the amount is now required per ton of such rails than was employed fifty years ago; but, remarkable as it may seem, the ultimate effect of an advance of this importance is actually to improve the position, in relation to this manufacture, of other nations less favourably circumstanced than Great Britain in the matter of coal, for, instead of having to multiply any difference in our favour in the cost of fuel required to produce a ton of rails by twelve, that difference has now only to be multiplied by three in order to arrive at the extent of our advantage.

"The history of the development of steel manufacture during the last twenty-five years affords a most instructive illustration of the fluctuations which may ensue in the value of our natural resources, and the consequent condition of one or other of our important industries, arising out of continued advances made in the application of science to the perfection or transformation of manufacturing processes, and of the stimulating effects of such fluctuations upon the exertions of those who are able to bring scientific knowledge to bear upon the solution of problems in industrial operations which entirely baffle the ordinary manufacturer. Within that period the inventions of Bessemer and of Siemens have led to the replacement of iron by steel in some of its most extensive applications. The Bessemer converter, by which pig-iron is rapidly transformed into steel by the injection of air into the molten metal, has, so far as this country is concerned, to a very great extent, superseded the puddling furnace, in which pig-iron is transformed by long-continued laborious treatment into steel or malleable iron. This important change in our national industry was, ere long, productive of a serious crisis therein, and for the reason that the pig-iron produced from a large proportion of those ores which, from their abundance and the cheapness of their treatment, have been largely instrumental in placing Great Britain in her high position as an iron-producing nation, could not be applied to the production of marketable steel by means of the Bessemer converter. In the purification of this pig-iron during its conversion in the puddling furnace into a suitable material for the production of rails, the elementary constituent phosphorus, which it had carried with it from the ore as a contaminating ingredient very detrimental to its strength, was eliminated, and by sufficient treatment a malleable iron of good quality was obtained; but in the production of steel from the same material in the Bessemer converter, the phosphorus is almost entirely retained in the metal, rendering it unsuitable for manufacture into rails or plates. Hence the application of this rapid steel-making process had to be chiefly restricted to particular kinds of ores, the supplies of which are limited to a few districts in this country. These had to be largely supplemented by importations from other countries; nevertheless the cheapness of production and superiority in point of strength, durability and lightness of the steel rails thus sent into the market from the Bessemer converter combined to maintain a supremacy of them over iron rails, etc., manufactured by the old puddling processes from the staple ores of the country.

"The advantages presented by steel over the wrought-iron of the puddling furnace for constructive purposes speedily became evident; combining as it does nearly double the strength with a more than proportionate superiority in elasticity and ductility, its value for shipbuilding purposes did not long fail to be realised. It was soon found more profitable to build a steel steamer, paying a price of nearly £9 per ton for the material, than to construct one of iron which cost only £6 5s. per ton. The effect of the rapid displacement of malleable iron by steel produced from ores of a particular class has been, that at least 85 to 90 per cent. of the iron ores of Great Britain could no longer be applied to the production of material for rails and for constructive purposes, being unavailable for steel-making by any method which could compete with the Bessemer and Siemens processes. Great has been the apprehension among the owners of those ores, that the demand for iron which they can furnish could not revive, but the scientific metallurgist has successfully grappled, from more than one direction, with the great problem of restoring their commercial importance.

"Modifications of the mode of working the rival of the Bessemer process—viz., the open-hearth (Siemens-Martin) process—have given successful results in the production of serviceable rails containing higher proportions of phosphorus than had before been admissible, and a simple alteration of the method of carrying out the Bessemer process has, within the last few years, led to really triumphant results, with the employment of those ores which before could only be dealt with by the searching operation of the old puddling furnace. By utilising the basic character of lime during the treatment of the melted pig-iron, yielded by phosphoric ores, with ores in the Bessemer converter, the phosphorus is fixed at the moment of its elimination by oxidation from the metal, and the objectionable impurity is held bound in the slag, while a steel is obtained rivalling in freedom from phosphorus the product furnished by the pure varieties of English and foreign ore which alone could previously be successfully dealt with by the Bessemer process. This modified treatment of iron for the production of steel, called the *basic treatment*, was soon applied also to the open-hearth (the Siemens and Siemens-Martin) processes of steel-making; thus a new era was established in steel manufacture by the quick processes, there being now but very few restrictions to their application to iron produced from all varieties of ores. Indeed the treatment is actually being applied profitably to the recovery of iron from the rich slag forming the refuse-product of the puddling furnace in the production of malleable iron, which, containing as it did the phosphorus eliminated from the pig-iron by the laborious purifying treatment, had been condemned to limited usefulness as a material for road-making, while now it ranks in market value with some ores of iron. Yet another most interesting and valuable result has been achieved by this simple application of scientific knowledge. The slag or refuse-product of the basic treatment of iron contains, in the form of phosphates of lime and magnesia, the whole of the phosphorus which it is the main function of that treatment to separate from the metal; it was soon found that the phosphoric acid which had been produced by the elimination of the pernicious element in the conversion of bad iron into good steel, existed in this refuse-slag in a condition as readily susceptible of assimilation by plants as it is in the valuable artificial manure known as superphosphate; this refuse-slag, simply ground up, constitutes therefore a manure which is already of recognised value and commands a ready sale at very profitable prices.

"The organisation of this latest advance in the development of steel manufacture dates back only nine years, and already the year's product of the basic process amounts to over 1,300,000 tons of steel. But although it is to Englishmen that the owner of iron property and the steel-maker are again indebted for these important results, and to English manufacturers that the first practical demonstration of the success of this process is due, its application has been far more rapidly elaborated upon the Continent than here; in Germany the importance of the subject was at once realised, and it is there that considerably the largest proportion of steel is produced by the basic treatment; it is in Germany also that the value of slag for agricultural purposes has been developed; the first steps in its utilisation here being but just now taken, in Staffordshire.

"I have already referred to the remarkable strides which have been made in the extension of iron manufacture in the United States: the development there of steel production has been no less marvellous. In 1879, 928,000 tons of Bessemer steel were produced; in 1885 the make amounted to 1,701,000 tons, while the productive capacity in that year was estimated at 4,102,000 tons. With other extensive steel-producing works in course of completion, provision is being made for increasing the power of production by another million tons. Looking to the fact that at the present time the railway mileage in the United States exceeds that of the whole of Europe, there being 1,300,000 miles of railway in operation, while at the beginning of 1865 there were only 34,000 miles, the causes of this enormous development of the iron and steel manufacture are evident; the resources of the country in ore and fuel are gigantic, and the systematic technical training of the people has made its influence felt upon the development of this as of every other branch of industry which our friendly rivals pursue. But it is not only in the United States that the development in the production of iron and steel has greatly increased of late years; thus, in Germany the increase in the production of pig-iron alone, during the last twenty-one years, has been 237 per cent., in Austro-Hungary 152 per cent., while the increase in France and Belgium is 64 per cent., and therefore not greatly inferior to our own (75 per cent.).

"Although, however, the increase in actual production of iron and steel in this country has not kept pace with that of some other countries, it is satisfactory to know that our *productive power* has very greatly increased in late years, and there is probably no one branch of our industries in which we have maintained our position so satisfactorily in regard to quality of product as that of iron and steel manufacture, even although, every now and then, we have indications that in the struggle with other nations for superiority of product and for pre-eminence in continuity of progress, we have to look to our laurels. While the country owes a deep debt of gratitude to such men as Neilson, Mushet, Bessemer, Siemens, Thomas and Gilchrist, who by their brilliant discoveries and inventions have maintained Great Britain's position as leader in the origination of successive eras of advance in iron and steel manufacture, there is no question that the trade generally has in recent years derived the greatest assistance and benefit from the organisation of the Society which, under the name of the Iron and Steel Institute, has brought the members of the trade to recognise that they themselves, and the country, reap incalculable benefit from their free interchange of knowledge and the results of experience, their candid discussion of successes, failures, and diversities of views and practice—the combination of friendly rivalry with hearty co-operation in the advancement of science and practice of their important calling.

"While we have succeeded in maintaining a foremost position in the iron and steel manufacture, there are some other important branches of industry, for a time essentially our own, the present condition of which, in this country, we cannot contemplate with equal satisfaction. Several instructive illustrations might be quoted, but I will content myself with a brief examination of one of the most interesting.

"A glance at the history of the utilisation of some products of the distillation of coal will present to us an industry created and first elaborated in England, which has, on the one hand, by its development effected momentous changes in other industries and in important branches of commerce, while on the other hand it has been in great measure wrested from us in consequence of the systematic collaboration of scientific and practical workers on the Continent."

Referring to the recent advances in chemical manufactures, and tracing step by step the discoveries in chemical science which led up to or greatly influenced these advances, Sir Frederick Abel emphasised as a specially interesting example the replacement of madder by coal tar alizarin. He then showed how that the manufacture of new colours and other coal-tar products led to the demand for new reagents and materials to serve as ingredients, and thus, substances formerly only laboratory curiosities, like phosgene, had come to be commercial products. The present magnitude of the coal tar colour industry was then referred to, both as regards quantity and value.

"These figures show that the value of the make of colours in England was less than one-fourth that of Germany, and that even Switzerland, which, in competing with other countries industrially, is at great natural disadvantages, was not far behind us, ranking equal to France as producers. The superior position of Germany in reference to this industry may be in a measure ascribable to some defects in the operation of our Patent Laws and to questions of wages and conditions of labour; but the chief cause is to be found in the thorough realisation by the German manufacturer of his dependence for success and continual progress upon the active prosecution of scientific research, in the high training received by the chemists attached to the manufactories, and in the intimate association, in every direction, of systematic scientific investigation with technical work.

"The young chemists which the German manufacturer attracts to his works rank much higher than ours in the general scientific training which is essential to the successful cultivation of the habit of theoretical and experimental research, and in the consequent appreciation of, and power of pursuing, original investigations of a high order. Moreover, the research laboratory constitutes an integral part of the German factory, and the results of the work carried on by and under the eminent professors and teachers at the universities and technical colleges are closely followed and studied in their possible bearings upon the further development of the industry.

"The importance attached to high and well-organised technical education in Germany is demonstrated not only by the munificent way in which the scientific branches of the universities and the technical colleges are established and maintained, but also by the continuity which exists between the different grades of education; a continuity, the lack of which in England was recently indicated by Professor Huxley with great force. Nearly every large town in Germany has its 'Real Schule,' where the children of the public elementary schools have the opportunity, either by means of exhibitions or by payment of small fees, of receiving a higher education, qualifying them in due course to enter commercial or industrial life, or to pass to the universities or to the polytechnic or technical high schools, which, at great cost to the nation, have been developed to a remarkable extent in recent years, and have unquestionably exercised a most beneficial influence upon the trade and commerce of the country. A most important feature in the development of these schools is the subdivision of the work of instruction among a large number of professors, each one an acknowledged authority in the particular branch of science with which he deals. Thus, at the Carlsruhe Polytechnic School—one of the very earliest of its kind, which was greatly enlarged in 1863—the number of professors is 41; and at Stuttgart the teaching staff of the polytechnic school amounts to 65 persons, of whom 21 are professors.

"The important part taken by the German universities in the training of young men for technical pursuits has often been dwelt upon as constituting a striking feature of contrast to our university systems. The twenty-four universities in the German Empire, each with its extensive and well-equipped science departments and ample professional staff, contribute most importantly to the industrial training of the nation in co-operating with the purely technical schools. The facts specified in the Report of the Technical Education Commission that, in the session 1883—4, there were 400 students working in the chemical laboratories at Berlin, and that, during the same session, 50 students were engaged in original research at Munich (where the traditions of the great school of Liebig are worthily maintained), illustrate the national appreciation of the opportunities presented for scientific training; and the expenditure of £30,000 upon the physical laboratory, and £35,000 upon the chemical department, of the New University of Strasbourg, serves to illustrate the unsparing hand with which the resources of the country are devoted to the provision of those educational facilities which are the very life-spring of the industrial progress whence those resources are derived."

THE BRITISH COLONIES.

(ILLUSTRATIONS OF THEIR DEVELOPMENT DURING THE QUEEN'S REIGN.)

Imports and Exports.

		IMPORTS £	EXPORTS. £
American Dependencies	1837	5,200,000	5,000,000
	1885	25,700,000	21,500,000
Australasia	1837	1,500,000	1,300,000
	1885	63,500,000	52,000,000
Africa	1837	2,000,000	1,500,000
	1885	10,000,000	12,000,000

All the Imports and Exports taken together were ELEVEN TIMES larger in 1885 than they were in 1837.

British Shipping Trade with Colonies	1837	3,700,000 tons.
	1885	56,600,000 ,,
British Export to Colonies	1837	£11,300,000
	1885	£51,500,000

Population.

Of all the Colonies existing in 1837	1837	4,204,700
	1881	12,753,277[*]
Of all the Colonies in 1881		15,763,072[*]

Rate of Increase from 1837 to 1881.

In European Colonies	SLIGHT.
In Ceylon	TWICE as large as it was.
In the Great Asiatic Colonies	About the SAME.
In the Cape of Good Hope	EIGHT TIMES as large as it was.
In Canada	THREE TIMES as large as it was.
In the West Indies	NOT quite TWICE as large as it was.
In Australia	Nearly TWELVE times as large as it was.

Trade Report.

(From the Board of Trade Journal.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

RUSSIA.

Recent Customs Decisions.

(*Note.*—Poud = 36lb. avoirdupois. Gold rouble = 3s. 2d.)

White Vaseline.—Section 140, duty 2 roubles per poud, with an addition of 20 per cent. on each rouble of duty leviable.

Aniline Dyes in small paper parcels. Section 120, duty (including dye and wrapper) 15 roubles per poud.

FRANCE.

Increase in Sugar Duties.

With reference to the notification that appeared respecting a proposed increase in the French sugar duties, a report, dated the 27th May last, has been received from Mr. J. A. Crowe, Her Majesty's Commercial Attaché for Europe, stating that the Chamber of Deputies and the Senate have passed the Bill establishing provisionally and until the 31st December next, a surtax on sugar of every origin to the extent of 20 per cent.—*i.e.*, at the rate of 10 francs per 100kilos. Molasses, other than for distillation, having a saccharine richness of 50 per cent. or less, are to pay a duty of 18 francs per 100kilos.; but if more than 50 per cent. they are to pay a duty of 38 francs 40 cents per 100kilos. Chocolate is to pay a duty of 98 francs 40 cents per 100kilos.

SWITZERLAND.

Classification of Articles in Customs Tariff.

(*Note.*—Quintal = 220·4lb. avoirdupois.)

The following decisions affecting the classification of articles in the Swiss Customs Tariff have been given by the Swiss Customs Authorities during the month of March last:—

The word "purified" to be added to Category 9*a*, after "lanoline."

Chlorate of baryta. Category 17, duty 1 franc per quintal.

Amber, raw, liquid. Category 18*a*, duty 1 franc 50 centimes per quintal.

Plates of glass, prepared for use in photography. Negative photographs on glass are no longer included in Category 95.

Lanoline, raw, not purified. Category 260, duty 50 centimes per quintal.

ITALY.

Classification of Articles in Customs Tariff.

(*Note.*—Quintal = 220·4lb. avoirdupois. Kilogramme = 2·204lb. avoirdupois. Hectolitre = 22 imperial gallons. Lira = 9$\frac{6}{10}$d.)

The following decisions affecting the classification of articles in the Italian Customs Tariff have recently been given by the Italian Customs authorities:—

Pure spirit, of 95 degrees, to which has been added a small quantity of essence of aniseed. Category 1, No. 5*a*, duty 12 lire per hectolitre.

Extract of sumach, for dyeing. Category 3, No. 29*c*, duty free.

Chloride of cinconina (alkaloid combined with chloric acid). Category 3, No. 32*b*, duty 5 lire per kilo.

Oxide of iron hydrate, with an admixture of carbonate of soda, intended for purifying illuminating gases. Category 3, No. 33, duty 2 lire per quintal.

"Acetanilid" (product derived from aniline and acetic acid, used for medicinal purposes). Category 3, No. 55, duty 10 lire per quintal.

"Resorcina" (a medicine). Category 3, No. 55, duty 10 lire per quintal.

Malt extract (medicinal). Category 3, No. 56, duty 120 lire per quintal.

Wine, containing quinine mixed with sugar. Category 3, No. 56, duty 120 lire per quintal.

Waggon grease. Category 3 No. 58*a*, duty 6 lire per quintal.

Red arsenic, pulverised. Category 4, No. 66, duty 12 lire per quintal.

Varnish, composed of resin dissolved in alcohol, and coloured with oxide of iron. Category 4, No. 67*a*, duty 30 lire per quintal.

Artificial black, in very fine powder, used instead of lamp-black. Category 4, No. 70*c*, duty 5 lire per quintal.

Foundry slag and iron scoriæ, used as manure. Category 15, No. 296, duty free.

SPAIN.

Classification of Articles in Customs Tariff.

(*Note.*—Kilogramme = 2·204lb. avoirdupois. Peseta = 9$\frac{6}{10}$d.)

The following decisions affecting the classification of articles in the Spanish Customs Tariff have recently been given by the Spanish Customs authorities:—

Carbon filters, with receiver of fine varnished earthenware. Category 16, duty 26ps. 58cs. per 100kilos.

Oxide of cobalt, pulverised, mixed with flint, to give a blue colour to majolica and porcelain. Category 70, duty 4ps. 80cs. per 100kilos.

Calcotite, a product used for making walls waterproof. Category 92, duty 10 cents. per kilog.

UNITED STATES.

Customs Decisions.

The following decisions affecting the classification of articles in the Customs Tariff, and the application of the Customs Laws of the United States were given by the United States Government during the month of April last:—

Paper filters which are in the form of discs are dutiable at the rate of 15 per cent. *ad valorem*, as manufactures of paper, but filtering-paper in sheets, which has not been manufactured into filters, and which is simply paper adapted by its character for filtering purposes, is dutiable at the rate of 25 per cent. *ad valorem*, under the provision in Section 392, for "all other paper not specially enumerated or provided for."

Platinum sheets and wire which have undergone a further process of manufacture than that which brought the crude material into commercial platinum are dutiable at the rate of 45 per cent. *ad valorem*, under the provision in Section 216, for "manufactures, articles, or wares, not specially enumerated or provided for in this Act, composed wholly or in part of . . . platinum."

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[*] These numbers must have considerably increased since 1881.

Photographic paper which has been subjected to the process of sensitising or albumenising, is held, under the recent decision of the court, and by the advice of the United States Attorney-General, to be dutiable at the rate of 15 per cent. *ad valorem*, under the provisions of Section 388, for "manufactures of paper . . . not specially enumerated or provided for."

MAURITIUS.

New Customs Tariff.

With reference to the notification respecting the alteration in the rates of Customs duties now levied in Mauritius, the following detailed statement has been prepared, showing the Customs duties now levied on imports into that colony compared with the rates previously in force.

Goods.	New Rates of Duty.	Old Rates of Duty.
	Rupees Cs.	Rupees Cs.
Manure of all sorts; and the following substances when imported for the purpose of being used in the preparation of manures or other colonial produce, or as disinfectants, viz.:—Ammoniacal liquor, bones, bone dust, bone oil, and dissolved bones, carbolic acid, chloride of lime, chloride of manganese, chloride of soda, solution of soda, chloride of zinc, coal and wood soot, dried muscular flesh and dried blood, ether, fish and other substances damaged and condemned by the Customs sanitary officers as fit for manure only, lime, carbonate of lime, sulphate of lime or gypsum, phosphate and superphosphate of lime, nitrates, silicilates, and carbonates of potash and soda, perchloride of iron, permanganate of potash, phosphate of soda, sulphate of iron, sulphate and muriate of ammonia and other ammoniacal salts, sulphate of potash, sulphate of zinc, sulphuric acid, urate and sulphurated urine	1000kilos. 0·25	Free.

CUSTOMS TARIFF OF CHILI.

(Peso = 4s. 2d.)

NOTE.—The surcharge of 40 per cent. levied on all the duties payable in Chili was raised on the 1st April last to 45 per cent., and will remain at that rate until the 31st December next. During the year 1888 it will be at the rate of 47 per cent., and at 50 per cent. commencing from the 1st January, 1889.

Articles, Etc.	Valuation.	Duty.
	Ps. Cs.	
Drugs, Patent Medicines, and Chemical Products—		
Sulphate of Copper	Kilog. 0·15	15% ad val.
Of every other kind	—	25% ad val.

TRADE BETWEEN SPAIN AND THE UNITED KINGDOM.

Imports into the United Kingdom from Spain.

Principal Articles.	April, 1886.	April, 1887.
Chemical Products unenumerated ....Value	£7,769	£6,431
Copper Ore and Regulus..Tons	3,763	1,865
Value	£74,161	£36,392
Manganese Ore .... .Tons	105	1,550
Value	£408	£1,937
Pyrites of Iron and Copp'r.Tons	40,744	49,878
Value	£80,349	£102,306
Quicksilver ....lbs.	452,400	843,900
Value	£36,196	£85,100
Total Value	£781,457	£799,058

Exports of British and Irish Produce from the United Kingdom to Spain.

Principal Articles.	April, 1886.	April, 1887.
Alkali .... Cwt.	20,972	33,325
Value	£7,059	£11,679
Manufactures of Caoutchouc Value	£1,011	£1,010
Cement .... Tons	875	430
Value	£1,609	£795
Chemical Products and Preparations, including Dyestuffs .... Value	£2,112	£2,710
Coal, Products of, including Naphtha, etc. .... Value	£2,663	£30
Glass Manufactures .... Value	£495	£313
Grease, Tallow, and Animal Fat .... Cwt.	1,491	1,233
Value	£1,439	£1,219
Manure ....Value	£23,099	£11,269
Soap ....Cwt.	940	432
Value	£768	£392
Total Value	£273,145	£246,897

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

THE DEPRESSION IN THE BELGIAN COAL TRADE.

Lord Vivian, Her Majesty's Minister at Brussels, in a dispatch dated the 14th April last, on the subject of the steps taken by the Belgian Government respecting the depression in the Belgian coal trade, says:—

"In view of the depressed condition of the coal trade in Belgium, the Government are instituting an inquiry into the question, and have appointed two committees to examine it both from a commercial and industrial point of view, with the object of developing the trade.

"The commercial committee has nearly concluded its labours, but the inquiry into the industrial side of the question will not be completed for some time. I am promised a copy of the report when it is ready.

"Meanwhile, I am informed that it has been exclusively shown that the present railway rates for the transport of Belgian coal for foreign markets are already so low as to leave no margin of profit which would admit of their further reduction, and that it is therefore doubtful whether it would be possible to export the Charleroi smokeless coal to England at a profit by railway; the question of the cost of transporting it by canal is now under consideration.

"The industrial committee is charged to ascertain and report what improvements and economies can be made (1) in the plant and machinery used in the mines for the extraction of the coal, and (2) in the machinery for loading and unloading it at the stations and ports."

DEPÔT OF RUSSIAN PETROLEUM AT GOTHENBURG.

Mr. John Duff, Her Majesty's Consul at Gothenburg, in a report dated 11th of May last, states that Messrs. Nobel, of Baku, on the Caspian Sea, petroleum manufacturers, have made arrangements for a depôt of their oil at Karingberget, on the south shore of the mouth of the river Gota, about six miles from Gothenburg, where a reservoir, to hold two thousand tons of petroleum, will be built.

MISCELLANEOUS TRADE NOTICES.

CHEESE ADULTERATION IN THE UNITED STATES.

See *Board of Trade Journal* for June.

TRADE OF BOLIVIA.

In an article contributed to *L'Economiste Français* of 30th April last, on the economic resources of Bolivia, M. A. F. de Fontpertuis draws attention to the fact that the trade of that country is almost entirely in the hands of foreign houses, mainly belonging to Germany, France and Spain. There are no English or American merchants in Bolivia; but the Germans, he says, arrive in great numbers. Speaking English and Spanish with fluency, they soon find themselves at the head of a thriving trade. They undertake to buy their goods entirely in Europe, and mainly in Germany, and they recoup themselves by purchasing the products of the country and sending them to Europe. The main elements of the commercial wealth of Bolivia are saltpetre and guano, and the natural stores of these articles were, so M. de Fontpertuis declares, the real cause of the late fratricidal war with Chili.

RUSSIAN SUGAR PRODUCTION.

The *Journal de St. Petersburg* for the 6th May last collects the opinions of the leading provincial Russian newspapers on the question of regulating the production of sugar by limiting its quantity, and insisting on the exportation of a considerable percentage. This question has been raised by the meeting of the principal sugar refiners of Russia, to the number of 114, at Kiev, in the first week of the month of May. The general opinion of these newspapers, according to the *Journal*, is that it will be advisable for the refiners to carry out their proposition of pledging themselves to export, at any price, twenty-five per cent. of their actual production, and that for three full years from the close of 1887. This, it is believed, is the only course by which the markets of Russia can be relieved, although it is not to be concealed that the dearer rate at which the remaining three-quarters of the sugar will have to be sold in the markets of the Empire will lead to many complaints.

COMMERCIAL INSTITUTE OF PARIS.

The *Moniteur Officiel du Commerce* for the 28th April last, states that on the 10th of March last, at an extraordinary meeting of the shareholders, it was unanimously determined to greatly increase the importance of the Commercial Institute of Paris; to remove it to a more important building; and to expend upon it enough money to give it a far greater place than it has ever before held in the development of technical training and the general commercial prosperity of France.

EXTRACT FROM REPORT ON THE NEW CUSTOMS LAW AND TARIFF OF MEXICO.

"A large reduction has been made in the duties on drugs and medicines, but the duties in many cases are still extravagantly high—*e.g.*, alkaloids and their salts not specified (131) 15 dollars per kilo. The effect of these high duties on medicines is two-fold.

(1) The poor are often unable to obtain proper medicines, and have to content themselves with cheaper substitutes;

(2) Drugs and medicines are often smuggled, especially those that are taxed the most heavily, and the exchequer obtains less revenue from the high duties than it would from moderate duties.

"On the whole, the new tariff is a considerable improvement on the old one; but it remains highly protective."

ANILINE DYES.

A noticeable feature, says the *Journal of the Society of Arts*, in the Indian trade returns is the large increase in the employment of aniline dyes in India, in the place of the indigenous colours formerly employed for their woollen yarns, silk, and cotton. The value of the imports now averages £100,000 a year. The imports of aniline dyes were of the value of £77,159 in 1883, £110,321 in 1884, £101,395 in 1885, and £61,619 in the first eight months of 1886.

DRUGS AND CHEMICALS IN DAMASCUS.

According to the *Petit Moniteur*, French pharmaceutic and photographic chemicals have taken the first rank in the Damascus trade, the Paris houses exporting goods against which nothing can be said as regards quality; but their high prices check trade, and consequently leave an opening for German competition, which the Teutons avail themselves of, especially in the colour trade and heavy products. The supply of sulphate of quinine found in the market is almost entirely of Italian origin. The correspondent does not mention English goods, which have probably escaped his notice; he estimates the value of imports thus—Chemicals employed in the city, 50,000f.; drugs, 30,000f.; colouring matters, 10,000f.; hospital supplies, 19,000f.

GENERAL VIEW OF THE WORLD'S TRADE.

See *Board of Trade Journal* for June.

STATISTICAL TABLES.

PERIODICAL RETURNS OF IMPORTS AND EXPORTS.

Imports and Exports into and from the under-mentioned Countries in the latest Month for which Returns have been received, with Aggregates for the Period of the Year, including such latest Month.

(*Note.*—Rouble = 2s. 0d.; Franc = $9\frac{6}{10}$d.; Milreis = 4s. 6d.; Lire = $9\frac{6}{10}$d.; Dollar = 4s. 2d.; Piastre = $2\frac{1}{2}$d.)

I.—*Imports.*

Name of Country.	Latest Months.	Value for the Month.		Aggregate for Period of the Year, including latest Month.	
		1887.	1886.	1887.	1886.
Russia in Europe ..	January	Roubles 21,415,000	21,036,000	–	—
	February	,, 16,539,000	18,532,000	40,951,000	42,618,000
	March ..	,, 19,592,000	23,513,000	60,516,000	66,131,000
France	April ..	Francs 351,864,000	369,329,000	1,132,126,000	1,432,543,000
Portugal	February	Milreis 2,705,000	2,156,000	5,308,000	4,794,000
Italy	April ..	Lire .. 141,511,000	131,222,000	508,768,000	456,675,000
United States	April ..	Dollars 63,537,000	57,366,000	237,586,000	221,506,000
Egypt	February	Piastres 55,771,000	59,829,000	120,559,000	128,541,000
	March .	,, 81,776,000	67,492,000	202,335,000	196,033,000
British India*	March ..	Rupees 5,53,03,416	4,74,59,880	58,69,60,717	51,81,15,365

The above figures are subject to revision in the Annual Returns.

[*] The aggregate figures are for the financial year commencing 1st April.

II.—*Exports.*

Russia in Europe ..	January	Roubles	54,000,000	27,181,000	—	—
	February	,,	35,307,000	20,501,000	69,316,000	17,682,000
	March ..	,,	32 813,000	25,801,000	102,129,000	73,186,000
France............	April ..	Francs	285,307,000	249,170,000	1,049,511,000	1,036,997,000
Portugal...........	February	Milreis	1,789 000	2,284,000	3,527,000	4,225,000
Italy	April ..	Lire ..	96,776,000	83,730,000	360,955,000	345,029,000
United States	April ..	Dollars	47,563,000	51,017 000	239,193,000	217,603,000
Egypt	February	Piastres	104,868,000	77,825,000	249,830,000	244,941,000
	March ..	,,	76,910,000	86,153,000	326,740,000	301,093,000
British India*	March ..	Rupees	9,31,55,852	9,49,56,036	88,13,95,786	83,82,78,401

The above figures are subject to revision in the Annual Returns.

NOTE.—The figures are those of the "special" imports and exports, except in the case of the United States and British India, where the figures are "general." "Special" means, in the case of imports, imports for home consumption, in the case of exports, exports of domestic produce and manufacture only.

* The aggregate figures are for the financial year commencing 1st April.

TRADE STATISTICS FOR MAY.

The Board of Trade Returns for May show the following figures :—

Exports.

	May, 1886.		May, 1887.
British and Irish Produce	£16,301,022	....	£16,497,836
Foreign and Colonial Produce (partly estimated)	4,592,142	....	4,700,128

Imports.

	May, 1886.		May, 1887.
Total value....................	£29,023,303	....	£27,921,321

Below are the details affecting drugs and chemicals :—

Exports.

		May, 1885.	May, 1886.	May, 1887.
British and Irish produce :—				
Alkali	cwt.	629,771	644,144	560,831
,, ...	value £	186,382	182,420	157,981
Bleaching materials	cwt.	149,089	112,218	125,187
,, ,,	value £	48,246	43,116	47,147
Chemical manure ..	value £	90,789	94,286	90,579
Drugs and medicinal preparations (unenumerated)	value £	64,126	65,121	69,607
Other chemicals and medicinal preparations	value £	161,266	171,847	177,352
Oil (seed)............	tons	5,393	7,228	6,613
,, ...	value £	126,175	148,955	134,922
Soap	cwt.	31,992	27,738	36,766
,, ...	value £	37,238	30,513	36,767
Painters' colours and materials (unenumerated)	value £	105,900	109,025	119,391
Foreign and Colonial merchandise :—				
Bark, Cinchona	cwt.	10,178	10,917	11,086
,, ,, ...	value £	49,566	48,837	47,749
Chemicals (unenumerated)	,,	21,955	16,010	25,288
Cochineal	cwt.	804	649	353
,, ...	value £	5,280	4,525	2,418
Cutch and gambier	tons	732	530	835
,, ,,	value £	17,721	13,029	21,378
Gum Arabic	cwt.	4,157	3,613	2,963
,, ...	value £	15,072	12,574	10,506
Indigo	cwt.	3,982	1,722	3,488
,, ...	value £	82,650	31,857	73,043
Lac, various kinds..	cwt.	7,617	6,045	4,595
,, ,, ,, ..	value £	24,431	16,078	13,411
Lard	cwt.	3,013	13,957	1,583
,, ...	value £	5,606	28,319	2,850
Oils, cocoa-nut......	cwt.	12,412	6,593	10,643
,, ,, ...	value £	18,631	8,822	13,906
,, olive	tuns	254	307	393
,, ,, ...	value £	11,925	13,185	16,979
,, palm	cwt.	26,087	32,708	32,548
,, ,, ...	value £	37,278	32,380	31,719
,, petroleum	gals.	35,566	35,744	70,026
,, ,, ...	value £	1,867	1,550	2,552
Quicksilver	lb.	240,396	416,731	301,062
,, ...	value £	17,792	32,281	27,196
Nitre (nitrate of potash)	cwt.	1,377	739	5,721
Nitre (nitrate of potash)	value £	1,380	591	5,397
Tallow and stearine	cwt.	17,583	15,113	56,479
,, ,, ,, ..	value £	20,691	17,761	69,795

Imports.

		May, 1885.	May, 1886.	May, 1887.
Drugs, unenumerated..	value £	53,592	50,780	59,653
Chemical manufactures—				
Products unenumerated	value £	119,552	96,020	111,277
Alkali	cwt.	5,745	11,726	3,737
,, ...	value £	4,178	6,983	2,809
Brimstone	cwt.	93,177	52,158	59,812
,, ...	value £	23,897	12,473	13,229
Nitre (nitrate of soda)	cwt.	113,606	185,396	396,684
,, ,,	value £	70,914	93,762	209,466
,, (nitrate of potash)	cwt.	31,066	22,854	30,938
,, ,,	value £	27,877	20,312	26,951
Quicksilver	lb.	715,875	782,700	315,000
,, ...	value £	52,498	65,165	27,875
Bark (Cinchona)........	cwt.	9,406	13,158	13,803
,, ...	value £	63,602	66,719	62,938
Gum Arabic	cwt.	9,205	3,243	2,753
,, ...	value £	26,270	13,587	11,700
Lac, seed, shell, stick, and dye	cwt.	16,175	12,168	19,739
Lac, seed, shell, stick, and dye	value £	51,923	34,493	51,179
Dyes and tanning materials—				
Bark (for tanners' or dyers' use)	cwt.	26,090	37,813	48,066
Bark (for tanners' or dyers' use)	value £	11,342	15,895	24,398
Anilin dyes	value £	15,741	11,627	21,833
Alizarin	value £	12,602	21,841	19,586
Other coal-tar dyes....	value £	313	—	75
Cochineal	cwt.	847	544	350
,, ...	value £	5,307	3,193	2,185
Cutch and gambier..	tons	1,522	2,047	1,513
,,	value £	33,422	46,697	35,426
Indigo	cwt.	2,580	855	3,200
,, ...	value £	45,014	19,023	62,263
Madder, madder root, garancine, and munject..................	cwt.	1,120	1,451	2,179
Madder, madder root, garancine, and munject..................	value £	1,650	1,768	2,353
Valonia	tons	3,771	3,945	1,657
,, ...	value £	58,150	54,105	24,800
Oils—				
Cocoa-nut	cwt.	4,911	21,161	9,018
,, ...	value £	7,726	28,203	11,915
Olive..................	tuns	2,721	2,708	1,921
,, ...	value £	109,463	102,995	70,422
Palm	cwt.	66,297	87,289	71,138
,, ...	value £	93,191	84,207	67,173
Petroleum	gals.	4,307,005	7,011,247	1,744,682
,, ...	value £	142,008	174,510	62,531
Seed, of all kinds	tuns	878	1,949	1,127
,, ...	value £	26,249	41,730	26,897
Train, blubber, and sperm	tuns	881	680	1,399
Train, blubber, and sperm	value £	25,154	18,437	29,737
Turpentine	cwt.	2,751	1,309	3,715
,, ...	value £	3,142	1,490	5,049
Rosin	cwt.	108,741	89,620	112,692
,, ...	value £	21,330	23,658	26,421
Tallow and Stearine....	cwt.	99,215	81,020	61,029
,, ...	value £	168,203	99,111	72,299

Indian Trade and Navigation Reports.

The Indian trade and navigation reports for April, compared with those for April of last year, show a net increase in the value of imports of 19,12,778 rupees, and an increase in every item of import except under two heads. The net increase in exports was 32,70,649 rupees, and every item showed an increase except chemicals, drugs, medicines, narcotics, and dyeing and tanning materials, which decreased by upwards of 17 lakhs.

A Prize for Chemists.

The Amsterdam Association opposed to the adulteration of butter has offered a prize of 1000 florins to the discoverer of the best method for immediately detecting foreign matters added to butter. The process must trace out any sort of fat that may have been introduced, whether it is harmful or not. The process is to be simple and practical enough to be worked without a chemical laboratory. Memoirs should be sent before January 1, 1888, to Mr. J. Binkes-Borgers, at Leyden. The prizetaker will be allowed to keep his copyright, and may take out patents in foreign countries.—*Chemist and Druggist*, June 18.

The Iodine Convention.

At the commencement of the present year the price of iodine, which had for some time been very low, and was expected to experience a further decline in consequence of the anticipated collapse of the combination of producers, suddenly, and to the astonishment of many dealers in the article, rose to 9d. per oz. The convention of the producers of iodine had been renewed, but the parties interested in it wisely kept their own counsel, and were enabled to reap a substantial benefit as the reward of their discretion. The new convention, to which most, if not all, of the manufacturers and the principal holders of stock in Europe, the United States, and the west coast of South America have acceded, was registered on February 18 at Iquique—the principal port of shipment in the iodine district—now held by the Chilians. The agreement, we understand, has been concluded for a term of three years, commencing on January 1, 1887, and it has been resolved that during this period the sale of the entire product will be vested in one house exclusively. The European manufacturers are to have for their share 40½ per cent. of the total sales effected, so long as the latter do not exceed 336,000lb. If the sales of iodine exceed that quantity—which means about ten months' consumption, and is, therefore, probably to be taken as an annual limit—ninety per cent. of the excess will fall to the share of the Chilian producers.

The parties interested in the convention, in addition to the English and French producers, are divided into three categories, viz.:—

Firms possessing iodine manufactories in working order and holding stock in Europe.

New manufacturers, carrying no stock in Europe.

Owners of iodine holding stock in Europe, who are not at the same time manufacturers of the article in South America.

The parties falling under the first category will be compelled, under the terms of the agreement, to suspend the manufacturer of iodine until their surplus stocks have been cleared off by their share of monthly allotments of sales effected. It is said that some firms hold enough stock in Europe to require two and a half or three years before, under this system, they will be allowed to resume working, and if the estimate of the European stock owned by Chilian holders is correct, this clause will apparently be tantamount to a virtual cessation of iodine production in the old Chilian works during the terms of the convention.

The new producers of iodine, forming the second class of contracting parties, have their output strictly limited to the quantity assigned to them as their monthly share of the orders. Firms who hold stock in Europe, but who do not possess works in South America, have to submit to a fixed reduction on the amount of their monthly share of the sales, in order to recoup the producers for the compulsory limitation or temporary cessation of their output. The producing capacity of all works included in the convention will be estimated, and the share of each contracting party in the orders is to be fixed according to the relation between the producing capacity of his works and the estimated annual consumption. To commence on January 1, 1887, the price for iodine for metallurgical and dyeing purposes is fixed at 6d. per oz., and for all other, including pharmaceutical uses, at 9d. per oz.

The aggregate capacity of production of sublimed iodine of not less than 98 per cent. standard in the South American works at the end of last year was estimated at 25,560 quintals, or 2,591,340lb.; the European stock of Chilian iodine at 10,177 quintals, or 1,032,965lb.; the export of iodine from the South American west coast in 1886 at 3,825·88 quintals, or 388,327lb.; and the world's consumption at 4000 quintals, or 406,000lb. These figures would prove that Chili is at present capable of producing six and a half times as much iodine as is required for all purposes to which the article is applied, and it must not be forgotten that there is at present no prospect of any considerable extension in the use of the article, even though the price should fall to a third or a fourth of that prevailing. The stock of Chilian iodine now held in Europe would alone suffice for two and a half years' consumption, and the convention must therefore necessarily restrict the output of iodine in South America to a very small fraction indeed of the present producing capacity. The directors of the iodine association purpose, it is said, to gradually raise the price considerably beyond their present quotation, and as they control the market at this moment they will probably succeed. But the combination is likely sooner or later to come to grief through the impatience of its own members to submit to an artificial stunting of their producing powers, nor could the collapse of an association based upon principles so essentially vicious from an economical point of view be regretted, however disadvantageous it might be to its own component parts.—*Chem. and Druggist*, June 18, 1887.

Foreign Competition in Brazil.

Consul Cooper remarks on foreign competition in Santos, in the province of Sao Paulo. In this province foreign competition has made but slight impression on the general course of British trade, but the Germans, who are the only serious rivals in the field, have possessed themselves of one or two branches, and are making great efforts to establish the supremacy of their woollen and cotton industries. In face of this opposition the Consul urges concerted action of all the industrial and commercial classes on well-organised principles of trade. "Apart from the low price at which the Germans produce and transport their production, a great secret of German success is their thorough training as mercantile men. German merchants abroad are shrewd, hard-working men, generally of ample education and agreeable social qualities, with broad unprejudiced views, and possessing the inestimable gift of being able to ingratiate themselves with the people with whom they reside and have to deal. In such men the German manufacturer finds solid support, and the most potent means for the extension of trade." Consul Cooper does not think much good will come from relying on the consular service, and suggests, as one among other plans of extending trade, the establishment of commercial and industrial museums or agencies at certain advantageous localities abroad, primarily in new countries.

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

7261 R. A. Gibbons, London. Smoke consuming apparatus for boiler furnaces. May 18

7286 R. W. Anderson, Liverpool. Improvements in means and apparatus for supplying air or draught to the furnaces of steam generators. May 19

7363 C. Tellier, London. An improved apparatus for utilising atmospheric or solar heat, for raising water or other purposes. Complete specification. May 20

7370 W. P. Thompson—From J. A. Sperry, United States. Improvements in amalgamators. May 20

7402 J. Smith and D. Cowan, London. Improvements in steam generators. May 21

7409 A. de Lande Long and C. Watson, Stockton-on-Tees. A new arrangement of regenerative furnace. May 21

7466 T. Nelson, Accrington. Improvements in filters. May 23

7515 C. A. Koellner, London. An improved filtering and lixiviating press. Complete specification. May 25

7525 H. H. Lake—From U. Cummings, United States. Improvements in air compressing apparatus. Complete specification. May 25

7628 H. Walker, Birmingham. Improvements in and connected with steam boiler and other heating, melting, and smelting furnaces, muffles, and the like, for various purposes. May 26

7610 R. Robson, Leeds. Grate bar for boilers and all purposes in raising steam and heating furnaces and such-like. May 26

7716 P. Evans, Liverpool. Improvements in and applicable to steam generators. May 27

7717 J. C. Stitt, Liverpool. Improvements connected with steam generators in which artificial or forced draught is employed. May 27

7723 O. Kruschki, Liverpool. New and improved heating apparatus with air supply from above. Complete specification. May 27

7725 C. W. Guy, London. Improvements in crushing mills. May 27

7726 R. W. Deacon—From W. Maxwell, Java. Improvements in centrifugal drying machines. May 27

7756 H. H. Lake, London—From B. Roberts, United States. Improvements relating to smoke-condensing apparatus for use in connection with steam boiler and other furnaces. Complete specification. May 27

7772 G. W. Allen, Manchester; and H. J. A. Bowers, London. Improvements in apparatus for purifying water for steam boilers. May 28

7815 T. Taylor, London. Improvements in or applicable to steam boilers for consuming smoke. May 28

7817 J. Kroog, London. Improvements in apparatus for automatically discharging water of condensation from steam pipes, and for similar purposes. Complete specification. May 28

7908 A. E. Barthel, London. Gasometer. June 1

7910 J. R. Robson, Leeds. Improvements for increasing and making more effective the heating surface of boiler flues. June 1

7931 W. P. Thompson—From R. A. Marshall. See Class VII.

8050 A. J. Marquand, London. Improved means for preventing corrosion and incrustation in steam boilers and other similar vessels. June 3

8054 G. Little, London. Improvements relating to pulverisers, and to means for separating or sorting pulverised or disintegrated materials. June 3

8179 J. Thiry and G. Chantrenne-Soiron, London. Steam and other injectors. June 7

8180 W. H. Farris, London. Steam generators, circulators, and pulsators. Complete specification. June 7

8285 W. Neilson, H. Neilson, and T. Williamson, Glasgow. Reversing valves for regenerative and other furnaces. June 9

8339 J. T. Collinge, Manchester. Rotary pumps, blowers and exhausters. June 10

8396 A. J. Marquand, London. Electrical apparatus for preventing corrosion of steam boilers and similar vessels, and for removing the incrustation when once formed. June 10

8413 G. H. Steehmann, Manchester. Combined automatic steam-boiler feeding apparatus and feed water heater. June 11

8111 J. A. Yeadon and R. Middleton, Leeds. Machinery for drying small coal or coke, or for desiccating substances of a like granular character. June 11

8192 F. Quénehen and A. Vansteenkiste, London. Apparatus for grinding animal, vegetable, and mineral substances. June 13

8658 W. H. Mirfin, Manchester. Construction of internal furnaces and flues for steam boilers. June 16

8670 W. J. Ellis, Manchester. Centrifugal pumps. Complete specification. June 16

8698 E. A. Cowper, London. Hot blast valves. June 16

*COMPLETE SPECIFICATIONS ACCEPTED.**

1886.

8105 E. Robinson. Apparatus for drying glutinous fibres, granular and other materials. May 25

8107 A. Tolhurst, C. A. Glazbrook and A. Philbey. Fire grates and smoke consuming apparatus for furnaces. May 21

9733 A. G. Meeze. Apparatus for cooling and heating fluids. May 28

10061 H. S. Stewart. Apparatus for exhausting, lifting, forcing, or measuring fluids. June 11

10098 J. Atkinson. Machines for cooling air or other gases. June 11

10378 C. J. Croft and F. Dowling. Apparatus for forcing draught in boiler furnaces. June 15

10595 A. Flamache and E. Pieard. Method and apparatus for desiccating wood and other porous substances. June 1

10663 J. Rankin. Furnace grates. May 28

10704 S. S. Bromhead—From L. Stauffert. Mixing apparatus for liquids. June 18

11244 A. W. Anderson. Filter presses. May 21

1887.

5793 J. King. Apparatus for use in roasting, drying, carbonising, or torrefying farnia, dextrine, manures, feeding stuffs, etc.; for heating, evaporating, or distilling liquids, and for heating disinfectors and water apparatus. June 18

7203 C. T. Schoen. Apparatus for burning liquid fuel. June 18

7363 C. Tellier. Apparatus for utilising atmospheric or solar heat for raising water, etc, June 22

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

7156 J. Keith, Glasgow. Improvements in apparatus for manufacturing oil-gas. May 17

7177 J. W. Corbett and R. D. Hardy, London. Improvements in and in means for the manufacture of gas. May 17

7230 J. E. Barwick, St. Petersburg. A system of heating boilers or generating steam. May 18

7268 A. Hommel, London. Process for obtaining oxygen. May 18

7274 F. V. Hadlow, Buxted. An improvement in the artificial manufacture of coal, so as to render it comparatively smokeless. May 19

7482 R. de Soldenhoff, London. Improvements in or addition to means or apparatus employed in the manufacture of coke for the desiccation and incineration of precipitants or solids resulting from sludge or other substances liable to putrify. Complete specification. May 23

7499 C. Birley and J. Sturgeon, London. New or improved apparatus for automatically regulating the supply of air to the combustion chambers of gas-producers according to the pressure of steam in boilers fired with the gas from such gas-producers. Complete specification. May 23

7518 J. Belou, London. A new or improved process for manufacturing pure hydrogen. Complete specification. May 25

7613 L. Sepulchre, London. Improvements in lighting and heating by mineral oils. May 25

7713 J. H. R. Dinsmore, Liverpool. Improvements in and apparatus for washing and purifying coal-gas. May 27

7711 J. H. R. Dinsmore. Improvements in and connected with the manufacture of illuminating gas from coal. May 27

7751 E. Fleischer, London. Improvements in separating solid matter from smoke or gases resulting from combustion, and apparatus therefor. May 27

7782 W. Defries and V. J. Feeny, London. Improvements in feeding oil for lighting and heating. May 28

7811 W. Backer, London. An improved process of treating tar for the purpose of producing illuminating and heating gas and coke. May 28

8005 H. Keevil, Bath. The more effectual combustion of the oil, and increasing the brilliancy of the flame and light of paraffin, petroleum, and benzoline lamps. June 3

8191 C. L. Baillard, London. Improvements in the treatment or preparation of mineral or other like oils. June 7

8218 E. W. Harding, Greenwich. Improvements in the manufacture of gas from coals, with other advantages in connection therewith. June 8

8392 J. A. C. Mackenzie, London. An apparatus to be employed for heating by means of ordinary gas-burners. June 10

8679 A. G. Meeze, Redhill. Improvements in the manufacture of gas, and apparatus therefor. June 16

8697 H. H. Doty, London. An improved method of and apparatus for generating light and heat from mineral or other oil. June 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

7289 M. Immisch. Apparatus for measuring heat. May 25

7580 C. F. Claus. Purification of coal-gas. May 25

7582 C. F. Claus. See Class VII.

7584 C. F. Claus. Purification of coal-gas. May 25

7585 C. F. Clans. Purification of coal-gas. May 21

9473 J. Livesey and W. Whitehouse. Apparatus for enriching gas by admixture of hydrocarbon vapour. May 21

9598 J. H. Johnson—From E. Delamare-Deboutteville and L. P. C. Malandin. Apparatus for carburetting air. May 28

9658 W. Welch. Means for utilising oils or gases as fuel, and for lighting fires. June 15

10698 T. Thorp. Non-regenerative gas-lighting. June 22

1887.

3267 C. W. Watts. Purification of coal-gas and apparatus therefor. May 28

5574 W. W. Horn—From A. L. Allen. Apparatus for the manufacture of gas. June 8

5863 R. Harrison and W. Oliver. Applying the vapour of volatile liquids as a source of motive power. May 25

6018 A. J. Boult—From D. M. Kennedy. Purifying hydrocarbon oils. May 28

7034 O. W. Bennett and S. O. Hemenway. Carburetting apparatus. June 15

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

APPLICATIONS.

7867 W. M. Fraser and J. Snodgrass, Glasgow. Improvements in primary distilling apparatus for shale or other oil-yielding mineral. May 31

8090 F. Lennard, London. Improvements in apparatus used in the distillation of tar or oil. June 1

8623 W. P. Thompson—From R. A. C. von Sehlieben, Berlin. Improved method of separating the chief component parts of coal shale. June 15

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

9550 O. Rose. Apparatus for the distillation of coal shale and other materials. May 25

11131 J. Jones. Retorts for the destructive distillation of shale, coal, and other bituminous substances. June 8

1887.

5785 A. L. Vale—From the Chemische Fabrik Actien Gesellschaft. Process for the purification of crude anthracene. May 21

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* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

7333 F. E. Schmuckert, London. An improved process of preparing indigo solutions for dyeing purposes. Complete specification. May 19

7627 I. Levinstein, Manchester. Improvements in the production of azo colouring matters. May 26

7733 J. Y. Johnson—From The Farbenfabriken vormals F. Bayer & Co., Germany. Improvements in the manufacture of dyes. May 27

7812 A. Liebmann and A. Studer, London. A process for producing a new mono-sulpho acid from alpha-naphtol. May 28

7833 J. Y. Johnson—From the Badische Analin and Soda Fabrik, Germany. Improvements in treatment and preparation of naphthazarine (dioxynaphthaquinone), and the production of a soluble derivative thereof, and the application of the same in dyeing and printing. May 28

8265 S. Pitt—From A. Weinberg, Germany. The manufacture of a new naphtol-disulphonic acid and of dyestuffs therefrom. June 8

8296 L. Paul, London. A process or processes for the production of colours from tetrazodiphenyldicarbon acid, and from its methyl and æthyl ethers. June 9

8381 P. McAra, J. Walker, J. A. Birrell, W. Brock, junr., and J. Adam, Glasgow. Improvements in and connected with the preparing or maturing and treating of cut or reduced logwood and other dye-woods for dyeing and other purposes. June 10

8431 I Imray—From La Societe Anonyme des Matières Colarantes et Produits Chimiques de St. Denis, A. F. Porrier, and D. A Rosenstiehl, France. A process for the manufacture of anthraquinone. Complete specification. June 11

8437 L. Paul, London. Process or processes for producing mono and diamidoazobenzidines, transformation of them into tetrazo compounds, and their combination with amines and phenols (naphtoles), or the sulpho-acids of these bodies. June 11

8501 C. A. Bennert, London. Improvements in the manufacture of colouring matters. June 13

COMPLETE SPECIFICATION ACCEPTED.

1887.

7333 F. E. Schmuckert. Preparing indigo solutions for dyeing purposes. June 22

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

7476 G. A. Hartington, Rochdale. A method of and apparatus for cleaning or separating seed or other extraneous matter from cotton, wool, silk, or other fibrous materials. May 23

7513 T Tschieret, London. Improvement in proceedings and apparatus for felting woollen thread. May 25

7932 G. I. J. Wells and S. L. Howard, Liverpool. Improvements in the manufacture of rhea or other like fibre from the rhea bark or china grass or like products of other plants of the Urtica family. June 1

8011 W. B. Nation and J. J. Worswick. See Class XIX.

8015 E. Jaegermayer, London. An improved method of and apparatus for determining the percentage of clean wool contained in a given quantity of raw wool. June 3

8167 G. F. Wilson, Westminster. Improvements in the method of and composition for treating textile fabrics. June 7

8178 E. Tremsal and A. Dicktus, London. Improvements in the process of scouring wool, and in apparatus therefor. June 7

8575 H. H. Lake—From C. Schrebler, United States. Improvements relating to the drying and carbonising of wool, and to apparatus therefor. Complete specification. June 15

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

10053 W. Mather. Apparatus for treating textile materials with liquids, gases or vapours. June 4

10176 H. R. Randall. Treatment of silk cocoons, raw silk, etc., and apparatus therefor. June 11

10250 J. S. Farmer. Apparatus for testing the purity of raw cotton. June 18

10545 A. Mitscherlich. Preparing fibres capable of being spun from wood. June 15

13197 G. Tolson and J. Illingworth. Carbonising wool, rags, etc. June 1

13198 G. Tolson and J. Illingworth. Carbonising wool, rags, etc. June 8

1887.

5685 A. J. Boult—From E. H. M. Caston. Manufacturing a merchantable material from thistledown. June 8

6121 E. W. Serrell, Junr. Process and apparatus for the mechanical "debavage" of cocoons after brushing. May 28

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

7550 E. B. Petrie and R. Wild, Rochdale. Improvements in the means and method of and for the washing, scouring, boiling and bleaching of fibres, fibrous materials and textile fabrics; and the stripping of fibres from hides and skins. May 25

7556 R. Lockwood and E. L. Adamson, Halifax. Improvements in the method of and means for dyeing yarns. May 25

7740 E. Boursier, London. Improvements in dyeing fabrics, and in materials and apparatus therefor. Complete specification. May 27

7911 W. Brierley—From R. Perzina, Germany. Improvements in automatic coppers or vats employed in the dyeing of fibres, and fabrics or pieces. June 1

8333 J. Takmine. See Class XVIII.

8361 J. A. Schofield, London. Improvements in appliances for attaching to lines, cords and rods, textile fabrics for the purpose of drying and bleaching the same, and for other purposes. June 10

8525 J. H. Smith, Glasgow. Improvements in apparatus for drying woven fabrics, yarns, or fibrous materials. June 14

8668 C. T. Clegg, Manchester, H. A. Clegg, Heaton Norris, and F. Lee, Didsbury. Improved machine for new process of dyeing wool or other material. Complete specification. June 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

10053 W. Mather. Apparatus for treating textile materials with liquids, gases or vapours. June 4

10542 T. Holliday. Dyeing textile fibres. June 18

10718 L. Harmell, J. Harmell, and A. Harmell. Rotary apparatus for preparing for dyeing combed wool in bobbins. June 22

13261 J. H. Storey, J. Wilkinson, and H. Bateson. Machinery for printing in several colours on paper, oil cloth, and other fabrics. June 22

1887.

5596 J. Bromley and T. Harrison. Machinery for bronzing, colouring, or otherwise ornamenting paper and other material in sheets or rolls. June 8

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

7270 E. W. Parnell and J. Simpson, Liverpool. Improvements in obtaining pure carbonic acid gas, and in apparatus therefor. May 19

7661 W. G. MacIvy, London. A new way of making soda. May 26

7701 C. F. Claus, H. L. Sulman, and E. E. Berry, London. Improvements in the manufacture of soda by the ammonia process. May 27

7859 L. A. Staub, Liverpool. Improvements in the manufacture of carbonate of soda and carbonic acid from the bicarbonate, and in apparatus therefor. May 31

7906 R. Schneider, London. Producing hydrate of baryta from sulphate of barium. May 31

7931 W. P. Thompson—From R. A. Marshall, United States. Improvements in demi-john and carboy cases for acids and other liquids. June 1

8129 L. A. Staub, Liverpool. Improvements in the manufacture of carbonates of soda. June 6

8213 S. Hallsworth and R. Bailes, London. A new or improved method or process of manufacturing ferric sulphate or sesquipersulphate of iron, commonly called nitrate of iron. June 8

8217 G. H. Bolton, J. R. Wylde, and H. Auer, Liverpool. Improvements in or relating to the manufacture of permanganate of soda, or of a mixture of the same with other disinfecting or oxidising matter. June 8

8289 W. Bramley, Middlesbro'-on-Tees. Improvements in obtaining chlorine or hydrochloric acid from chloride of calcium. June 9

8622 L. Mond, Liverpool. Improvements in obtaining ammonia, chlorine, and hydrochloric acid from ammonium chloride. June 15

8666 A. M. Chance and J. F. Chance, Liverpool. Improvements in treating alkali waste to obtain sulphuretted hydrogen, and in apparatus employed therein. June 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

7582 C. F. Claus. Preparation of ammonia compounds from coal gas. June 4

8819 L. A. Chevalet. Apparatus for distilling and purifying ammoniacal liquids. June 11

9208 H. W. Deacon and F. Hurter. Apparatus for producing ammonia from sulphate of ammonia. May 28

10000 A. W. Gillman and S. Spencer. Apparatus employed in the manufacture of sulphites. June 11

10419 G. Jármay. Separating the ammonium chloride from liquors obtained in the manufacture of soda by the ammonia soda process. June 22
1588? W. F. Nast. Treatment of manure and other organic matters, and production therefrom of ammonia and residual products free from ammonia. June 11

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

7151 S. Bunting, Dublin. Improved moulds with apparatus attached for blowing glass by means of compressed air, and completing the manufacture in the mould. May 17
7229 S. Bunting. Improved compressed air apparatus suitable for glass blowing. May 18
7279 J. D. Watson, Glasgow. Improvements in the enamelling of metallic and other surfaces, and in the materials employed therefor. May 19
7516 H. Godwin and W. Hewitt, Hereford. Making and connecting tile or ceramic fenders and ceramic mouldings generally on new and improved principles. May 25
7560 H. M. Ashley, Sheffield. Improvements in the manufacture of internally stoppered bottles and other like vessels of glass. May 25
7609 F. Siemens, London. Improvements in ceramic kilns. May 25
8003 L. A. Holmes, Blackpool. A novel adaptation in the manufacture of plaques for teapot stands. Complete specification. June 3
8016 A. H. Hull, London. An imperishable opal letter for buildings. June 3
8170 J. H. Hughes and J. Holdsworth, London. A new or improved compound or material capable of being moulded and used as a substitute for natural stone or marble, for pottery, metallic, wooden, and other articles. June 7
8235 R. Stuart, London. An improvement in the production of glassware. June 8
8272 G. F. Chance, London. Improvements in the manufacture of rolled glass, and in appliances used in the said manufacture. June 10

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

8677 J. C. Arnall and H. M. Ashley. Manufacture of bottles and other articles in blown glass. May 28
9798 H. Defries. Manufacture of lenses. June 11

1887.

1911 J. Critchlow, T. Forester, W. Forester, H. Forester, and L. Forester. Improved potters' filter-press. May 21
2618 F. Bennett. Earthenware and china plates and dishes. June 1
5698 S. H. Rowley. Preparing articles of glass or pottery to receive metal pipes or other metal connections. May 28
5723 S. Pitt—From G. Falconnier. Manufacture of building materials from glass, and application of the same. May 28
5866 J. Blair. Improvements in china and crockeryware. May 25

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

7178 J. W. Corbett and R. D. Hardy, London. Improvements in and means for the manufacture of cement. May 17
7243 L. G. Knemeyer, London. Cement adapted for artificial stone work, and for coating walls, etc., with a suitable surface for the reception of waterproof painting. May 18
7252 J. Gollings and H. Hicks, London. Improvements in the construction of "formers" for plastic brick manufacture. May 18
7381 J. Dudley and J. Hamilton, Derby. Improvements in concrete and artificial stone mantelpieces. May 20
7411 A. Busch, London. Improvements in the manufacture of cement for building and general constructive purposes. May 21
7539 S. Smith, J. Roberton, and J. R. Andrew, Glasgow. Improvements in making Portland cement. Complete specification. May 25
7708 N. R. Foster, Uxbridge. A new or improved method of constructing kilns and drying floors for the manufacture of cements and limes. May 27
7757 C. Rabitz, London. Improvements in the construction of walls, ceilings, roofs, and the like. May 27
8024 J. Stevenson—From J. Salvat, France. A new process for the preservation of woods. June 3
8266 W. D. Cliff and B. E. Pete, London. A new or improved brick or building block. June 8
8316 C. F. Laspe, London. Improvements in the manufacture of firebricks. June 9
8318 A. Scrutton—From D. B. McLaren, New Zealand. A new or improved manufacture of material or compound suitable for paving. June 9
8139 C. F. W. Doehring, London. Improvements in street and other paving. Complete specification. June 11
8489 W. C. Milton, London. Fireproof metallic plastering. June 13
8618 A. W. Rummage, London. An improved fireproof column and staunchion combined, for building construction. Complete specification. June 15

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

9551 W. F. Reid. Hydraulic cement. May 21

1887.

5723 S. Pitt—From G. Falconnier. See Class VIII.
6283 A. Murray. Manufacture of bricks, mouldings, ridges, etc. June 8
6496 C. Chambers, jun. Brick-making machines. June 8

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

7186 G. Downing—From C. Baily, France. Improvements in means and appliances for supporting the roofs of cuttings in coal mining and analogous operations. May 17
7198 W. A. Baldwin, London. A process of obtaining aluminium from its ores or from aluminiferous earths, or earths containing alumina; and of combining aluminium with other metals. Complete specification. May 17
7278 J. S. MacArthur, R. W. Forrest, and W. Forrest, Glasgow. Improvements in treating ores to obtain gold, silver, lead, zinc, copper and other metals or useful compounds thereof. May 19
7282 G. Hatton, London. Improvements in the manufacture of malleable iron and steel, and in apparatus employed therein. May 19
7283 J. Houlston and M. Croft, London. Improvements in puddling and mill furnaces. May 19
7328 N. S. Burnell, Liverpool. Improvements in galvanising sheet iron or steel, and in apparatus therefor. May 19
7368 R. Chambers, London. Improvements in mill puddling and other furnaces used in the manufacture of iron and steel, and other metals, and for other manufacturing purposes. May 20
7426 A. C. Henderson—From P. L. T. Héroult, France. An improved process for the preparation of aluminium, aluminium bronze, and alloys of aluminium, by electrolysis. May 21
7494 P. C. Gilchrist, London. Improvements in the manufacture of steel or ingot iron by the basic process. May 23
7495 P. C. Gilchrist. Improvements in the manufacture of iron and steel. May 23
7506 The New Portable Electric Lamp and Power Syndicate Co., Limited. See Class XVIII.
7514 C. Akrill, London. An improvement or improvements in chilled grain and steel rolls used in the rolling of iron and steel, and other metallic alloys, which improvement or improvements is or are also applicable to rolls generally. May 25
7519 J. Beleu, London. Improvements in treatment of ores. Complete specification. May 25
7533 F. J. Clamer and J. G. Hendrickson, London. A process of cleaning, preparing, and coating metal plates and other metal surfaces. Complete specification. May 25
7563 F. W. Seaman, Sheffield. Improvements in the manufacture of ingots, bars, and tools of self-hardening steel combined with other steel. May 25
7567 D. Owen, London. Improvements in the manufacture of tin and such like metal-coated plates, and in the apparatus employed therein. May 25
7657 J. Weirich, London. Improvements in the treatment of auriferous minerals. May 26
7730 H. Johnson. See Class XXI.
7761 E. A. Jones and F. F. Jones, London. Improvements relating to the preparation of oxides of iron, and to apparatus therefor. May 27
7785 G. A. Jarvis, Wellington. Improved converter bottoms, plugs or blocks. May 28
7924 W. G. Jackson, London. An improved shield for miners' safety lamps. June 1
7977 R. Marlin, London. Improvements in "pots" employed in coating tin and terne plates, and in apparatus connected therewith. June 2
7998 M. Kennedy and G. Green, Glasgow. Improvements in apparatus for washing ores. June 3
8004 J. Williams, Swansea. Improvements in apparatus or machinery for cleansing terne, tin, or other plates. June 3
8026 E. Dutton, Glasgow. Improvements in and connected with hauling gear for iron and steel works. June 3
8101 J Garvie, jun., London. Improvements in steel furnaces. June 6
8207 H Burrows, London. Improvements in open hearth steel furnaces. June 7
8276 A. L. Dowie, Glasgow. Improvements in treating iron and castings thereof. June 9
8277 W Jukes, London. Improvements in the manufacture of steel and in apparatus connected therewith. June 9
8284 S. P. Thompson, London. Improvements in the electro-deposition of the heavy metals. June 9
8343 W. Pegge, Stoke-on-Trent. Breaking off coals without blasting or wedging. June 10
8347 A. C. Patrick and W. Hunter, Glasgow. Improvements in machinery for bending and for straightening or flattening iron or steel plates or bars. June 10

8426 J. B. Thompson and W. White, London. Improvements in the manufacture of sodium and potassium, and apparatus for the purpose. June 11

8427 J. B. Thompson and W. White, London. Improvements in the manufacture of aluminium and its alloys, and apparatus for the purpose. June 11

8498 L. W. Adamson and W. F. Hall, Newcastle-on-Tyne. Improvements in miners' safety lamps. June 13

8599 E. Walsh, jun., London. An improved method of and apparatus for reducing zinc ores and collecting the metallic zinc therefrom. Complete specification. June 15

8630 W. Muirhead, Glasgow. Improvements in and connected with furnaces for the production of steel. June 15

8705 H. Lawrence, London. Improvements in machinery or apparatus for screening coal, mineral ores, and other substances. Complete specification. June 16

8712 J. Y. Johnson—From A. de Meretens, France. A new or improved process for browning or colouring iron or steel surfaces and protecting them from rust. Complete specification. June 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

8966 D. Owen. Manufacture of tin and other metal-coated plates, and apparatus therefor. June 8

9214 F. F. E. Elmore. Means and apparatus for coating various metal wares by combined electro-chemical and mechanical process. June 1

9345 J. Swift, Sheffield. Apparatus for boring coal, rock, or other mineral substance. May 21

9390 W. B. Ash. Casing for iron and other metals, specially applicable for the metal work of bedsteads and chandeliers. May 21

9432 H. Leipmann. See Class XVIII.

9486 L. Grabau. Production of aluminium and alloys thereof. May 25

9515 D. Davy. Apparatus for moving ingots or blooms into position for passing through the rolls of rolling mills. May 25

9815 J. Pinder and B. Woodcock. Hardening and tempering steel wire. June 4

9919 E. W. Parnell and J. Simpson. Treatment of ores containing sulphide of antimony for obtaining the sulphide in a concentrated form, with any gold or silver present. May 25

9999 T. Archer, jun., and J. Fairley. Means for storing and supplying compressed air for use in mines for ventilating or other purposes. June 8

10185 O. P. H. A. Straube. Method of igniting mining cartridges and discharging firearms. June 11

10594 J. Clark. Obtaining alloys of aluminium with copper or other metals. June 11

11600 A. E. Tucker. Linings of copper, lead, and similar furnaces, and of steel or Siemen's furnaces and steel converters. May 21

1887.

6087 E. D. Wassell. Reducing the point in carbon in steel, and forming a homogeneous weld. June 8

6487 R. L. Short, J. Short, and J. B. Short. A safety lamp for miners. June 4

XI.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

7213 F. Vogel, Manchester. A process for dissolving tallow or other fatty matter in water. May 18

7681 H. J. Haddan—From P. Schroder, Germany. Improvements in apparatus for purifying oil. May 26

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

5960 S. Schofield. Extracting oil from greasy waste, and making same into soap. May 25

6986 W. Sanzenbacher and S. Tanatar. Method and apparatus for distilling fatty acids by means of superheated steam. June 15

XII.—PAINTS, VARNISHES, AND RESINS.

APPLICATIONS.

7159 H. Dell, Brighton. A polish for leather, linoleum, stained floors, furniture, etc. May 17

7376 F. Crane—From J. Hale and W. D. Field. Improvements in lacquers and varnishes. May 20

7377 F. Crane—From J. Hale, United States. Improvements in varnishes. May 20

7521 H. H. Lake—From J. P. Perkins, United States. Improvements in the manufacture of pigment or paint. Complete specification. May 25

7809 G. Harrison and O. Trimming, London. Improvements in the preparation of fireproofing fluids or paints to be applied to textile and other inflammable materials. Complete specification. May 28

8031 R. Gould, London. A new or improved composition for distempering. June 3

8253 F. Crane—From W. D. Field, United States. Improvements in pyroxyline compounds and varnishes, and in the treatment of certain alcohols for obtaining acetates, chiefly applicable as solvents for pyroxyline. June 8

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

10960 M. Benedictus. Material for removal of old paint. May 28

1887.

6323 W. L. Wise—From R. Lehmann. Apparatus for the manufacture of varnish. June 14

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

10987 J. Townsend. Treating hides or skins. June 22

16411 J. H. Lorimer. Apparatus for drying hides, skins, etc. June 8

XIV.—AGRICULTURE, MANURES, Etc.

APPLICATIONS.

7746 T. Darling and J. Ford, Glasgow. Improvements in and relating to machinery or mechanism for breaking, crushing, and grinding phosphate stones and similar hard materials used in the manufacture of manure. May 27

8415 J. L. Wood, London. Improvements in apparatus for distributing "Thanatos" or any other insecticide, moist or dry, on plants, shrubs, etc. June 11

8528 D. McGregor and J. McArthur, jun., Glasgow. Improvements in absorbing moisture from and deodorising fæcal and other refuse matter, and utilising the whole as a manure. June 14

XV.—SUGAR, GUMS, STARCHES, Etc.

APPLICATIONS.

7259 F. Harm, London. Improved process for converting the syrups from sugar manufacture into mono-saccharates. Complete specification. May 18

7813 F. Bosshardt—From G. Bocquet, France. Improvements in the method of filtering and refining sugar. May 28

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

10161 H. J. Haddan—From A. Z. Champy, A. N. Champy, and L. P. Champy. See Class XVI.

10181 M. Strasser. Manufacture of artificial gum. June 15

10873 A. Rossi and C. Hellfrisch. Manufacture of gum. June 22

XVI.—BREWING, WINES AND SPIRITS.

APPLICATIONS.

7190 J. Wallace, London. An improved mode of and apparatus for distilling and maturing alcohols. Complete specification. May 17

7277 J. Takamine, Glasgow. Improvements in the maufacture of alcoholic liquids. May 19

7825 W. T. Ramsden and L. Briant, London. Improvements in the method of, and in means and apparatus for, sterilising beer and other fermented liquids. May 28

7883 A. W. Gillman and S. Spencer. Improvements in the preparation of rice to be used in brewing, distilling, and vinegar-making. May 31

7896 A. M. Coyle, E. F. Andrews, and E. C. Davidson, London. Improvements in distillation. Complete specification. May 31

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

10161 H. J. Haddan—From A. Z. Champy, A. N. Champy, and L. P. Chamy. Treating the Jerusalem artichoke to prepare it for use in distilling, in the manufacture of glucose, and similar industries. June 8

10722 F. Foster. Machinery for charging liquids with carbonic acid gas. June 22

1887.

7190 J. Wallace. Method and apparatus for distilling and maturing alcohols. June 18

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

APPLICATIONS.

A.—Chemistry of Foods.

8008 T. A. Marshall, Glasgow. An improved preparation of farinaceous substances for use as food. Complete specification. June 3

8298 J. H. Lock, London. Improvements in the treatment, preparation, and preserving of certain alimentary substances. June 9

8664 H. H. Doty, London. A process for preserving eggs in the shell. June 16

B.—Sanitary Chemistry.

7392 H. H. Lake—From C. Lortzing, United States. Improved methods or processes and apparatus for the purification of sewage and for similar purposes. May 20

7482 R. de Soldenhoff. See Class II.

7619 C. J. Bühring, London. Improved means to be employed in the purification of water and other liquids, and the preparation and treatment of materials therefor. May 25

7830 W. Macnab, sen., W. Macnab, jun., and D. Donald, London. Improvements in apparatus for separating by subsidence solid matters from the liquids in which they are suspended. Complete specification. May 28

8357 H. Rimmer, London. Improvements in and connected with the manufacture of material for purifying and filtering water, saccharine, alcoholic and other fluids. June 10

8411 J. Hanson, London. Apparatus to be used in the disinfection, deodorisation, and purification of foul matter. June 11

8528 D. McGregor and J. McArthur, jun. See Class XIV.

C.—Disinfectants.

8063 J. C. Mewburn—From J. J. Bate, United States. Improvements in processes for preserving crustacea and certain new and useful chemical solutions of special utility in such connection. Complete specification. June 4

8217 G. H. Bolton, J. R. Wylde, and H. Auer. See Class VII.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1886.

9733 A. Brin. Treating milk for preserving it. May 25

1887.

3091 E. Wylam. Preparation of food for animals, game, or poultry. May 28

6285 A. R. Leerbeck and J. F. Holm. Producing albumen-maltose dietary malt powder for food. June 11

B.—Sanitary Chemistry.

1886.

8144 H. R. Newton. Drainage and drainage works applicable to towns or country districts; and dealing with sewage and waste waters. June 22

9227 J. S. Lawrey. Means for softening and purifying water. May 25

9569 W. Burns. Manufacture of depurating and decolourising charcoal for purifying sewage and other foul liquids, and for decolourising syrups. May 21

10047 W. Astrop. Apparatus and process for solidifying and drying sewage sludge, etc. June 15

10703 E. Sergeant. Furnaces for treating refuse and materials infected with disease. June 22

13313 R. H. Reeves. Construction and arrangement of apparatus for the ventilation of drains, the deodorising of sewage, and disinfecting gases. June 8

C.—Disinfectants.

1887.

6037 R. D. Hunter. Compositions for treating matters having an offensive smell. May 28

XVIII.—ELECTRO-CHEMISTRY.

APPLICATIONS.

7189 W. H. Akester, London. Improvements in secondary batteries. May 17

7317 J. Kynoch and W. Habgood, London. Improvements in reversible electric batteries. May 19

7360 G. C. Fricker, Putney. Improvements in dynamo-electric machines. May 20

7391 J. A. Kingdon, London. Improvements in primary electric batteries. May 20

7396 C. M. Pielsticker—From F. C. G. Müller, Prussia. Improvements in galvanic elements. May 21

7426 A. C. Henderson—From P. L. T. Heroult. See Class X.

7506 The New Portable Electric Lamp and Power Syndicate Company, Limited. D. Urquhart and B. Nicholson, London. Improvements in and connected with electric batteries and lamps suitable for miners' use or for analogous purposes. May 23

7527 R. M. Hunter, London. Improvements in electric motors or dynamo-electric machines. Complete specification May 25

7553 F. George, Dursley. Regulating the electro-motive force of dynamo-electric machines. May 25

7664 L. N. Loeb, London. Improvements in primary batteries. May 26

7745 R. M. Baily, jun., and A. Grundy, London. An improved construction of dynamo-electric machines. May 27

7865 F. George, Dursley. Improvements in dynamo-electric and electro-dynamic machines. May 31

7975 L. C. E. Lebiez, London. Improvements in secondary batteries or accumulators. June 2

8126 P. A. Fichet and A. Nodon, London. Improvements in chlorine batteries. Complete specification. June 6

8145 D. Skrivanow, London. Improvements in galvanic batteries. June 6

8262 W. M. Mordey, London. Improvements in electric generators. June 8

8267 J. A. Timmis and D. Halpin, Westminster. Improvements in the working and controlling of electric currents June 8

8333 J. Takmine, Manchester. Improvements in the method of and apparatus for bleaching paper pulp and analogous substances by electrolysis. June 10

8443 R. McKenzie—From H. Weymersch, France. Improved electrolytes for electric batteries. June 11

8611 H. Edmunds, London. Improved system and means to be used in the supply or distribution and control of electricity for lighting or other purposes. June 15

8701 J. Ross, Glasgow. Improvements in and relating to the production and application of electric energy for lighting or other purposes. June 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

9082 A. R. Upward and C. W. Pridham. Improvements in galvanic batteries and in their application to electric lighting, etc. May 21

9132 H. Leipmann. Process for treating auriferous substances by electrolysis. May 21

7636 D. J. Fitzgerald. Manufacture of negative elements for voltaic batteries. June 8

8379 A. Reckenzaun. Secondary batteries or accumulators. May 25

8842 E. Andreoli. Plates without support, entirely made of active material, for voltaic batteries. June 8

9478 J. A. Fleming. Dynamo-electric machines. June 22

9514 E. H. Desolu. Galvanic batteries. May 25

9708 A. B. Holmes and J. C. Vaudrey. Apparatus for automatically making and breaking circuit for a dynamo charging accumulators; and for use in running several compound-wound dynamos in parallel circuit. June 22

9991 H. Aron. Electric batteries. June 4

10600 J. E. Rogerson, J. G. Statter, and J. S. Stevenson. Electric furnaces or heating apparatus. June 22

1887.

5687 W. P. Thompson—From H. W. Spang. Fusible connections for armatures for electric generators. May 21

6828 E. T. Higham and D. Higham. Regulation of dynamo-electric machines. June 22

6829 P. Jensen—From O. Lugo. Electric batteries. June 11

6869 H. H. Lake—From W. J. Ludlow. Primary and secondary batteries. June 11

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

7226 R. C. Menzies and C. M. King, Glasgow. Improvements in preparing safety paper for cheques or other documents. May 18

7738 The British Xylonite Co., Limited, and L. P. Merrian, London. A novel xylonite celluloid or pyroxylin fabric suitable for making shirt fronts, collars, cuffs, hats, and bonnets; and for other purposes. Complete specification. May 27

7980 K. Klic, London. Improvements in the preparation or treatment of paper for drawing purposes. June 2

8011 W. B. Nation and J. J. Worswick, London. Improvements in the treatment of vegetable fibres suitable for paper-making, spinning, weaving, and other analogous purposes. June 3

8391 J. Craig—From C. J. Stanbold, Saxony. An improved manufacture of bowl-paper. June 10

8591 R. Wood, Glasgow. Improvements in apparatus for straining paper pulp and the like. June 15

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

7901 C. Weygang. Waterproofing and sizing paper and suchlike material. June 8

8118 C. Morfit. Manufacture or treatment of paper. May 21

8193 A. Wilkinson. Manufacture of paper pulp and papier mache. June 1

9358 E. Musil. Preparation of paper for bills of exchange, cheques, etc. June 22

9874 A. M. Clark—From La Compagnie Française du Celluloid. Colouring, or producing coloured designs on, celluloid and analogous products. May 21

9885 R. Kron. Machinery for grinding, mixing, sizing, dyeing, and otherwise preparing materials for the manufacture of paper. June 1

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

7501 P. G. W. Typke, London. The utilisation of by-products resulting from the manufacture or production of certain phosphorus compounds. May 23

8387 J. Tranbe and G. Bolander, London. Improvements relating to the separation of fusel or ethereal oil from substances containing the same. June 10

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

10281 A. Knoll. Process for the production of the ethers of morphincarbonic acid. May 25

10387 A. Knoll. Process for producing methyl-morphin (codein), ethyl-morphin, and the higher homologues of morphin. May 28

XXI.—EXPLOSIVES, MATCHES, ETC.

APPLICATIONS.

7453 T. A. Velschow, London. Improvements in submerged mines and in apparatus for operating or controlling the same. May 21

7603 G. S. Speneer, London. Improvements in and relating to detonating signal apparatus for railways. Complete specification. May 25

7608 H. H. Lake—From Wohanka & Co., Austria. Improvements in the manufacture of explosives. May 25

7730 H. Johnson, London. Improvements in cartridges for blasting coal and other minerals, and for other like purposes. May 27

7742 E. P. Leresche, London. Improvements in or applicable to the exploding arrangements of automatically ignited-submarine mines or torpedoes. May 27

8067 T. G. Hart, Bath. Improvements in explosives for use in firearms. June 4

8109 C. V. Boys, London. A new luminous signal or firework. June 11

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

8736 C. J. D. Oppermann. Detonating fire alarms. June 15

1887.

3920 A. J. Boult—From L. Bagger. Igniting explosive charges and combustibles. May 25

5883 F. W. Smith—From Messrs. Klée and Koecher. Construction of exploding charges or cartridges. June 1

5899 P. M. E. Audouin. Improved explosives, and manufacture of same. May 25

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THE JOURNAL
OF THE
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A MONTHLY RECORD
FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 7.—Vol. VI. JULY 30, 1887. Non-Members 30/- per annum; Members 21/- per Set; Single Copies 2/6.

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NOTICES.

Comment having been made on the delay in reprinting the numbers for January, 1882 and 1883, the Secretary begs to inform those whom it may concern, that the delay is due to the fact that up to the present not more than twenty orders for those numbers have been received. It is hoped that this notification may stimulate those who desire to complete their sets, to make early application with a view to expedite the consideration of the question of reprinting by the Council. Notice is also hereby given that the numbers for January and February, 1886, being exhausted, no orders for those copies, nor for complete sets of Vol. V., can be executed.

Authors of communications read before the Society or any of its Local Sections are requested to take notice that, under Bye-Law 43, they cannot receive the prescribed 50 copies of their communications unless they comply with the condition laid down in that Bye-Law—viz., that they give notice of their desire to receive such copies upon their manuscript before sending it to the Editor. Mention should also be made as to whether the Discussion is to be included in the reprint.

CHANGES OF ADDRESS, ETC.

Sir Wm. G. Armstrong; address letters, etc., in future to Right Hon. Lord Armstrong.

J. H. Beckingham, l/o Royal Insurance Buildings; Messrs. Scott Bros., Dean Street, Newcastle-on-Tyne.

R. Cameron, l/o Blantyre; 31, Westbourne Gardens, Kelvinside, Glasgow.

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J. N. Cuthbertson; address letters, etc., in future to Sir John Neilson Cuthbertson.

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T. W. Lovibond, l/o Newark-on-Trent; Tyne Brewery, Newcastle-on-Tyne.

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L. J. Whalley, l/o Fairlop Road; Ash Villa, Fillebrook Road, Leytonstone, E.

A. Wuth, l/o Ramsbottom; retain all communications until further notice.

Death.

Jno. Williamson, of Jarrow Chemical Works, South Shields—at Lake Como, July 9.

PROCEEDINGS OF THE SIXTH ANNUAL MEETING.

The Annual Meeting was held on Wednesday morning, July 13th, at Eleven o'clock, in the Chemical Theatre of the Owens College, Manchester. The chair was taken by the President, Mr. David Howard, who called upon the General Secretary to read the minutes of the last meeting. After these had been duly confirmed the President read letters of apology for non-attendance from Sir H. E. Roscoe, M.P.; Mr. J. J. Coleman, chairman-elect of the Glasgow Section; Mr. J. C. Stevenson, M.P.; and Sir Isaac Lowthian Bell, F.R.S.

The General Secretary then read the Report of the Council.

REPORT OF THE COUNCIL.

The Council has the satisfaction of reporting that the number of members on the register is 2302, as

SOCIETY OF CHEMICAL INDUSTRY.—TREASURER'S STATEMENT FOR THE YEAR 1886.

Dr.		£ s. d.
To Cash on Deposit (31st December, 1885)	£600 0 0	
Balance at Bank, ditto	141 13 4	
Balance in Secretary's hands ....ditto	11 0 10	
		752 14 2
Annual Subscriptions:—		
3 for the year 1881	£3 3 0	
22 for the year 1885	23 2 0	
2142 for the year 1886	2250 3 0	
1 for the year 1886	0 10 6	
(Only one-half paid on a/c).		
Excess payments............	0 4 2	
Amount paid on a/c of 1887—in error	0 4 0	
19 for the year 1887 (at £1 1s.) ..	19 19 0	
57 for the year 1887 (at £1 5s.) ..	71 5 0	
2245		2368 10 8
Life Composition Fees		195 0 0
Interest on Deposit Account		18 11 7
Interest on Metropolitan Stock............		8 12 6
Journal:—		
Advertisements............	£231 18 10	
Sales	215 10 8	
		447 9 6
		£3791 1 5

Cr.		£ s. d.
By Journal Expenses:—		
Publishing	£1154 10 0	
Editorial	594 11 10	
		1749 1 10
Printing Sundries, etc.		104 11 0
Sectional Expenses:—		
Birmingham Section	£7 5 1	
Glasgow Section	17 13 1	
Liverpool Section	26 7 4	
London Section	57 15 0	
Manchester Section............	46 18 3	
Newcastle Section	21 4 0	
Nottingham Section............	16 1 5	
		223 4 2
Secretary's Salary............		200 0 0
Honorarium voted to Edward Hughes for assistance rendered to Hon. Treasurer in 1885 ..		21 0 0
Office Expenses:—		
Rent............	£60 0 0	
Fires, Cleaning, Attendance, etc.	12 2 10	
Gas	0 6 10	
		72 9 8
Stationery............		28 6 8
Amount paid on account of Expenses in connection with the Inventions Exhibition		14 15 9
Reporting Annual Meeting		2 2 0
Auditors' Fee		5 5 0
Purchase of £396 9s. 9d. Metropolitan 3% Consolidated Stock		395 0 0
Solicitors' Charges		7 17 6
Bank Charges on Scotch and Irish Cheques, etc.		1 16 10
Secretary's Petty Cash:—		
Postage, Telegrams, etc.	£26 19 10	
Sundries............	0 16 6	
Law Charges	0 12 0	
Gratuities	1 11 0	
Expenses of Meeting	2 3 6	
Expenses attending Annual General Meeting	7 2 9	
Stationery, Books, etc.	1 13 10	
Clerical Assistance (issuing Circulars, etc.)	4 4 6	
Carriage of Parcels	0 5 11	
Sundry Travelling Expenses....	0 14 8	
		46 4 6
Treasurer's Petty Cash:—		
Postage, P. O. Orders, etc.	£13 17 7	
Stationery, Office Requisites, etc.	0 14 10	
Carriage on Parcels, Fares, etc.	0 5 3	
Fire Insurance Premium	0 2 6	
		15 0 2
Cash on Deposit (31st December, 1886)	£750 0 0	
Balance at Bank, ditto	134 11 11	
Balance in Treasurer's hands ditto	21 11 0	
	906 2 11	
Less Amount owing to Secretary (31st December, 1886)	1 19 7*	
		901 3 4
		£3791 1 5

* In addition to this there is an amount of £396 9s. 9d. Metropolitan 3% Stock, invested in the names of Mr. David Howard and Mr. E. R. Cook.

We have compared the above Statement with the Receipts, Counterfoils, Vouchers and Books of the Society, and certify it as correct.

23, St. Swithin's Lane, London, E.C.,
18th February, 1887.

THEOBALD BROS. & MIALL,
Fellows of the Chartered Accountants.

STATEMENT OF REVENUE AND EXPENDITURE FOR THE YEAR 1886.

REVENUE.			£ s. d.
Annual Subscriptions:—			
1 for 1886 in 1884		£1 1 0	
36 for 1886 in 1885		37 16 0	
2143 for 1886 in 1886		2250 3 0	
1 for 1886 in 1886		0 10 6	
14 for 1886 in 1887		14 14 0	
*2195 Excess payments		0 2 2	
			2304 6 8
13 Life Composition Fees		195 0 0	
Interest on Deposit Account			18 14 7
Interest on Metropolitan Stock			8 12 6
Journal:—			
Sales—Received	£203 1 11		
" —Owing	8 11 8		
		£211 13 7	
Advertisements—Received	£168 19 10		
" —Owing	61 9 3		
		230 9 1	
			442 2 8
			£2773 16 5

EXPENDITURE.		£ s. d.	£ s. d.
Journal Expenses:—			
Publishing—Paid	£1057 7 2		
" —Owing	104 1 1		
		1161 8 3	
Editorial—			
Editor's Salary	200 0 0		
" Expenses—Paid	38 9 7		
" " —Owing	18 4 10		
Sub-Editor's Salary	60 0 0		
Abstractors'—Paid	79 12 4		
" —Owing	88 6 6		
Indexing Journal	25 0 0		
Foreign Journals, etc.	14 16 6		
Loan of Blocks, etc.	2 3 9		
Patent Lists	29 18 1		
Secretary's Expenses attending Publication Committees	15 4 0		
Sundries	0 8 2		
		572 3 9	
			1733 12 0
Sundries Printing, etc.—Paid		89 10 10	
" " —Owing		12 15 3	
			102 6 1
Secretary's Salary			200 0 0
Sectional Expenses			223 4 2
Office Expenses—Rent		60 0 0	
" " —Fuel, Cleaning, etc.		12 2 10	
" " —Gas		0 6 10	
			72 9 8
Stationery—Paid		19 5 6	
" —Owing		16 3 3	
			35 8 9
Reporting Annual Meeting			2 2 0
Auditors' Fee			5 5 0
Bank Charges			1 16 10
Secretary's Petty Cash			42 13 10
Treasurer's Petty Cash			15 0 2
Balance of Revenue over Expenditure			339 17 11
			£2773 16 5

Memorandum. 30 Subscriptions for 1886 owing not included in above.
Journals in Stock:—10,800 Nos. value £— "First Proceedings," value £—

SOCIETY OF CHEMICAL INDUSTRY.

CASH STATEMENT.

	£ s. d.
Cash on Deposit	1000 0 0
Balance at Bank	445 18 9
Cash in Hand	55 0 0
	£1500 18 9

35 Life Composition Fees and £500 from Deposit Account invested in 3 Metropolitan Stock .. £1039 10 4

2031 Members have paid Subscription for year 1887.
174 Members owe Subscription for year 1887.
25 Members owe Subscription for year 1886 (*not included in above*).
38 Members have now paid a Life Composition Fee, 9 having paid since the last Annual Meeting.
213 Members have been elected during the past 12 months, 15 of whom have not yet paid Subscriptions.

Bow, E.
30th June, 1887.
EDWD. RIDER COOK.

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compared with 2271 at the last Annual Meeting. During the year 213 new members have been elected, and 182 members have been removed by death, resignation and other causes, showing a net gain of 31. Having regard to the continued depression in the Chemical Industries, and the raising of the Society's subscription to 25s., this progress, though small, is a matter for congratulation.

Among those whose death we have to record are Professor Ripley Nicholls, of the Massachusetts Institute of Technology; Colonel Sir Francis Bolton; M. Emile Leroy, Director of the Alkali Department of the famous Glass Works of St. Gobain; Mr. G. T. Chinnery, killed by a disastrous explosion at the Redheugh Tar Products Works in December last; and Mr. J. M. Roberts, of the well-known firm of Roberts, Dale & Co., of this city.

The papers read before the various Sections show a further increase this year. Manchester heads the list with 29, London 21, Glasgow 19, Liverpool 13, Newcastle 8, Nottingham 4, and Birmingham 4; making, together with three communications, a total of 101, as against 82 last year.

On the 30th of October last the Council affirmed the desirability of giving information in the columns of the Journal on foreign statistics, alterations in tariffs, customs regulations, patent laws, and new openings for trade. Accordingly the first Trade Report appeared in November, and has been continued from month to month ever since. The Council would welcome any suggestions tending to increase the value of these reports.

In consequence of joint representations from the Committees of the Glasgow and Manchester Sections, it was resolved in January last to meet in Manchester this year in order that members might have an opportunity of visiting the Royal Jubilee Exhibition, and to defer the meeting in Glasgow until next year, when there will also be an exhibition in that city.

In February, at the request of Sir Frederick Abel, the Council empowered the President, in concert with the Presidents of the Chemical Society and Institute of Chemistry, to take action in furtherance of the scheme to found the Imperial Institute, and an appeal was made to the members at large for subscriptions in aid of the project. The Council trusts that the Imperial Institute will be successful in promoting the happiness and prosperity of the people of the British Empire.

In the same month it was determined to refer the question of the spirit duties and their effect upon the Chemical Industries to the General Purposes Committee. The Council invites members to render such assistance and information on this most important subject as will enable the Committee to effectively deal with the question.

The Council is happy to be able to report that owing to the increase in the subscription sanctioned last year, together with economy in the publication of the Journal, without in any way detracting from its efficiency, the finances of the Society are in a satisfactory state, as will be seen from the Treasurer's Report. This condition of prosperity, nevertheless, must not induce members to spare a single effort to increase our numbers, both for the sake of the Society and for the good of the Chemical Industries.

Mr. J. Carter Bell moved that the Report be adopted.

This motion, seconded by Professor J. Campbell Brown, was carried unanimously.

The Report of the Treasurer was then read.

The Secretary also read a letter from the Honorary Treasurer, regretting his inability to attend, and stating that financially the Society was in a stronger position: but that, in regard to new members, only 213 had been elected since the last meeting, as against 266 in the corresponding period of 1885 and 1886. He also urged members to endeavour to induce their friends to join the Society, so as to maintain the rate of increase.

ELECTION OF OFFICERS AND COUNCIL FOR THE ENSUING YEAR.

The scrutineers appointed to examine the Ballot Lists were:—Dr. Bailey, Mr. Wm. Thomson, Mr. F. Baden Benger, and Mr. Batty. Whilst the votes were being counted the President delivered his Address.

THE PRESIDENT'S ADDRESS.

In past years the Presidential Addresses have been, in most part, devoted to the study of some one branch of chemical industry, and it would be difficult to find monographs, more fully and clearly setting forth the progress which has been made in recent times in the various branches of industry with which they have dealt. If we wish for information on the sudden development which has taken place in the science of explosives, after remaining almost stationary since the time of Friar Bacon; or on the varied interests of the great soda industry, the earliest and most important of the great chemical industries; or on the magic art which has transformed what was but the waste of the gas-works a short thirty years ago, the despair of the utilitarian chemist, the very type of hopeless waste, into a marvellous chromotrope of colours of ceaseless variety, giving a practical meaning to the labours of Hofmann on the ammonias, of Kekule and others on the benzol hexagon, that in their untiring efforts for pure knowledge they never dreamt of,—we cannot do better than turn to the pages of our Journal, and in those addresses trace the progress of these great industries.

I do not propose to adopt the same course, or to attempt to deal exhaustively with one subject, but rather to consider less profoundly, but more widely, the scope of our Society and its operations, not indeed attempting to exhaust the subject, for I am proud to feel that it is far too wide to be included in one short address.

It would be difficult to avoid a certain discursiveness, with the admirable illustrations of the varied progress of chemical industry that are afforded us by the Exhibition we see here. It is true that the last fifty years have not seen the first beginnings of by any means all the branches of these industries, but there are few in which that period has not witnessed new departures of progress, which in very many instances have created new industries rather than merely improved the old. Yet, when we study these varied illustrations of the progress of applied chemistry, we must at once be struck by the different stages which have been attained. There is first the purely empiric stage, where science has no part, but where ruled supreme the art and mystery of the trade, to use the term so familiar in old time, and so expressive of the stage arrived at.

Do not let us undervalue this stage, it is marked throughout by perfection of individual skill, the processes were indeed often imperfect and wasteful, handed down from one to another by laborious apprenticeship, the teacher not knowing himself the secret of his own skill; and yet for all that, the result was often all that we can hope to attain with fuller knowledge and accumulated experience. It is a true sense of the real meaning of this word art that has led those whom we now call artists to steal the word for themselves alone, leaving us, who have as much need as they of true art in our work, with no word to express it; and this is all the more to be regretted, as the alternative word craft has fallen as much in society as the other has risen. The mischief is done, and it is in vain for a Carlyle to tell us, however vigorously, that every maker is indeed a poet, or to bring back any other lost meaning to a word; yet it is a great evil that we should in great measure, while losing the word, have lost sight of the importance and dignity of the art of manufacture, for indeed in the linking of that art to science, instead of to mystery, lies the true hope of advancement in our work.

It is well, therefore, to bear in mind how these excellent results were attained, that we may not lose what is well worth preserving in the industry of the past, while making the fullest use of the opportunities of the present. It is indeed difficult for us fully to realise what it must have been to carry on an investigation with no science to direct its course, or to give any certainty to anticipations as to what lines of research were worthy to be followed out, and where we might hope for successful results, and without even in the simplest matters any certainty *à priori* that a result must of necessity be impossible.

There is indeed much of guess work in the earlier stages of an investigation now, but then there was nothing else, nothing but patiently feeling the way by the simple process of trial and error, till the instinctive judgment born of experience alone, by a process of unconscious cerebration that it is impossible to trace, has laboriously felt its way to its goal.

There are few more curious mental problems than this unconscious reasoning upon long experience. It is often unerringly true as long as it remains unconscious, yet if the possessor of it tries to explain his skill, his attempt will in most cases be so wide of the mark as to throw doubt upon his possession of any skill at all. A shepherd can often guess with surpassing accuracy what the weather will be, yet ask him why he says it will rain, and he will, if wise, give no answer; if he does it will probably be misleading. We hear much of poisoned wells in the histories of the epidemics of the Middle Ages, or indeed in those of the late outbreak of cholera in Italy. The instinct was right, the wells *were* poisoned, but by dirt, not by malice.

It is easy to multiply examples of results of marvellous excellence, attained by this laborious process of unaided experience, in the most varied branches of human workmanship—results so excellent that applied science cannot hope to do more than imitate the materials and workmanship. Damascus blades or early Nankin china are still the standards beyond which we have not progressed; and artistic skill cannot emulate the perfection of Greek statuary, nor can all our anatomy teach a truer knowledge of the possibilities of the human form, than had the unscientific Greek; and great as is our progress in knowledge of applied mechanics, and of the strength of materials, our architects cannot try bolder flights than those of mediæval architects with experience alone to guide them.

Perhaps some of you may think that we have so far outgrown this elementary stage of progress upon which I have dwelt, that it is but a waste of time to study it, but I am sure that just in proportion as we study the later developments of progress we shall see that through them all there has been need for the same patient care that inspired the workers of the past. Doubtless just in proportion as our science is complete and perfect, we can dispense with the laborious processes that led to progress in the pre-scientific stage, but we never shall reach a point where we can dispense with careful and accurate application of science.

The next stage of development in which the general outlines of science having been grasped, and what we now consider the merely elementary laws of combination and substitution, of simple and double electric affinity as they were then called, were placed at the service of the practical man, and when analysis had become a science and not mere guess work, was naturally a most rapid one. From this stage, manufacturing chemistry, as we now understand it, may be said to begin. It is well worth studying the chemical literature of that period, to appreciate what a flood of light science poured upon those who had been groping in the dim twilight. We assume the law of atomic proportion as the simplest matter of course, yet a life-time has hardly passed since Dalton's enunciation of his law.

All seemed plain, then, in practice as in theory, yet in spite of the great advance there was a need almost as great as ever of the patient observation and experimental verification of even the simplest matters. The practical man had then, for example, as the student has now, to find out that soluble and insoluble are at best relative terms (if, in fact, there be such a thing as insolubility), and to work out with infinite patience all that mass of practical knowledge which we daily take advantage of.

Perhaps no branch of industry suffered a greater check in its scientific development than agriculture. Here, at any rate, all seemed clear—burn the plant, analyse the ashes, add the right constituents to the soil; nothing could be simpler—yet the life labours of Gilbert and Lewis have not yet fully solved the problems that seemed to less thoughtful minds so simple. But the failure in practice of much that claimed to be the teaching of science has added to the prejudices apparently inherent in the agricultural mind, and undoubtedly retarded the adoption of real improvements.

Very many of the chemical industries have not advanced beyond the stage in which elementary rather than advanced science is taken advantage of, and in all these there is evidently great scope for progress; in some, on the other hand, all the resources of science have been brought to bear, and progress must be looked for in science itself before we can expect it in practice. Perhaps the most brilliant example of such full application of scientific research is to be found in the great colour industry. If we study the pages of abstracts in our Journal under the head "Colouring Matters, Dyes," we may be inclined to ask if all this is really industrial chemistry, or if much of it is not pure science of no practical interest, yet great pains are always taken to include nothing that is not either actually of practical value or promising to be so.

As a study of industrial progress we must remember that here, too, most admirable results had been attained before the aid of science was called in. The old craftsmen who practised the art and mystery of dyeing, with madder-red or lac, achieved results as brilliant and even more permanent than their scientific successors, and we can make no greater mistake than to suppose that even in this art nothing is now needed but the mere appropriation of scientific research. If anyone were to imagine that nothing was needed but abstract science to prepare the varied colours that meet the ever varying demands of fashion, he would need but little experience to find that, on the other hand, the scientific craftsman succeeds just as much as he preserves all that was valuable in the older system, accurate knowledge of manipulation, patient study of the effect of small and apparently trivial variations of a process, and, above all, that chief characteristic of genius, an infinite capacity of taking pains. The seeming facility of the adept is the fruit of the profoundest study of applied as well as of pure science.

In urging forward, therefore, in the path of scientific industrial progress, which we are bound to do till in all branches of industry all scientific progress is fully appreciated; while valuing most fully the advantages afforded us by science, we shall ever do well to avoid what is perhaps a natural inclination to regard with a feeling akin to contempt the long experience treasured up in traditional rules. Exactly the same process of careful induction and verification is needed in the application of science to practice, as in the developement of science itself; we must never regard the work of the scientific chemist as the terminus *ad quem*, but as the terminus *a quô*, and starting therefrom we must work out for ourselves the application, all the more carefully if the way seems perfectly plain.

Let no student suppose that the knowledge, however perfect, of theoretic results, or practical results either, will ever make him a practical chemist, unless he has learned the method of research as well as the results of research.

The experience of practical life is but too full of instances where, even though the scientific aspect of a problem seems quite plain, some unnoticed, or, it may be, undiscovered factor, upsets all our calculations, and we have need of all our patience to work out our seemingly simple problem. And instances numberless abound also where scientific knowledge is yet imperfect, and where we need all the teachings of long practical experience to enable us to make progress. Yet it is on this borderland between the known and the unknown that applied science can in the future hope to gain the greatest triumphs, and it is just here that scientific training and research, at once scientific and practical, can most avail. But the first requisite of progress here, also, is the fullest and most careful study of what is found by experience to give practical results; devoting our science to understand practice rather than attempting too soon to make practice fit with science.

The great danger to the modern student lies in the very fulness of knowledge ready to his hand. There is no small risk that some may devote all their energies to merely acquiring knowledge, and falling into the snare of imagining that a living dictionary of science, pure or applied, is a practical chemist. The knowledge of the work of others is often sufficient to enable a student to pass examinations brilliantly, but will not in itself enable him to undertake practical work; it may even be an evil to him by producing an arrogant habit of mind, leading him to think, if I may quote the words of a well-known epigram, that "what I know not is not knowledge," and that if facts do not fit with his theory they must be made to do so. It were better far for him to have learned how to work for himself, even if he had learned less of the work of others.

We must bear in mind, moreover, that applied chemistry is never pure chemistry; the application of theoretic knowledge involves invariably questions of physics and mechanics, and the study of these is almost as much a part of chemical industry as is that of chemical science itself. In fact, very often the successful development of chemical theory in practice is entirely a question of these allied branches of knowledge.

The production of pure iron might seem a purely chemical problem, yet in the great strides that have been made in that direction, chemistry seems to fall into the background. The successful working of the Bessemer process involves not merely most interesting and obscure problems of chemistry, but even more of physics and thermo-chemistry, and is itself a triumph of engineering skill; while in the Gilchrist-Thomas process, which has given the full development to Bessemer's discovery, the apparently easy, yet most difficult, problem of burning off phosphorus is solved by an application of chemical engineering in the basic lining of the converter, the simplicity of which is the highest proof of genius.

It would be easy to multiply examples. I will only add one that has recently come under my observation in the Brin process for producing pure oxygen by the use of baryta as a carrier, where the whole question of success turns upon the engineering rather than upon the merely chemical side of the question. It is hardly necessary to point out how great an advantage to chemistry a supply of pure oxygen at a reasonable price must prove, if the process, as appears to be demonstrated already, is capable of ready and economical application.

A glance at the variety of the products in the Chemical Section of the Exhibition shows how wide a field is now claimed for chemistry, and yet even the most careful classification cannot include all the directions in which chemistry has found or should find an application.

Even the twenty-four heads under which the abstracts in our Journal are divided, do not always include readily all the subjects that belong to us, yet even in those industries which are undoubtedly within our field, we find not a few branches where as yet chemistry is but imperfectly applied, where still the empiric stage has hardly yielded to strict science, and others where processes really chemical are carried on without even the attempt to bring science to bear upon them. We ought not to rest content till scientific study and scientific practice has pervaded every industry where chemical action is involved, and though this may seem to open up an over-wide field, where can we stop short of such a claim?

It is true that the statute law gives us a simpler, if narrower definition of a chemist, and visits with pains and penalties every one who so calls himself who has not passed the due examinations prescribed by law for those who practise pharmacy. The very fact that the name of chemist has been monopolised by the wisdom of our Legislature for those practising one branch—the most ancient indeed, but certainly not the only branch of the science—is a curious proof how little this all-embracing character of chemistry was recognised, even as late as the date of the Pharmacy Acts. Such a claim is not even historically accurate, though it has its origin in the history of our science. The older chemists had a wider field, and they aimed at gaining wealth as well as health for the adept, and for generations, countless lives were spent in the twofold searches for the elixir of life and the philosopher's stone, and though often we seem to find but one object of search, it is only when imbued with quaint mysticism, they held that one supreme medicine must suffice to heal the diseases, and refine the constitution of the macrocosm and of the microcosm alike; turning imperfect copper into royal gold and sick lead into healthy silver, by the same power that could give back health and strength to suffering man.

We as the inheritors of their accidental successes, though we have outgrown their system, and have a truer knowledge of the workings of nature, can yet ask no wider field of aspiration than the health and wealth of mankind, and thus we find their objects most comprehensively embrace all of ours—at any rate, if we take them in a Benthamite sense, as the wealth and health to the greatest possible number;—the practical applications of the science of explosives, for instance, from the time of Roger Bacon to our own, has not always tended to the health of the individual.

As, however, our alchemical predecessors found the human constitution less refractory than that of the metals, the art of the chemist came to be regarded almost exclusively as applicable to the productions of powerful medicinal agents, and the value of his labours in dealing with inanimate nature was for a time almost forgotten. In spite, however, of parliamentary draughtsmen, our science has made good her claim to provide for the wealth as well as for the health of mankind, and it is most encouraging to see in how many directions the energy of the local sections of our Society reflect the many-sidedness of science. Of the importance of the papers that we owe to that energy there can be but one opinion, and time would fail me to review, even hastily, all the subjects dealt with. I can but touch upon a few as illustrating the wide scope of applied chemistry, and the methods by which progress has been secured.

Though we may not acknowledge the claim of pharmacy to monopolise chemistry, there can be no doubt that pharmaceutical progress is chiefly to be won by the assistance of chemistry. The work in this direction is no doubt chiefly done by those who devote themselves to pharmacy, and it is in the pages of the journals specially devoted to that subject that we must seek for the record of it. But though it would be an unnecessary repetition to reprint in our Journal what is already accessible to those interested, we have a right to regard that work as part of the subject that we are dealing with. There are few subjects more interesting either to the scientific or to the practical chemist than the active principles of plants. It is true that their investigation is beset with difficulties, the delicate structure of their complex molecules calls for the most careful manipulation in dealing with them, while the properties of many of them render their isolation and study a matter of the greatest difficulty, yet their study is of the highest theoretical interest and practical use. There are few more important needs of the pharmacist than accurate methods of analysis to enable him to standardise the drugs he employs, accurate observation and botanical knowledge may determine with certainty the authenticity of the drug and its condition and probable value; but such knowledge is rather qualitative than quantitative, and in many, or indeed most, instances the most accurate observer can but guess at the relative strength of a drug without analysis. Where accurate methods of analysis have been brought to bear, it is most surprising how very greatly the active principle of a pant varies. It is hardly necessary also to point out the great importance of this analytical study of all cultivated medicinal plants, to guide the grower in the choice of plants and methods of cultivation much has been done in this direction, but much more remains to be done, as also in the separation of active principles that they may be administered without the needless, or even harmful, accompaniments that must be found in the simpler galenical preparations. The study of the natural alkaloids in particular, has not only enriched science with a class of bodies of endless interest and opened out fields of research of the highest promise, but has been of the greatest practical benefit to the human race. I would specially recommend to the notice of those interested in these questions the very valuable paper on the alkaloids, communicated to the London Section by Professor Armstrong, which gives in a concise form much of the latest developments of knowledge of these bodies, and of the light thrown by recent researches upon their constitution. Owing to the great complexity and ready destructibility of these molecules, their synthesis appears so far to have eluded research except in the case of coneine, though there has been a partial success in other cases, as in the methylisation of morphia and benzoyl ecgonine forming codeine and cocaine respectively. Researches in this direction are of the highest theoretic interest, but whether they will ever bear fruit industrially in the production of the natural alkaloids is another question. When we see what can be done by skilful cultivation, guided by analysis, in increasing the alkaloidal contents of certain plants—in the case of the cinchonas, for instance, some of the Java barks yield 10 per cent. and upwards of quinine—it must be doubtful if the synthesis in the laboratory of nature may not prove more economical than that which can be effected in the laboratory of the chemist. Indirectly, indeed, such researches have already borne fruit in the discovery of a class of alkaloids not found in nature, but possessing therapeutic properties peculiar to themselves and of high value.

Another branch of this subject treated of in the same paper is of the highest interest. No branch of modern science has proved at once more fascinating and more fertile in results than that of micro-organisms. Our conceptions of decay and putrefaction have undergone a fundamental change, and what wise men guessed as to the nature of disease have proved to be certain truth. The result of these researches, moreover, has brought the question within the scope of both theoretical and applied chemistry. Not only does this consideration of these organisms indirectly govern all considerations of sanitary chemistry and of the preservation of food, but we find that among them are potent chemists transforming harmless bodies into terribly poisonous alkaloids, and in the case of pathogenic organisms of disease, acting on the human frame not merely by their presence, but by the chemical changes that they bring about. Closely allied to the medicinal applications of chemistry is that of the water supply, not all great towns and still less all villages are as fortunate as Manchester in natural sources of supply, or as much in earnest to obtain the best. The question is not merely one of engineering, as would seem to be the official idea, if we may judge from the qualifications of those appointed as water examiners, nor even of chemical analysis, great as is the progress made in that branch of science, but also of the chemico-biological problem of the organisms present and their results. In our Journals we have most interesting accounts of work done in this direction in the papers of Dr. P. Frankland and of Professor Bishoff, and in the discussions thereon. The subject is yet in its infancy; those who have worked most in the field know best how much remains to be done, but we can already recognise the value of the results obtained, and the promise of a brilliant future for these investigations.

The other end of the question of water supply, the disposal of sewage, has occupied the attention of chemists numberless both within our Society and without. So far the practical aim of the engineers and the chemist is to get sewage safe into the sea, or into a river large enough to take it without notice, with as little chemical treatment as will prevent micro-organisms making their presence too offensively felt. If this is the best we can do it is certainly a reproach to science, but at present the engineers seem unable except in a few cases to cope with the question of irrigation, while the successful precipitation of the most valuable constituents of the sewage seems a chemical problem, almost as hopeless as the philosopher's stone.

Micro-organisms have other claims on the attention of the industrial chemist. The study of fermentation in all its branches, resolves itself more and more into the study of micro-organisms and their life products. Here again we may find in our Journal evidence of what has been done, and may yet be done. It is most interesting here also to observe what accurate results have been obtained by accumulated experience, with no knowledge of the causes at work, though it is needless to point out how impossible improvement must be to those who are bound by mere empiricism, unless they are prepared to face endless failure.

In agriculture, again, we find that the same unnoticed, yet most powerful agents, are at work, and must explain problems hitherto obscure. The papers of Warington, read before the Chemical Society, on nitrifying organisms of soils, gave the history of a research not only valuable in its results, but as a pattern of method, in them we may trace the accurate induction that demonstrated the presence and history of the nitrifying organism with perfect certainty, before ever it had been actually identified, affording an example of indirect evidence of great interest.

Perhaps it is premature to decide whether it is sufficiently proved that to another branch of the same family is due the slow fixation of nitrogen in soil. The question is of the greatest interest; it is difficult to believe that no such process is going on, and that there is no repair of the incessant waste of the nitrogen in the soil, yet the researches of Dr. Gilbert, carried on with the greatest accuracy, have failed to trace any such in the growth of crops.

The great progress which electro-chemistry has made, and is making, affords another instance of most valuable aid already given, and far more promised to chemistry by a kindred science. Electrotype processes of all descriptions have long been worked out, and it is needless to speak of them unless it be to call attention to the interesting development of photogravure. A very interesting paper, read at Nottingham, by Professor Bothamley, giving the results of recent experiments in the use of dyes in correcting the fundamental defect of all ordinary processes of photography, the inaccurate tendency of colours, gives a brief description of the new process of combined photogravure and chromo-lithography, by which it is hoped to solve the problem of photographing in colours, at any rate in part.

The metallurgical applications of the electric current are, however, far wider than the electrotype process. In many cases inventors are working processes not yet divulged, trusting to the protection of secrecy rather than that of the patent law, but there is no doubt that its use in the separation and recovery of metals is capable of most extended application. Great results have also been claimed for the electric furnace, amongst others the cheap production of aluminium. Our past president, Mr. Weldon, whose loss we cannot sufficiently regret, clearly showed that in no other direction can we hope for the direct reduction of that metal; but it remains to be seen if the reduction of the price of sodium by such processes as that of Kestner described by Mr. Mactear, will not be even more effectual in supplying aluminium at a cheap rate. And not only in metallurgy, but in other branches of technical work, the cheapened production of the electric current, which we owe to the attempts to provide economically the electric light, have led to applications in other directions. Much of the work done has no doubt been tentative, but there is no doubt that we have here one of the most promising fields for research.

It has sometimes been remarked that analysis occupies too prominent a position in the Journal. In this view I for one cannot agree; anyone who has had much experience of practical work, knows the value of any method or apparatus that can facilitate the multifarious analyses that scientific processes of manufacture involve, and many of the processes and apparatus described are not merely valuable in themselves, but suggestive of application in other directions. It is no doubt true that too great a multiplication of appliances is undesirable for a student; it is a real misfortune for him to become dependent upon elaborate apparatus, if, as often happens, he finds himself called upon to work with imperfect tools, and when he is called upon, as every practical man must be, to adapt and improve apparatus and processes. To those, however, in charge of technical laboratories, all the information that can be given them in that direction is certain to be welcome.

To turn from the past to the future, amid much that is discouraging in the commercial aspect of chemistry, as in the commercial aspect of most else, there is no small reason for a hopeful view of the future in the evidences of vigorous life in our industries, and of sound method and good work on the part of those who conduct them; that our papers show and we may well hope that the officers and members of the various sections of our Society will show in the future the same zeal as in the past.

Yet there is no easy task before us. The progress of science in one sense makes our work easier no doubt, but on the other hand it demands of us continually increasing efforts to keep up to a standard constantly being raised to a higher level, and it is for us to show that England is not behind other countries in intelligence and aptitude for work. There is need for all our energies to do so. We need, no doubt, the technical education of which so much is talked nowadays, but it must be real and thorough to an extent that many who theorise about it seem to have no idea of; and, above all, we must know what we do want. I fear in many minds there lurks the idea that the technical education of workmen will release their employers from the necessity of thinking for themselves. The technical education of the fingers alone will never make a musician, and unless the heads of industrial concerns are willing to be so in deed as well as in name, that harmonious action on which success depends, is certainly impossible. Without a real scientific appreciation on the part of the head, it is impossible that the scientific training of subordinates can be of much avail.

Of novel ideas there seems no lack; it is rather sound application that we need. The patent law is supposed to give some guarantee of the novelty and practicability of the subjects of the patents granted, and the publications of the office show a ceaseless flow of invention, much of it really novel (though it does include preserving eggs with lime water, or lubricating the bearings of machinery with decomposed cabbages), yet of all this novelty, such as it is, no small portion is, as far as I can judge, never heard of again, beyond the stage of the blue pamphlet or the notices in our own or similar journals.

It is surely rather to that practical working out of ideas, whether new or old, of which we have been speaking, that we must look for progress, than to mere fertility of invention. Of that there may be the same abundance that there is of seeds in nature, which yet never can come to maturity without the needed seed bed and the farmer's fostering care.

VOTES OF THANKS.

Prof. Dewar moved that the hearty thanks of the Society be accorded to the President, Mr. David Howard, for his address. He added, with reference to the President's remarks upon the synthesis of conia, that during the last few weeks two French chemists had succeeded in synthesising the complex alkaloid of *Jaborandi*—viz., pilocarpine.

Colonel Gamble seconded the motion, which was carried unanimously.

The President replied, and then read the

REPORT OF THE SCRUTINEERS,

showing that the following had been duly elected Ordinary Members of the Council for the ensuing year:—

John Calderwood, F.R.S.E.
Eustace Carey.
R. Forbes Carpenter.
James Duncan.
Dr. John Evans, F.R.S.
S. H. Johnson.
John Pattinson.
B. S. Proctor.
F. J. Rowan.
Dr. Edw. Schunck, F.R.S.
T. W. Stuart.
Lewis T. Wright.

And that the nominations of Council for President, Treasurer, Foreign Secretary, and Vice-Presidents had been duly confirmed.

The following is therefore the composition of the Council for 1887—1888:

President.

Prof. James Dewar, F.R.S.

Vice-Presidents.

Prof. F. Clowes, D.Sc.
Sir J. Neilson Cuthbertson.
David Howard.
Dr. Ferdinand Hurter.
Ivan Levinstein.
E. K. Muspratt.
Dr. W. H. Perkin, F.R.S.
Sir H. E. Roscoe, M.P., F.R.S.
John Spiller.
Prof. W. A. Tilden, F.R.S.
John Williams.
Philip J. Worsley.

Members of Council.

John Calderwood, F.R.S.E.
Eustace Carey.
R. Forbes Carpenter.
James Duncan.
Dr. John Evans, F.R.S.
S. H. Johnson.
John Pattinson.
B. S. Proctor.
F. J. Rowan.
Dr. Edw. Shunck, F.R.S.
T. W. Stuart.
Lewis T. Wright.

Treasurer.
E. Rider Cook.

Foreign Secretary.
Ludwig Mond.

The President then proposed the re-appointment of Messrs. Theobald Bros. and Miall as Auditors for the ensuing year. The proposal was seconded by Mr. S. H. Johnson, and carried unanimously.

On the motion of Mr. Alexander M. Chance, seconded by Dr. D. B. Hewitt, a vote of thanks was accorded to the Treasurer and Officers of the Society, and the Chairman and Secretaries of Sections.

Mr. Ludwig Mond and Mr. Chas. Hunt replied.

On the motion of Mr. E. K. Muspratt, seconded by Mr. Ivan Levinstein, a hearty vote of thanks was given to the Council of Owens College for granting the use of the Chemical Lecture Theatre for the purposes of the meeting.

THE NEXT ANNUAL MEETING.

Mr. G. G. Henderson, as Secretary of the Glasgow and Scottish Section, then formally invited the Society to hold its Annual Meeting for 1888 in Glasgow.

On the motion of Prof. J. Campbell Brown, seconded by Prof. F. Clowes, it was resolved to accept with hearty thanks the invitation from the Glasgow Section.

VISIT TO THE ROYAL JUBILEE EXHIBITION.

In the afternoon, and indeed immediately after the conclusion of the proceedings in the morning, most of the members visited the Exhibition, in the Chemical Section of which they found one of the finest collections of the kind ever brought together. Nor was it to be wondered at that a high degree of interest should be felt by members of the Society of Chemical Industry in the Chemical Section of the Exhibition, for the arrangement and classification of the exhibits is such as to appeal at once both to their understanding and sympathy. The reason of this is not far to seek, for does not the committee of the Chemical Section of the Exhibition contain two of the Vice-Presidents (Mr. Levinstein the chairman, and Dr. Schunck), the Editor of the Journal, with the Secretary of the Manchester Section of the Society, and are not all its members members of the Society of Chemical Industry? It may be fairly claimed then that what success the Chemical Section of the Exhibition has achieved, is a triumph not only for the Committee of that section, but for the Society of Chemical Industry. The collection of the relics of great discoverers, and of their discoveries in the fields of chemical and physical science, made for the Exhibition Section by Mr. Watson Smith, created much interest. There were to be seen the battery, at least a part of it, with which Davy decomposed the alkalis, and his note-book, in which the record of the isolation of the alkaline metals could be read; the gases liquefied for the first time by Faraday, enclosed in sealed tubes, and his note-book opened at the place where the record of this remarkable discovery occurs; and, exceedingly interesting for Manchester and its neighbourhood, the specimen of the very first benzene isolated by Faraday, and the apparatus with which Joule determined the mechanical equivalent of heat. When it is added that there also was to be seen the manuscript of that page of Dalton's "Principles of Chemistry" which contains the table of his original atomic weights: the penny earthern inkpots and soda-water bottle he has converted into classic relics, and the original lamps which Davy constructed when feeling his way, with high-minded benevolence and scientific skill, towards a solution of the terrible problem which in those days forced itself to the front in men's minds—how to save from wholesale destruction those who laboured in the bowels of the earth to provide means of warmth, comfort, and light for their fellows—the question may be fairly asked—"Was not a sight of these things well worthy of a pilgrimage to Manchester?" Then, turning to more modern times, we have exemplified by specimens, dyed and printed fabrics, and picture representations, the researches which in their several directions have done much to keep the name of England in the front, as that of the land in which the first springs of chemical science, as applied to the chemical industries more especially, have arisen, whatever may be said of after developments and advances. It is only necessary to mention the names of Perkin, Griess, Schunck, Roscoe, Schorlemmer and Dale, to indicate sufficiently to chemists what mainly was to be seen in this interesting collection. It is a fact, and one worthy of some thought and consideration for the country, when the urgency of the special study of technical chemistry is in many cases so prematurely pushed, that the teaching of the applications of chemical science to the industries is demanded before the knowledge of the science itself is acquired, or anything approaching it,—that neither Perkin nor Griess were searching for colours or dyes when they obtained those results, which make them respectively the originators of the aniline- and the azo-colour industries. These chemists were both investigating the constitution of certain organic bodies, and were so far exploring the realms of abstract scientific truth, when with one and the same stroke there came with the practical refutation of their theories as first entertained, new revelations with a more tangible reward.

THE ANNUAL DINNER.

The annual dinner of the members of the Society of Chemical Industry was held in the Palm House of the Exhibition, and a little after six o'clock about 150 gentlemen sat down, Mr. David Howard, the retiring president, taking the chair. He was supported by the President-elect, Professor James Dewar, F.R.S.; Messrs. E. K. Muspratt, Ivan Levinstein, Dr. Hewitt, Ludwig Mond, Dr. Hurter, J. T. Brunner; Hy. Brunner, Prof. J. Campbell Brown, Mr. Alex. M. Chance, Mr. E. Carew, Mr. J. Brock, and Prof. F. Clowes.

The usual loyal toast, "The Queen," was given by the Chairman, in a speech in which he mentioned that those who had studied at the College of Chemistry in London in earlier days could appreciate how much the Queen, in conjunction with the late Prince Consort, had fostered chemical science, and that he was glad to think that the Prince of Wales also took a deep and practical interest in all scientific matters. The toast having been duly honoured, the next, "Prosperity to the Society of Chemical Industry," was then proposed by Mr. J. T. Brunner, who said he knew that the Society had done and was doing an immense amount of good. He was much pleased to know that his old friend, Prof. Dewar, was to be their president during the next year, and he was sure they could not have made a better choice.

Professor Dewar replied, and referring to his election, thanked the members for their recognition of the recondite side of chemical science. That Society had been founded, said he, not for the benefit of a class, but rather for the purpose of blending the classes of chemistry together; the manufacturing branch, on the one hand, and the abstract on the other. From the past history of the Society, its recognition of all classes in the disposal of its honours, and more on account of the unity which the members showed and the quality of the work produced, he was sure that its future was safe. He referred especially to the paper recently contributed to the Liverpool Section, by Dr. Hurter, which he considered to be a most admirable example of research and reasoning. He was not disposed to consider ominous the shifting—the apparent instability of science. They were merely moving on to higher things, getting nearer to the truth.

Dr. Hewitt then proposed the health of the President, whose name had been familiar to him since he was a boy. And now amidst advancing years, he knew that Mr. David Howard had a lineage and was connected with a firm foremost in making this country famous for the manufacture of fine chemicals.

Mr. Howard, replying, said that the Society was doing an amount of work which could only be appreciated by those who knew the difficulties which past generations of chemists had to contend with.

Mr. Tyrer next proposed "The Local Sections." He said that if that Society was anything it was democratic; but the elements of a thorough, sound and healthy Republicanism were there. He always had faith in its policy, and now, when, greatly through the concerted efforts of its sections, the Society and its Journal—with the life and prosperity of the latter of which that of the former was indissolubly connected and bound up—had undoubtedly become a powerful factor in the industry of the country, all should put their shoulders to the wheel and assist in the onward movement.

Mr. J. Carter Bell responded.

The health of the "Secretary and Editor" were finally proposed by the President.

Mr. C. G. Cresswell, replying, referred to the necessity for permanent quarters for the Society: and later on, Mr. Brunner expressed the hope that something definite would come out of it, if for no other reason than that they should have a room in which the library of the late Mr. Weldon could be placed.

Mr. Watson Smith joined Mr. Cresswell in returning thanks for the good wishes conveyed in the toast; and as he had assumed the direction of the musical arrangements and programme on that occasion, he would take that opportunity of expressing himself musically by playing Schubert's Impromptu in G.

During the evening a selection principally of part songs, by Mendelssohn and Schubert, from the well-known Orpheus series, was most effectively given by a choir of twelve men's voices.

THE EXCURSIONS, ETC.

On Thursday Morning a considerable number of members assembled at the Exchange Station for a trip to Wrexham, to visit the Wrexham Lager Beer Brewery. After an inspection of the brewery the party was entertained at an excellent lunch by the manager. After the repast a vote of thanks to the company was proposed by Mr. Howard, and carried unanimously. The party then returned to Chester, where conveyances were waiting to take them to Eaton Hall, the palace of the Duke of Westminster. After partaking of tea at Eccleston Ferry, the members returned in barges by the river Dee to Chester, and from thence they journeyed by rail to Manchester. Meanwhile smaller parties visited the works of Messrs. Crossley Bros. ("Otto" Gas Engine Factory); of Messrs. Beyer & Peacock, Engineers; Messrs. Kerr and Hoegger, Dyers; Messrs. Ermen and Roby, Bleachers; Messrs. Knowles & Co., Print Works; the Buxton Lime Works; Mr. J. Hollingworth; Messrs. I. Frankenburg, India-rubber Works; Messrs. Haworth & Co., Cotton Spinning; Messrs Chadwick & Taylor, Paper Works; Salford Sewage and Gas Works; and the *Guardian* newspaper office.

On Friday Morning another party was formed for visiting Chapel-en-le-Frith and Castleton, in Derbyshire. The members joining this excursion will not soon forget the satisfaction and pleasure it gave them, and the complete success of this, as well as the Chester excursion, were certainly in a large measure due to the indefatigable exertions of Mr. J. Carter Bell, the local secretary of the Manchester Section, as well as to the all-important circumstance of most propitious weather.

Another excursion was also organised, under the guidance of Mr. Wm. Thomson, to visit the extensive Printing, Bleaching, and Dye Works of Messrs. Ed. Potter & Co., at Dinting Vale, and thereafter the Paper Works of Messrs. Olive and Partington, at Glossop. Some twenty-five to thirty members availed themselves of these opportunities, and greatly enjoyed the combined excursion and visits.

In each and every case the members were received and treated with unvarying kindness by the proprietors of the works thrown open to them, and probably never before in the history of the Society has such a large variety of manufactures connected with the chemical industries been available for inspection at an annual meeting as on this occasion at Manchester.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

Chairman: David Howard.

Committee:

Sir F. A. Abel.
H. E. Armstrong.
W. Lant Carpenter.
W. Crowder.
W. J. Dibdin.
C. Graham.
S. Hall.
C. C. Hutchinson.
R. Messel.
B. E. R. Newlands.
B. Redwood.
T. Royle.
John Spiller.
Wm. Thorp.
J. Williams.
C. R. Alder Wright.

Hon. Local Sec. and Treasurer: Thos. Tyrer, Garden Wharf, Church Road, Battersea, S.W.

The meetings of the London Section will be resumed on Monday, 7th November next.

The last meeting of the Session was held on Monday, 6th June, at the Chemical Society's Rooms, Burlington House, Piccadilly.

THE PRESIDENT IN THE CHAIR.

THE ALKALOIDS—THE PRESENT STATE OF KNOWLEDGE CONCERNING THEM, AND THE METHODS EMPLOYED IN THEIR INVESTIGATION.

BY HENRY E. ARMSTRONG,

Professor of Chemistry in the City and Guilds of London Institute, Central Institution.

Within recent years our knowledge of the alkaloids has increased to an extent and with a rapidity which is perfectly astonishing: a study of the circumstances to which this progress is due, and of the manner in which it has taken place, is in the highest degree instructive to the technologist.

The term "alkaloid," like so many of the generic terms in use in chemistry, is indefinable: literally it means alkali-like, but practically it is restricted to certain nitrogen compounds more or less directly derived from ammonia. It is hardly worth while, however, to discuss where the line shall be drawn; or to which among the almost innumerable alkali-like derivatives of ammonia the privilege shall be granted, or from which it shall be withheld, of appearing in the class of alkaloids: such a question is of importance only to those who may desire to put forward a claim to be the first to synthesise a natural alkaloid.

The vegeto-alkaloids have long been of importance on account of their medicinal and toxic properties. The amines—that group of alkaloids immediately derived from ammonia, with the discovery and investigation of which the names of Wurtz and Hofmann are so inseparably linked—have acquired the highest industrial importance as being the progenitors of a large proportion of modern dye-stuffs. And quite recently we have begun to recognise alkaloids among the products of putrefactive changes induced by micro-organisms, and to regard it as probable that the sufferings provoked in zymotic diseases may, at least to a large extent, be due to the toxic properties of alkaloids thus produced. From this last point of view alone the study of alkaloids is of enormous importance to the human race, our chance of combating the effects of zymotic disease being necessarily dependent on the recognition not merely of the immediate causes of such effects, but especially of the chemical attributes of the alkaloids concerned as well as of their physiological action. It is now many years since *the chemist* Louis Pasteur—to the eternal glory of our science be it said—made clear to all seeing eyes the important functions exercised by micro-organisms throughout the organic world; the study of these organisms necessarily passed into the hands of the morphologist, but the wheel of time is fast going round, and it is daily becoming more and more evident that the next great advance must be the outcome mainly of the chemist's labours. I recommend those who doubt this to study Brieger. Sooner or later also it will be for the chemist to suggest and prepare antidotes to the toxic alkaloids, and in concert with the physiologist to devise means of diverting the activity of disease-producing bacteria into harmless channels; it may even be suggested that the protection afforded by vaccination and by attenuated virus is perhaps in a measure due to alkaloids.[*] Indeed, it is obvious that there is an almost unbounded field awaiting exploitation by chemists, and that abundant opportunity is here afforded them of still further ministering to the public wants.

Having said so much by way of preface, let me also at the outset try to make clear the point of view from which I propose to consider the alkaloids. The various non-metallic elements in the states in which we know them are without exception compound in their nature—*i.e.*, their molecules consist of two or more atoms of the constituent stuffs: and we are as little able to infer the properties of these stuffs from observation of the properties of the elements as they present themselves to us as we are, for example, those of chlorine and sodium from those of common salt. In consequence of our disregard of molecular composition in the case of the elements, we are entirely misled by having become accustomed to speak of the elementary stuff symbolised by N and of its compound N_2 by the same name: hence it is that nitrogen is popularly regarded as the most inert among elements. Probably it is one of the most active: but so great is the stultifying effect exercised upon us in early youth by text-book statements that many will hesitate to accept this proposition. Nevertheless I advance it, and venture to maintain that we gain no idea whatsoever of the properties of nitrogen-stuff from a consideration of those of nitrogen gas or azote—to give it the older and more suggestive name—and that if we desire to determine its properties we must devote ourselves to the comparative study of the alkaloids. If the effects produced by alkaloids were effects produced by the molecules as wholes, we could not expect to deduce the properties of nitrogen-stuff from those of its compounds: but I believe we are justified in assuming that such is not the case, and that in every molecule there are one or more "points" from which the influence is exerted.

In formulating the nitrogen compounds, a difficulty arises owing to the fact that chemists still agree to differ regarding the valency of the element. The popular view at the present day is that nitrogen is a triad in ammonia and the amines, and a pentad in ammonium salts: some few among us—and I am one of these—regard the ammonium salts as "molecular compounds." This is not the occasion to discuss such a question: I refer to it to prevent misunderstanding.

The great majority of vegeto-alkaloids are derivatives of pyridine: before attempting to consider these I desire to direct attention to a group of alkaloids of natural origin, and to the *ptomaines* or alkaloids resulting from the putrefactive change of animal matter.

Trimethylamine alkaloids.—Under this name may conveniently be included four closely related compounds, the names, formulæ and proximate constituents of which are as follow:—

NAME.	FORMULA.	PROXIMATE CONSTITUENTS.	
Neurine	$NMe_3[HO.CH.CH_2]$	Trimethylamine	+ vinyl alcohol
Choline	$NMe_3[HO.CH_2.CH_2.OH]$.	,,	+ glycol
Muscarine	$NMe_3[HO.CH_2.CH(OH)_2]$	,,	+ hydroxyacetaldehydrol
Betaine	$NMe_3[HO.CH_2.COOH]$ ..	,,	+ hydroxyacetic acid

Choline is a constituent of brain matter, but has also been obtained from a variety of other sources. It may be prepared synthetically by digesting an aqueous solution of trimethylamine with ethylene oxide. Neurine has also been separated from brain matter, but it may be prepared from choline, and it is a question whether it is a proximate product of hydrolysis or whether it is not formed from choline during the process of separation. Muscarine occurs, together with choline, in the fly agaric (*Agaricus muscarius*), and may be produced by oxidising choline by means of nitric acid. Betaine was originally separated from the juice of the beet (*Beta vulgaris*), but has since been found in other plants; it may be prepared synthetically from trimethylamine and chloracetic acid, also from glycine, and it is obtained on oxidising choline—with which it is associated in cotton seed, for example—with chromic mixture. It will be obvious, therefore, that a close genetic connexion exists between the four compounds, and this being the case, the differences in their toxic qualities are especially noteworthy. Muscarine, neurine and choline all have a similar physiological action: muscarine, however, is a virulent poison, and so also is neurine, but I believe to a less extent, and choline is a much less active substance than even neurine; I am not aware that betaine is credited with any poisonous qualities. Now, if physiological activity be in any way proportional to alterability in a chemical sense—to the tendency to be acted upon by, or to enter into combination with, or to interact with, other substances, then muscarine should certainly be the most active of the four compounds in question, as it is an aldehydrol (aldehyde hydrate), the reactivity of aldehydes exceeding that of all known compounds. For similar reasons it is to be expected that neurine would take the second place, and choline the third, glycol, which may be regarded as a proximate constituent of choline, being undoubtedly less prone to undergo change than would be (the hypothetical) vinylic alcohol, which it may be assumed is

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[*] Since writing this I have received the Proceedings of the Royal Society, No. 254, which contains a most suggestive "Note on Protection of Anthrax," by Dr. L. C. Wooldridge. Dr. Wooldridge has grown the anthrax bacillus in a culture fluid consisting of a solution of a proteid body discovered by himself, obtained from the testis and from the thymus gland; and he finds that if a small quantity of the filtered culture fluid be injected into the circulation of a rabbit, the animal will not take anthrax. The injection of the fluid in which no anthrax bacillus has grown is without effect, and if the bacillus grown in the fluid be inoculated it either kills or it has no effect. If other albuminous fluids—*e.g.*, blood serum, be used as a culture medium, and the filtered culture fluid be injected, it exerts no protection. Hence, as Dr. Wooldridge says, it may fairly be concluded that the growth of the anthrax bacillus in the special culture fluid used gives rise to a substance which, when injected into the organism, protects against an immediate and subsequent attacks of anthrax. In this note apparently we have the germ of a discovery the practical importance of which it is impossible to exaggerate.

contained in neurine. The very slight difference in composition between choline and either neurine or muscarine is also to be remarked, the withdrawal of the elements of a molecule of water sufficing to convert choline into neurine, while its conversion into muscarine involves but the displacement of a single hydrogen atom by the hydroxyl group. Seeing that many micro-organisms act most powerfully in inducing oxidation, it is obvious that no great margin of safety can be counted on, as choline—or its potential elements exists widely distributed throughout the animal organism.

Ptomaines. Within recent years the attention of toxicologists has been directed—especially by the Italian chemists—to the presence in putrid animal matter of poisonous basic substances, more or less resembling certain natural alkaloids, and which become separated in the course of the treatment usually adopted in the toxicological examination of human remains. The discovery is obviously one of the first importance to the medical jurist, and naturally attracted much attention. Selmi, whose systematic study of the subject entitles him to be regarded as the pioneer in this field of investigation, although he was by no means the first to recognise their existence, has designated alkaloids which result from the putrefaction of albuminous matters as *Ptomaines* (πτωμα—a corpse). The recognition of the production of *ptomaines* during putrefaction was based, in the first instance, on qualitative chemical and physiological tests, and not on their separation in the pure state. Nencki appears to have been the first to isolate a ptomaine, but did himself the injustice of publishing his experiments in a semi-private pamphlet. It is to Brieger, however, that we are indebted for the exact knowledge which we now possess on the subject. His labours, carried on uninterruptedly since 1882-83, have resulted in the discovery of numerous non-poisonous, as well as poisonous, alkaloids, and are of the highest importance, not only to the physiologist and medical jurist, but also to the chemist, on account of the light which they throw on the composition of animal albuminous matters, and on the course of putrefactive changes.

Brieger's researches not only prove that a variety of alkaloids result from the poisonous decay of animal matters, but they establish the fact that ptomaines are formed during the earlier stages of decay, and that they are of a non-benzenoid character; as putrefaction continues, they gradually disappear, and give place to well-known benzenoid compounds—phenol, cresol, hydroxy-acids, indole, etc. In the first part of his collected researches,* Brieger describes the ptomaines produced—(*a*) from putrid horseflesh, beef and human muscular tissue; (*b*) from putrid fish; (*c*) from putrid cheese; (*d*) from putrid glue; and (*e*) from putrid yeast. In every case large quantities of material were taken, and the methods employed in separating the ptomaines were such that, as far as possible, their decomposition was prevented. The same substances were separated from putrid horseflesh, beef and human flesh, but horseflesh gave the largest amounts, and therefore was chiefly used. The products from animal flesh were neurine—the intensely poisonous nature of which has already been mentioned, and a non-poisonous diamine ($C_5H_{14}N_2$), the hydrochloride of which crystallises in well-defined long needles resembling urea crystals. This was named *neuridine*, as it appears to bear some relation to neurine, being resolved into a mixture of dimethylamine and trimethylamine when boiled with caustic soda solution. Putrid fish gave a toxic base of the composition of ethylene diamine ($C_2H_8N_2$) but isomeric therewith; muscarine; a second novel base of the formula $C_7H_{17}NO_2$, which Brieger names gadinine from *Gadus callarias*, the fish used: it appears to be non-poisonous: and, lastly, triethylamine, which had not previously been known to be derivable from any such source. From soft cheese allowed to putrefy for six weeks, he obtained neuridine and trimethylamine. Glue, from which Nencki obtained a collidine by allowing it to putrefy in contact with ox pancreas, gave neuridine in larger quantities than any other material examined, together with dimethylamine and traces of a substance resembling muscarine in physiological properties. Putrid yeast gave only dimethylamine.

In the second part of his collected researches, Brieger describes the results of his examination of the basic products of the gradual putrefaction of human remains, especially the internal organs—viz., the lungs, heart, liver, spleen, stomach and intestines; and he particularly directs attention to the progressive character of the changes. Material taken from corpses which had lain 24—48 hours in a cool cellar gave choline in small quantity, but no other ptomaine. After a slightly longer interval, neuridine was the chief product, only traces of choline being found, and, in some instances, trimethylamine. Putrefaction being allowed to continue for a considerably longer period, the choline was found to have entirely disappeared, three new physiologically indifferent bases being now separable—viz.:

Cadaverine	$C_5H_{16}N_2$
Putrescine	$C_4H_{12}N_2$
Saprine	$C_5H_{16}N_2$

At least two toxic alkaloids are also formed in the later stages of putrefaction, but in such small quantity that Brieger did not succeed in isolating sufficient for analysis. It is remarkable, as Brieger points out, that the bases which he was successful in isolating are all diamines;† no previous investigation of albuminous substances entitles us to anticipate the formation of such compounds, or affords any clue to their origin. In the experiments under discussion, the air had free access; in the third monograph, Brieger briefly describes experiments made on a very large scale in which human remains, horseflesh and fish of different kinds were allowed to putrefy during the months of October to January in a stable loft at a temperature ranging from 5° to 9° C. in such a way that the access of air was almost prevented: it is a matter of interest that although under these conditions cadaverine and putrescine were formed in considerable quantity, no highly-poisonous ptomaines could be discovered. It would seem, therefore, that their formation takes place only when a certain amount of atmospheric oxygen has access.

The most important results obtained by Brieger, however, are undoubtedly those relating to the putrefactive action of pure cultivations of certain pathogenic bacteria. The *staphylococcus pyogenes aureus* and *streptococcus pyogenes*, described by Rosenbach, gave only negative results, no toxic alkaloid being formed by them; but by means of the *typhus bacillus* of Koch and Eberth, a toxic alkaloid was obtained of the formula $C_7H_{17}NO_2$ but unfortunately in very small quantity, its formation being apparently dependent on certain very

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* "Ueber Ptomaine," von Prof. Dr. L. Brieger. Berlin: Hirschwald.

† Brieger's cadaverine has been shown by Ladenburg to be identical with the pentamethylene diamine

$$(NH_2.CH_2.CH_2.CH_2.CH_2.CH_2.NH_2)$$

obtained on reduction of trimethylene cyanide

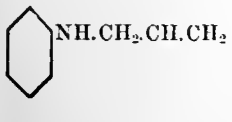
$$(NC.CH_2.CH_2.CH_2.CN).$$

special conditions being fulfilled. Employing a microbe which has been recognised as the primary cause of traumatic tetanus in man to cause the putrefaction of beef, Brieger, however, has succeeded in isolating an alkaloid, which he has named tetanine, of the formula $C_{13}H_{30}N_2O_4$; this produces in animals all the symptoms characteristic of human tetanus. Bocklisch, at Brieger's suggestion, has recently studied the products of putrefaction obtained by means of Finkler and Priors's comma bacillus, but without discovering any specific toxic alkaloid. Enough has now been said to make clear the enormous importance of Brieger's researches; they certainly may be described as "epoch-making."

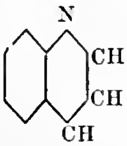
Pyridine Alkaloids.

Pyridine was discovered by Anderson in 1857, in the course of his classical researches on bone-oil: quinoline was discovered by Gerhardt in 1842. The nature of these compounds long remained undetermined, comparatively little attention being paid to them, probably in consequence of the difficulty of obtaining the pure substances in quantity. Gradually, however, their importance as progenitors of the vegeto-alkaloids became recognised. The discovery by Skraup of a most elegant synthetic method of preparing quinoline, available also for the preparation of a variety of quinoline derivatives, followed as it was very rapidly by the discovery of other simple methods of preparing both pyridine and quinoline derivatives, not only rendered their systematic study possible, but highly fashionable among chemists, many of whom doubtless were not uninfluenced by the hope that their researches might furnish results of immediate pecuniary value; the result is that the special literature of the subject is already almost overpowering, the rate of progress having been simply marvellous.

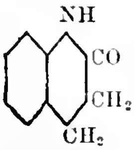
The suggestion that pyridine closely resembles benzene—that in fact it is benzene in which N takes the place of CH, and that quinoline is related to naphthalene in the same way that pyridine is to benzene, is more often than not attributed to Körner, but is sometimes ascribed to Dewar, to whom I believe it to be due: the now conventional formula of pyridine having been first published by him in a paper read at the Royal Society of Edinburgh on the 6th of June, 1870 (*R. S. Ed. Trans.* 26, 189). The method of oxidation by permanganate, which has been of such signal service in the investigation of pyridine derivatives, was also first described in this paper. The truth of Dewar's surmise was experimentally verified in 1879, when Koenigs showed that allylaniline is converted into quinoline by passing it over red-hot lead oxide, and Baeyer succeeded in converting hydrocarbostyril (orthamidophenylpropionic anhydride) into quinoline; the nature of the proof of the constitution of what is conventionally termed the "pyridine ring," which these syntheses afford will be obvious on reference to the following formulæ :—



Allylaniline.

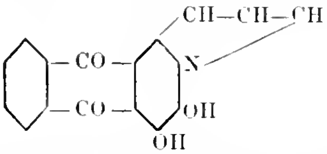


Quinoline.



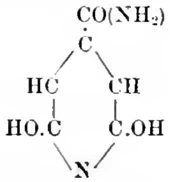
Hydrocarbostyril.

Skraup's invaluable synthetic method of preparing quinoline—the discovery of which may be said to be the critical feature in the history of our knowledge of the vegeto-alkaloids—affords one of the most instructive instances on record of the fact that every experiment, however unpractical it may seem at the time, has its value; it also illustrates the intimate connection of theory with practice, and should for ever silence the so-called practical man who knows nothing of, and cares less for, theory. Prudhomme, in 1877, stated that if β-nitroalizarin (alizarin orange) be heated with glycerol and sulphuric acid, a mixture of two colouring matters is produced, the one giving a violet with alumina mordants and a blue with iron mordants, the other giving browns. Most people would characterise such a mixture as a "dirty mess," and it is difficult to understand how the experiment came to be made, but made it was, very fortunately. H. Brunck, a member of the Badische Anilin- and Soda-fabrik, took up the study of the subject, and succeeded not only in determining the conditions under which the blue dye was formed, but in producing it on a manufacturing scale; and it is now well known as a very valuable dyestuff under the name alizarin blue. The scientific investigation of alizarin blue was undertaken by Professor Graebe with material furnished to him by Brunck, and ultimately he came to the conclusion that it has the composition indicated by the formula—



being in fact a derivative of anthraquinoline—*i.e.*, a compound bearing the same relation to anthracene that quinoline bears to benzene. Now it is remarkable that Graebe's paper immediately follows in *Liebig's Annalen* a paper by Skraup on the "Constitution of Cinchonine;" whether Skraup was thus led to take particular note of Graebe's work I do not know, but at all events it suggested to him that nitrobenzene might be converted in the same way—*i.e.*, by heating it with glycerol and sulphuric acid, into quinoline, and he was thereby led to discover his method of preparing quinoline.

Among the very numerous syntheses of pyridine derivatives, there is one to which attention should be specially directed, on account of the conditions under which it takes place. I refer to the action of aqueous ammonia on the acetyl derivative of ethyl citrate, which interact at ordinary temperatures to produce *citrazinamide* (Ruhemann, *Chem. Soc. Trans.*, 1887, 403), a compound represented by the following formula * :—



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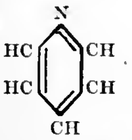
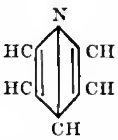
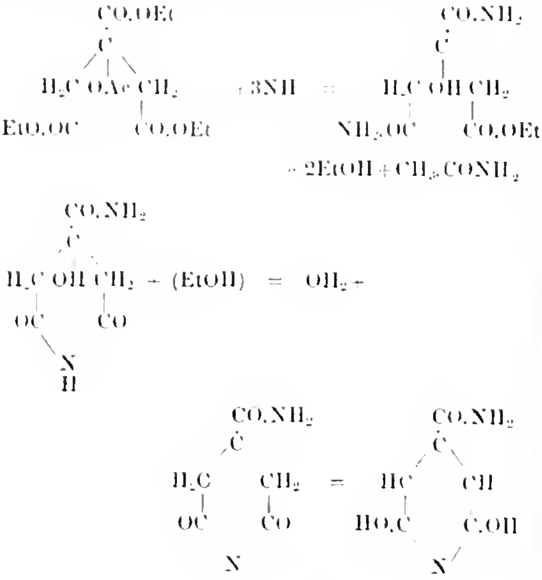
* Just as in the case of benzene, much discussion has taken place regarding the possible alternative formulæ of pyridine—viz :—



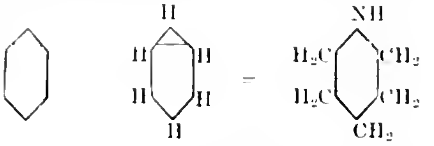


—Ruhemann contending that the formation of a pyridine derivative in the manner above described affords conclusive evidence in favour of the second formula. Like all such questions, this is one of considerable importance, but it would be out of place to discuss it here; I refer to it merely in order to point out that, in my opinion, neither can be accepted. I would, in fact, employ a formula corresponding to that which I have elsewhere contended should be assigned to benzene (*Chem. Soc. Trans.* 1887, 264). For all practical purposes it is sufficient, It is pyridine in which two hydrogen atoms are displaced by OH, and one by $CO(NH_2)$. Its formation may be symbolically represented, thus :—



It remains now to consider the chief evidence which recent investigations afford of the nature of the vegeto-alkaloids.

Piperidine ($C_5H_{11}N$).—This alkaloid was shown by Anderson in 1850 to be produced together with piperic acid, $C_{12}H_{10}O_4$, on hydrolysing piperine—a constituent of pepper. The nature of piperidine was not finally determined until 1869, when Koenigs succeeded in converting it into pyridine by heating it with sulphuric acid at 300°. The change involves the mere withdrawal of six atoms of hydrogen. Taking into account the fact that piperidine is a secondary amine, pyridine being a tertiary amine, the relation between the two is satisfactorily denoted by the formulæ :—



Pyridine. Piperidine.

Complete confirmation of the formulæ here given is afforded by the synthesis of piperidine from pentamethylenediamine effected by Ladenburg in 1886. This diamine is prepared by the action of sodium on a boiling alcoholic solution of trimethylene cyanide :—

$$NC.CH_2.CH_2.CH_2.CN + 8H = H_2N.CH_2.CH_2.CH_2.CH_2.CH_2.NH_2.$$

A certain quantity undergoes conversion into piperidine even during this process, and complete conversion is effected by submitting the hydrochloride of the diamine to dry distillation.

Piperic acid has been shown by the researches of Fittig and his pupils to be a derivative of protocatechuic or 1 : 2 : 4 dihydroxybenzoic acid of the formula :—

$$CH_2 \left\{ \begin{matrix} O \\ O \end{matrix} \right\} C_6H_3.CH.CH.CH.CH.COOH.$$

Piperine is a stimulant stomachic (Lauder Brunton's "Pharmacology"). Pyridine is said to diminish the reflex activity of the spiral cord and respiratory centre ; from Dewar and McKendrick's experiments it would appear to have a slight exciting action on the nerve centres, and those of Lee show that this is usually followed by paralysis. Piperidine appears to act chiefly as a local anæsthetic, paralysing the peripheral terminations of sensory nerves. It depresses the action of the heart and respiration.

Coniine.—Coniine is the poisonous principle of hemlock (*conium maculatum*), from which it was separated by Giesecke in 1827. It was supposed to have the composition $C_8H_{15}N$ until 1881, when Hofmann showed that its formula is $C_8H_{17}N$; later on, in 1884, he brought forward a number of observations which practically all but solved the problem of its constitution. Desiring to convert coniine into octylamine, Hofmann distilled the hydrochloride over heated zinc dust, but obtained instead a base of the formula $C_8H_{11}N = C_8H_{17}N - 6H$, which he named *conyrine*, and bearing therefore the same relation to coniine that pyridine bears to piperidine. Conyrine was reconverted into coniine by heating it with hydriodic acid. On oxidising conyrine Hofmann obtained the pyridinecarboxylic acid known as picolinic acid, which Skraup and Coblenzl had a short time before proved to contain the carboxyl group in the ortho-position relatively to the nitrogen. Conyrine therefore is N : 2 propyl- or isopropyl-pyridine, and coniine is the hexhydro-derivative of this compound. The next chapter in the history of coniine relates to its synthesis. It is well known from Hofmann's researches that methylaniline is converted into the isomeric toluidine at a high temperature : Ladenburg therefore endeavoured to prepare propyl and isopropyl-pyridine by heating pyridine with propyl-and isopropyl-iodides, but succeeded in obtaining only the isopropyl compound ; the hydro-derivative prepared from this very closely resembled coniine in physiological action, but was slightly different in other respects : it therefore appeared probable that coniine was the propyl compound. To prepare orthopropylpyridine, pure N : 2 methyl-pyridine (α-picoline) was prepared from bone oil ; this was converted into

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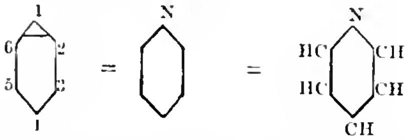
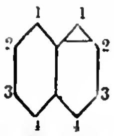
as in the case of benzene, to use a simple hexagon to represent pyridine ; and I here venture to suggest that in order to simplify printing, instead of writing N at one of the angles a line should be drawn across, thus :—



It is desirable to number the positions exactly as in the case of benzene, the nitrogen position being marked 1 : the usual continental custom of disregarding the nitrogen in numbering, and of marking the remaining positions 1, 2, 3, 4, 5, is unnecessarily misleading. The positions of the radicles are best indicated relatively to the nitrogen, assuming this to be in position 1. Thus the pyridinecarboxylic acid in which the COOH is contiguous to the N atom may be represented as the N : 2 acid. Applying this same principle to quinoline derivatives, the positions may be numbered alike in the two hexagons, thus :—



The position of radicles in the N ring are represented precisely as in the case of pyridine derivatives : cinchonic acid, for example, is N : 4 quinolinecarboxylic acid. Positions in the N-free ring are indicated by writing the figures in front of the N symbol—thus quinanisol, the methoxyquinoline derived from quinine, is 3 : N methoxyquinoline. Quininic acid, the oxidation product of quinine, is 3 ; N ; 2 methoxyquinolinecarboxylic acid.

allylpyridine by heating it with paraldehyde; and finally, N : 2 propyl-piperidine was obtained by hydrogenising the allylpyridine so prepared. The product differed from natural coniine in optical behaviour, being without action on polarised light; and its hydrochloride fused at 204°, that prepared from natural coniine fusing at 218°; in all other respects the two substances were indistinguishable. Attempts were therefore made to obtain from the synthetic product an optically active modification by the method successfully adopted with a similar object by previous workers—viz., that of selective destruction by means of a mould allowed to grow in a solution of the alkaloid; but the attempt was unsuccessful. The alkaloid was therefore converted into the acid dextro-tartrate: on adding to the very concentrated solution a few fragments of the acid dextro-tartrate from natural coniine, crystallisation took place, and from the crystals so prepared, after due purification, an optically active product was separated having the rotatory power $\alpha_D = 13·87$, that of natural coniine being $\alpha_D = 13·79$; the hydrochloride from this synthetic alkaloid had the same fusing point as that from natural coniine. Inasmuch as α-picoline may be prepared without resorting to any natural source, Ladenburg therefore has performed the feat of preparing coniine by purely artificial processes: there is no more brilliant achievement recorded in the annals of chemical science, and it would be difficult to select a research which more clearly illustrates the perfection of our modern chemical methods; the inter-dependence of researches undertaken at various times and with the most diverse objects; the necessity for the continued exercise of the severest logic; the multiplicity of processes with which the chemist must be intimately acquainted; and the demands made not only on his manipulative skill, but also on his patience and persevering fortitude under the trial of repeated failure and rebuff.

The physiological action of piperidine has already been mentioned. Dr. Lauder Brunton tells me that an interesting relation appears to exist between that of piperidine and coniine, inasmuch as the former acts chiefly by paralysing the peripheral terminations of sensory nerves, while coniine paralyses the corresponding parts of motor nerves.

Atropine.—This alkaloid, which is a powerful poison, is extracted from the leaves of the deadly nightshade, *Atropa Belladonna*: its most noteworthy physiological action is that which it exercises on the eye, causing dilation of the pupil. Atropine is easily hydrolysed, thus—

$$\underset{\text{Atropine.}}{C_{17}H_{23}NO_3} + OH_2 = \underset{\text{Tropic acid.}}{C_9H_{10}O_3} + \underset{\text{Tropine.}}{C_8H_{15}NO}$$

Tropic acid is the *phenylhydroxypropionic acid* of the formula

$$CH_2(OH).CH(C_6H_5).COOH.$$

The precise relation of atropine to its products of hydrolysis is not known: it is probably an ethereal salt. Ladenburg has shown, however, that atropine may easily be reproduced by merely digesting the tropic salt of tropine with dilute muriatic acid on the water bath; and by substituting other acids—such as benzoic, the hydroxy-benzoic, mandelic (phenylhydroxyacetic) and cinammic—for tropic acid he has prepared a number of compounds allied to atropine, which he proposes to term *tropeines*. It is especially noteworthy that *homatropine*, $C_{16}H_{21}NO_3$, the lower homologue of atropine prepared from mandelic acid, acts almost as powerfully as atropine as a mydriatic, but the effect which it produces is less persistent, lasting from 12 to 24 hours instead of eight days; it is also a far less powerful poison than atropine: hence in placing homatropine at the disposal of the eye-surgeon, synthetic chemistry has provided a material which in many cases is to be preferred to the natural alkaloid. This example is a good illustration of the important nature of the service which chemistry will undoubtedly afford to medicine, and therefore to mankind at large, as our inquiries are pushed forward in the particular field considered in this paper. Cinnamyl-tropeine, $C_{17}H_{21}NO_2$, has a very slight, if any, mydriatic action, but is a powerful poison: this is an interesting fact on account of the slight difference in composition which obtains between cinnamyl-tropeine and atropine.

The constitution of tropine cannot be regarded as finally determined: Ladenburg, however, is of opinion that his experiments, to which reference will now be made, prove it to be a tetrahydropyridine derivative of the formula—

$$C_5H_7(C_2H_4.OH)N.CH_3.$$

By the action of acids, and especially of concentrated sulphuric acid, tropine is readily deprived of the elements of a molecule of water and converted into tropidine, $C_8H_{13}N$; the connection of tropine with pyridine is established by the observation that on heating tropidine bromhydride with five molecular proportions of bromine at 165°, dibromopyridine and ethylene bromide are obtained.

Tropine has the properties of a tertiary base; that the nitrogen atom carries a methyl group is proved by the observation that tropidine methyl-iodide—prepared from tropidine and methyl iodide—yields *dimethylamine* when decomposed by alkali, thus:

$$C_8H_{13}N.CH_3I + KOH \quad NH(CH_3)_2 \quad C_7H_{10}O + KI.$$

If tropine be heated with hydriodic acid and phosphorus, it is converted into tropine iodide, $C_8H_{15}NI_2$; this compound exchanges only one of its iodine atoms for chlorine when it is digested with silver chloride, although both are displaced when it is boiled with silver nitrate solution, in this respect resembling the iodide $C_5H_{13}NI_2$ obtained from choline, and the bromide formed by combination of trimethylamine and ethylene bromide.

By digesting tropine-iodide with zinc dust and dilute muriatic acid, hydrotropidine, $C_8H_{15}N$, is produced, and by distilling hydrotropidine hydrochloride in a current of hydrogen chloride norhydrotropidine, $C_7H_{13}N$, is obtained; norhydrotropidine is a secondary base, and its production in this manner affords further evidence that the nitrogen atom in tropine is associated with a methyl group. On distilling norhydrotropidine hydrochloride with zinc dust, a decomposition is effected similar to that which takes place in the case of coniine, a pyridine base of the formula $C_7H_9N = C_7H_{13}N - 4H$ being produced. This base is α or N : 2 ethylpyridine, and hence it may be inferred that the side chain $(C_2H_4.OH)$, which probably is present in tropine, is in the ortho-position relatively to the N-atom.

Hyoscyamine and *Hyoscine.*—These alkaloids are isomeric with atropine, and like it in physiological action. Hyoscyamine, which was originally obtained from *Hyoscyamus niger*, occurs together with atropine in Atropa Belladonna; *Datura Stramonium* also contains the same two alkaloids, hyoscyamine, however, being the chief constituent, whereas Atropa Belladonna yields a larger proportion of atropine (Ladenburg, *Berichte*, 1880, 380, 909). Hyoscine occurs together with hyoscyamine in Hyoscyamus (*Ibid.* 1880, 1549; 1881, 1870; 1884, 151). *Duboisine* from the Australian plant *Duboisia Myoporoides* was found by Ladenburg to be impure hyoscyamine (*Ibid.* 1880, 257); recently he has examined another sample and has found this to consist of hyoscine (*Ibid.* 1887, 1661).

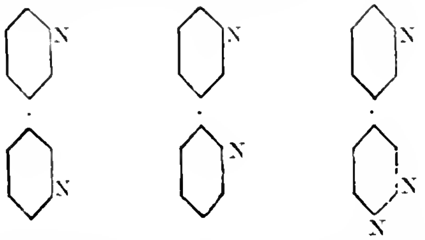
Hyoscyamine gives the same products of hydrolysis as atropine, and Ladenburg has prepared atropine from the products of the hydrolysis of hyoscyamine, thus converting the one alkaloid into the other: the relation between the two alkaloids must therefore be of an intimate character. Hyoscine on hydrolysis gives tropic acid, together with an isomer of tropine —pseudotropine.

Cocaine, which has recently acquired such notoriety in surgical practice, also belongs to the class of mydriatic alkaloids; on hydrolysis it yields benzoic acid, methyl alcohol and ecgonine (Lossen):

$$C_{17}H_{21}NO_4 + 2H_2O = C_7H_6O_2 + CH_4O + C_9H_{15}NO_3$$

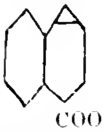
Cocaine has been prepared by methylating *benzoyl-ecgonine*, which accompanies cocaine in coca leaves. Ecgonine exhibits phenolic properties: its constitution, however, remains to be determined.

Nicotine: $C_{10}N_2H_{14}$.—It is desirable to briefly refer to this alkaloid, as it appears to belong to a distinct and unusual type. Mild oxidising agents deprive nicotine of four atoms of hydrogen, but more powerful agents convert it into nicotinic acid—the pyridinecarboxylic acid in which the COOH group and the N atom are relatively in the meta-position. It would therefore appear probable that nicotine is the hexhydro-derivative of a dipyridyl of which there are but three modifications capable of yielding nicotinic acid on oxidation—viz.:



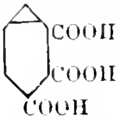
That represented by the first formula, would yield only nicotinic acid on oxidation; that represented by the second might also furnish picolinic acid, which, however, on account of its instability, might well escape detection; and that represented by the third formula may be expected to yield the N : 4 carboxy-acid, which is very stable and not likely to be overlooked.* The probability that the first or second represents the dipyridyl from which nicotine is derived is therefore considerable. By reducing by means of tin and muriatic acid the dipyridyl obtained by the action of sodium on pyridine, Weidel and Russo have prepared an isonicotine, the poisonous properties of which are much less marked than those of nicotine; this is probably a derivative of para-dipyridyl, as the dipyridyl is converted into the N : 4 carboxy-acid on oxidation. In a similar manner, Skraup and Vortmann have prepared a second isomer of nicotine—*nicotidine*—from the dipyridyl represented by the first of the above formulæ; this appears to be a powerful poison. We have therefore a certain amount of negative evidence in favour of the second of the above formulæ, provided it be assumed that the dipyridyl from which nicotine is probably derived would be directly converted into nicotine by the treatment adopted; but this does not follow as a matter of course.

Cinchona alkaloids.—Of the numerous alkaloids derived from the *cinchonas*, cinchonine and quinine have hitherto chiefly engaged the attention of chemists, and notwithstanding the persistent attack to which these two have been subjected, our knowledge of their constitution is still far from complete. Both are quinoline derivatives. In the case of cinchonine, $C_{19}H_{22}N_2O$, this is proved by its behaviour on oxidation with chromic liquor, whereby it is converted into *cinchonic acid*, the quinoline carboxylic acid of the formula

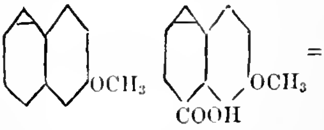


$= C_9NH_6.COOH$

Quinine, $C_{20}H_{24}N_2O_2$, in like manner, yields *quininic* acid, $C_{11}H_9NO_3$, when similarly treated. Both acids give the same tricarbopyridinic acid on oxidation by permanganate, viz.:—



and it is therefore evident that the difference in composition of cinchonic and quininic acids is due to the presence of a radicle in the "benzene ring" of quinoline: this radicle is proved to be methoxyl, CH_3O, by the formation from quininic acid by the action of muriatic acid of methyl chloride and xanthoquininic acid, $C_{10}H_7NO_3$, and by the resolution of this latter acid into carbon dioxide and hydroxy-quinoline. Quininic acid is split up in like manner on heating into carbon dioxide and methoxy-quinoline or quinanisoil. The hydroxy- and methoxy-quinoline obtained in this way are respectively identical with the compounds synthetically prepared by Skraup's method from paramidophenol, $C_6H_4(NH_2).OH$, and paramidanisoil, $C_6H_4(NH_2)OCH_3$, and hence the constitution of quininic acid is fully determined.



$= C_9N(OCH_3)H_5.COOH$

Quinanisoil. Quininic Acid.

Deducting C_9NH_6 from the formula of cinchonine, and $C_{10}NH_8O$ from the formula of quinine, the difference, $C_{10}NH_{16}O$, represents the composition of the group which is associated with quinoline in cinchonine, and with 3 : N-methoxyquinoline or quinanisoil in quinine; and it is not improbable that this group is associated with the quinoline by means of one of its carbon atoms, and occupies the para-position relatively to the nitrogen atom. We have no reason to suppose that the group $C_{10}NH_{16}O$ differs in structure in the two alkaloids.

Besides cinchonic or quininic acid, a complex mixture of products is obtained when either cinchonine or quinine is oxidised. Skraup, to whom especially we are indebted for our knowledge of the facts on which the determination of the constitution of the cinchonine alkaloids is based, has stated that he has succeeded in unravelling these, and in his preliminary notice (*Monatshefte*, 1886, 517) he mentions having isolated, among other compounds, a base of the composition $C_9H_{17}NO_2$, which, on distillation with zinc dust, yields ethylpyridine identical with that previously obtained by various observers from cinchonine, and there can be little doubt therefore that the group

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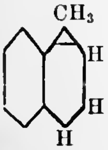
* Weidel has obtained this acid in very small quantity, and thinks that nicotine may perhaps be a mixture of isomeric substances.

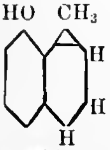
$C_{10}NH_{16}O$ in cinconchonine and quinine is derived from ethylpyridine, and that both alkaloids contain a pyridine besides the quinoline ring.

It has been assumed above that the quinoline ring is present in the unreduced form: but from the amount of hydrogen contained in cinchonine and quinine there can be no doubt, when all the facts are taken into account, that either the quinoline or the pyridine ring must be reduced to the tetrahydride. Skraup, by a most ingenious train of reasoning, has shown that it is more probable that the pyridine ring is reduced. The argument may be briefly stated as follows:—Quinanisoil is easily converted by digestion with tin and hydrochloric acid into a tetrahydride, which has been named *thalline* on account of the green colour which is produced in its solutions by oxidising agents but not by chlorine and ammonia; thalline is a strong antipyretic; it does not fluoresce. Quinanisoil itself is a weak antipyretic; it fluoresces, and moreover it resembles quinine in its behaviour with chlorine water and ammonia. The resemblance which quinanisoil bears to quinine, therefore, is destroyed when, by reduction, it is converted into the tetrahydride. On the other hand, quinine itself may be reduced, and furnishes a product which behaves exactly like thalline with oxidising agents; this behaviour affords a further indication of the presence in quinine of an unreduced quinoline ring.

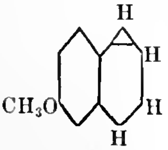
Quinine Substitutes.—The discovery of synthetic methods of preparing quinoline and its derivatives soon gave an impulse to the investigation of the physiological action of various quinoline derivatives, and attention appears to have been specially directed to the tetrahydro-derivatives by Dewar and M'Kendrick's investigation (*R. Soc. Proceedings*, 1874, 290), in which it was determind that the physiological activity was greater in those bases which contained the larger proportion of hydrogen. In 1881, Otto Fischer prepared from 1 : N-hydroxyquinoline the tetrahydro-derivative, and displaced the H of the NH group by CH_3. The compound thus produced was found to be a powerful antipyretic, and under the name of *kairine* has acquired some popularity in medicinal practice. Subsequently methylated tetrahydroquinoline was prepared by L. Hofman and Koenigs, and was also proposed as an antipyretic, being known as *Kairoline.* Thalline, the isomer of kairine, prepared by Skraup from quinanisoil, to which reference has been made above, was brought forward at a later period as an antipyretic. The formulæ of the three compounds are as follows:—



Kairoline.



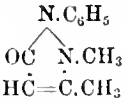
Kairine.



Thalline.

Many noteworthy observations indicating the connection between constitution and physiological activity have been made in the course of the inquiries which culminated in the introduction of these various substances as medicinal agents. Thus Filehne, who studied the physiological action of 1: N-hydroxyquinoline and its derivatives at Otto Fischer's instigation, found that this base and the methoxyquinoline formed from it possessed poisonous properties; their tetrahydrides manifested a certain resemblance to quinine, but produced objectionable subsidiary effects; on displacing in these latter the H of the NH group—to which, on chemical grounds, there was reason to attribute their activity—by methyl or ethyl, powerful antipyretics were obtained which were not subject to the objections which could be made against the parent hydro-base. Tetrahydroquinoline hydrochloride was found to act more powerfully than the quinoline salt, but could not be used on account of the marked local effects to which it gave rise, the quaternary ammonium salt $C_9NH_{10}(CH_3)_2Cl$ prepared from it, which has a strong bitter taste like that of quinine, like most compounds of this class, had an action resembling that of curare. The methyl and ethyl derivatives of tetrahydroquinoline, however, were found to act as antipyretics, without producing the unpleasant subsidiary effects which characterised the parent base in which the H of the NH group was undisplaced. Kairoline is unfavourably distinguished from kairine by its sharp bitter taste. Kairoline 1 : N-ethoxymethyltetrahydroquinoline and 2 : N-hydroxyethyltetrahydroquinoline, which all exhibit a resemblance to quinine, differ with respect to the length of time during which their physiological action persists, the effect being most persistent in the case of the 1 : N-ethoxy compound. Skraup's quinanisoil is physiologically much less active than its tetrahydride thalline; the hydroxy-compound from which thalline is prepared is poisonous, but loses its poisonous properties and is converted into an antipyretic when the H of the OH group—not that of the NH group—is displaced by CH_3.

Within recent years, under the name *antipyrine*, a further important addition to the stock of antipyretics has been made by Knorr. Antipyrine is prepared by methylating the compound which is formed by condensation of ethylic acetoacetate and phenylhydrazine according to the equation—$C_6H_5.N_2H_3 + C_6H_{10}O_3 = C_{10}H_{10}N_2O + C_2H_6O + H_2O$.
Its formula may be written as follows:—

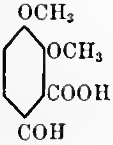


According to Lauder Brunton ("Pharmacology," 3rd ed., p. 825) its "uses" are:—"In febrile diseases generally. It seems specially useful in typhoid fever and phthisis, but is also useful in erysipelas, surgical fever, pleurisy and pneumonia."

The ardour of searchers after new valuable antipyretics among the qunoline and other more complex nitrogenous compounds, however, has not long since received a check in the discovery that so commonplace a substance as ordinary *acetanilide*, prepared by merely digesting aniline with acetic acid, is even preferable to all the artificial antipyretics hitherto discovered; a quarter of a grain is said to have the same effect as one grain of antipyrine. This substance has become enshrouded in an unnecessary halo of mystery by the adoption of the reprehensible practice of re-baptising it *antifebrine.*

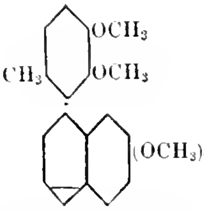
Opium Alkaloids.—The poppy, as is well known, affords a number of alkaloids—narcotine, papaverine, codeine, morphine, thebaine and others of less importance, which are remarkable on account of the variety of types represented by them.

Narcotine, $C_{22}H_{23}NO_7$.—On hydrolysis this alkaloid is resolved into meconine and hydrocotarnine, or by the combined action of hydrolytic and oxidising agents into opianic acid and cotarnine. Opianic acid is now known to be the derivative of 1:2:4 dihydroxybenzoic (protocatechuic) acid of the formula



Cotarnine, $C_{12}H_{13}NO_3$, is a very remarkable compound (v. Gerichten, *Liebig's Annalen*, 210, 79; 212, 165): its relation to pyridine is established by its conversion into cinchomeronic acid, one of the pyridinedicarboxylic acids, and also by its conversion into dibromopyridine. A number of most interesting intermediate derivatives have been prepared from it, but the data are not yet sufficient to finally establish its constitution.

Papaverine, $C_{20}H_{21}NO_4$.—Goldschmidt (*Monatshefte*, 1885, 372, 667, 954; 1886, 485), chiefly from the study of the oxidation products of this alkaloid, concludes that it is a derivative of *phenylquinoline* of the formula



the position of the two OCH_3 groups in the quinoline ring being as yet undetermined.

Codeine, $C_{18}H_{21}NO_3$: *Morphine*, $C_{17}H_{19}NO_3$.—Morphine, according to Beckett and Wright, is a dihydroxy- and codeine a monhydroxy-derivative. Grimaux has succeeded in converting morphine into codeine by acting on it with sodium hydroxide and methyl iodide: *homocodeines*, which, as compared with codeine, present interesting differences in physiological behaviour, may be prepared by means of other iodides. The most remarkable results hitherto obtained are those of v. Gerichten and Schrötter, which appear to show that morphine and codeine are derivatives of phenanthrene, the isomer of anthracene (*Berichte*, 1882, 1484, 2179).

Thebaine, $C_{19}H_{21}NO_3$, according to W. C. Howard's experiments, is a tertiary base of the formula $C_{17}H_{15}NO(OCH_3)_2$; it is converted into morphothebaine, $C_{17}H_{15}NO(OH)_2$, by the action of concentrated muriatic acid. From recent experiments by Howard and Roser (*Berichte*, 1886, 1596), it appears probable that thebaine may also be related to phenanthrene; from the ease with which the hydroxide prepared from thebaine methiodide undergoes decomposition, these chemists have concluded that the N in thebaine is not present in the form of the pyridine ring, it being apparently essential in the case of ring compounds to add on a paraffin iodide twice in order to obtain the hydroxide which will decompose on heating in the manner which Hofmann has shown to be characteristic of the hydroxides of quaternary ammonium derivatives.

The foregoing account is but the faintest sketch of our knowledge of the alkaloids, but I trust that it will be sufficient to make clear the importance of the issues involved in the inquiry into their nature, formation and uses, as well as to give some idea of the difficulties to be encountered and overcome; and also that it may aid in showing that the chemist at the present day requires to have been as carefully-trained, and to be as fully equipped intellectually, as a member of any other learned profession: in plain terms, that a couple of years spent in acquiring practice as an analyst does not suffice to make a youth a chemist.

I know of no other branch of chemical inquiry which presents problems of the same magnitude or so fraught with interest, for it cannot be doubted that when we shall have succeeded in determining the structure of typical alkaloids and shall have gained an insight into the true nature of their physiological functions, our power of alleviating human suffering will be increased to an enormous extent.

It may be asked in conclusion: What part are we taking in this inquiry; are we doing our duty; are we even aware what is our duty? The present generation are working mainly on foundations laid down by Anderson and also by Greville Williams. Matthiessen, in conjunction with Foster and subsequently with Alder Wright, made the first systematic attempt to determine the constitution of an alkaloid, and had he lived English chemists would undoubtedly have undertaken a far larger share of the work; Wright and his fellow-workers have since rendered most important service in the investigation of certain of the opium alkaloids, and of those separated from the aconites and veratrums; the intimate connection between chemical constitution and physiological action was first established by the classical research of Crum-Brown and Fraser: but of late years English workers have been all but silent in these matters, and what is most remarkable, we have always devoted ourselves solely to the analytic examination of alkaloids. Synthetic chemistry, which during recent years has developed in so marvellous a manner in the German schools, has been all but neglected by us.

DISCUSSION.

The CHAIRMAN said the meeting had to thank Dr Armstrong for a paper of most unusual interest—a paper so pregnant with both information and suggestion that it was difficult to deal with it briefly. A clear summing up of some of the most valuable researches of modern chemistry had been given. Dr. Armstrong had said truly that England had dropped behind in these researches. He would suggest that restrictive legislation had prevented the possibility of experiment on living creatures, and, therefore, the only really useful method of investigating the physiological action of these bodies. That had, in his opinion, much to do with England's present position on this question. Unless English investigators were prepared to face the ordeal of the "ticket of leave," the proper investigation of the effects of these bodies must be left to other countries whose legislatures were less swayed by their feelings; and all that was left to English chemists was to study the researches of others. He had been appealed to recently by a gentleman who believed that he had discovered quinine; but when he found that gentleman entirely ignorant of so well-known a body as coniine, and of the work of Caro and Graebe, he decided that that was not the quarter in which such work could have been done. When one considered these bodies, which were so easy to analyse and so difficult to reconstruct, one appreciated the value of the work for which we had to thank German chemistry.

Dr. C. R. ALDER WRIGHT could not let the opportunity pass without thanking the author for the enormous amount of valuable information conveyed by his paper. He could not but cordially endorse the remarks of Dr. Armstrong and the Chairman as to the deleterious effect which "grandmotherly" legislation had had on work of this sort. It was nearly twenty years since, while under Dr. Mathieson, his attention had been drawn to the very peculiar effects resulting from slight changes of composition in alkaloids, but the matter was deeply impressed on his memory by the fact that he was the unfortunate individual who first suffered from the curious change produced in morphia by the mere removal of a molecule of water. The result was the production of apomorphine, the action of even a fraction of a milligramme of which body on the human system was most remarkable. He could recall now with amusement how everybody, from the principal down to the laboratory man, suffered in a very distressing manner from what is best described as a sea-sickness. No one could make out what was the cause of this, until it was discovered that a tube in which morphine had been sealed up with hydrochloric acid had burst. The contents had dried up and blown about the place, and it was this dust, breathed in with the air probably, which had caused their discomfort. That was a case in which a very limited amount of change in the construction of the molecule produced a great difference in its action when taken internally. In this instance the nitrogenous part of the molecule was not affected, the change consisting only in the removal of the elements of water. Dr. Armstrong had remarked that the addition of four atoms of hydrogen to a trebly-linked base containing a nitrogen atom in a pyridine derivative produced a material change in the physiological properties of the substance; and he (Dr. Wright) had observed analogous changes in other alkaloids. For example, the addition of two atoms of hydrogen to the base cotarnine (derived from narcotine by splitting up) converted it into the far more active body hydrocotarnine.

Dr. Stevenson desired to express the deep gratification with which he had listened to the author's very lucid summary of the vast amount of important matter relating to the subject with which he had dealt, the mere reading of which must have been a work of great labour and time. He had carefully studied Brieger's monographs, and considered his work to be far in advance of anything previously done in the same direction. His careful analysis of products obtained by the putrefaction of animal bodies had placed on a satisfactory basis matter which had before been highly problematical. Previous observers in the same direction had obtained products from the putrefaction of various bodies by very rough processes, which must of necessity have led to the hydrolisation of the putrefactive products; but the great amount of care which characterised Brieger's work on the alkaloids warranted chemists in accepting his results with confidence. What had struck him with regard to Brieger's products had been their great simplicity, judging from the number of chemical atoms implicated in the molecule. Tetanine differed from the others in that it appeared to be a much more complex body and to produce effects much more sharply marked. Probably Brieger himself, however, would be inclined to attach some doubt to the formulæ of his earlier described products, and would wish to have their optical properties investigated. He looked for great advances in the direction indicated by Dr. Armstrong. Where one met with an optically inactive body, productive of very little physiological effect, it might be split up into other and physiologically active bodies. He could speak personally of the immense difficulties thrown in the way of chemico-physiological work by the legislation alluded to by the President.

Mr. Crowder, while feeling unable to discuss the subject dealt with by Dr. Armstrong—since his study of organic chemistry had been limited—yet felt bound to point out to those gentlemen who had complained of the hindrance to their work resulting from the operation of the Anti-Vivisection Act, that there was another side to the question. He for one could not admit that they had any moral right to interfere with the lives and the happiness of the lower animals.

The Chairman said: There being no hostile criticism of the paper, he need not call on Dr. Armstrong to reply. He was himself responsible for the remarks about the Anti-Vivisection Act. He did not desire to enter on so perilous a field of discussion, but he was decidedly of opinion that researches having the benefit of mankind as their object were justifiable; and, when he found a relative materially the better for the administration of certain bodies, previously tried on the lower animals, he felt thankful to those gentlemen who had first made dogs uncomfortable.

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ON THE CORRECT ANALYSIS OF PLAIN AND AMMONIATED SUPERPHOSPHATES.

BY JOHN RUFFLE, F.I.C., F.C.S.

In my paper read before the London Section of the Society, 16th May, and appearing on page 327 of this Journal, current volume, it was shown:—

1st. The acidity of ordinary superphosphates and of ammoniated superphosphates is due to phosphoric acid (as free acid or as monocalcium phosphate), and not to sulphuric acid; there is, therefore, no free sulphuric acid in such manures.

2nd. The soluble P_2O_5 exists as monocalcium phosphate but to a minor degree; the remainder is free phosphoric acid.

3rd. In ammoniated superphosphates monocalcium phosphate exists in such small amounts that practically it may be ignored.

On page 331 the table shows the soluble P_2O_5 as the monocalcium salt and as free acid, which in their amounts and relative percentages are exhibited here on Table I.

TABLE I.

	Carolina.		Sombrero.		Spanish.		Curacao.	
Soluble P_2O_5 as monocalcium salt	1·99 —	36·62	10·28 —	61·63	1·82 —	11·95	8·21 —	45·05
„ free acid	8·69 —	63·38	6·40 —	33 37	13·40 —	88·05	10·05 —	54·95
	13·68	100·00	16·68	100·00	15·22	100·00	18·29	100·00

Thus of the soluble P_2O_5 only from 11·95 per cent. to 61·63 per cent. can at the outside be present as the monocalcium salt, and this only by giving it the full benefit of all the soluble CaO found in the solutions referred to in second table, p. 330. Along with the soluble P_2O_5 were found SO_3 and CaO in solution; if there be no free SO_3, this soluble SO_3 should have its due amount of CaO allotted to it, in which case we find there is only enough CaO left to give the following proportions of the monocalcium salt and free acid, the latter naturally rising as the former is lowered. By calculation from the second table, page 330, we find there was of soluble SO_3 in proportion to the soluble P_2O_5, as in Table II. So that if, as was assumed in my first paper (for purposes of arriving at the combined water and "moisture"), all the soluble CaO were combined off as mono-salt, or if as now the SO_3 in solution were assumed present as dissolved calcium sulphate, the soluble conditions of the soluble P_2O_5 would respectively be as in Table III.

TABLE II.

Soluble P_2O_5.	Soluble SO_3.	Needing of CaO to form $CaSO_4$.	
CAROLINA—			
13·68	0·21	0·14	Deduct this 0·11 from 1·97 CaO of the mono-salt, page 331, leaves 1·83 CaO to form mono-salt with 4·61 of P_2O_5 instead of 4·99.
SOMBRERO—			
16·68	0·18	0·33	Ditto from 4·04 leaves CaO 3·71 with 9·40, against 10·28.
SPANISH—			
15·22	0·60	0·42	Ditto from 0·72 leaves 0·30 CaO with 0·76 instead of 1·82.
CURACAO—			
18·29	0·17	0·32	Ditto from 3·25 leaves 2·93, with 7·42 instead of 8·24.

It is in every degree probable that the soluble SO_3 is present as calcium sulphate.

The whole object of the manufacturer in introducing the SO_3 to the calcium phosphate is that the SO_3 shall attack and combine with the CaO, and free the P_2O_5. The SO_3 is present in less quantity than is necessary to combine with all the CaO, and there is no reasonable ground why the SO_3 should of the three molecules of CaO belonging to the calcium phosphate attack and combine with two only (as is very commonly presumed), and not proceed to also attack the third. On the contrary, the fact that there is not sufficient soluble CaO to form a mono-salt with the soluble P_2O_5 is proof that the SO_3 has attacked the third molecule of CaO of the calcium phosphate and more or less combined with it; doubtless it would proceed to do so completely, and if present in sufficient quantity would succeed so that the manure would contain all its soluble P_2O_5 as free phosphoric acid. But the manufacturer stops before reaching this point, so as to retain a good dry condition for his produce; and indeed the whole art of the manure manufacturer hinges on his ability to introduce the maximum quantity of O.V. and water, whilst keeping to a good marketable condition.

TABLE III.

	Carolina.		Sombrero.		Spanish.		Curaçao.	
		%		%		%		%
All soluble CaO as monocalcium phosphate	4·99 —	36·62	10·28 —	61·63	1·82 —	11·95	8·24 —	45·05
And free acid	8·69 —	63·38	6·40 —	33·37	13·40 —	88·05	10·05 —	54·95
Whilst the	13·68	100·00	16·68	100·00	15·22	100·00	18·29	100·00
Soluble SO_3 combined off as calcium sulphate leaves monocalcium phosphate	4·61 —	33·91	9·40 —	56·35	0·76 —	4·99	7·42 —	40·56
And free acid P_2O_5	9·04 —	66·09	7·28 —	43·65	11·46 —	95·01	10·87 —	59·44
	13·68	100 00	16·68	100·00	15·22	100 00	18·29	100·00

The soluble P_2O_5 varying from 4·99 per cent. to 56·35 per cent., against 11·9 per cent. to 61·63 per cent. in Table I.

Such being the condition of affairs regarding the SO_3 in the manure, it is evident that the whole of the SO_3 in a plain superphosphate should be combined off and stated as calcium sulphate.

Now it is usual in writing out an analysis of a manure to combine off as much CaO as will form a mono-salt with the whole of the soluble P_2O_5; add this to the CaO of the insoluble phosphate, and the sum deduct from the total CaO, calculating the balance as calcium sulphate, and stating this in the report (no mention being made of any further SO_3). Such amount is much too low.

Any manufacturer can at once see practically that such a way of accounting for the SO_3 put in the manure is far too insufficient. On reference to Table VI. we see that the calcium sulphate, as ordinarily put down, would be respectively—

TABLE IV.

	Carolina.	Sombrero.	Spanish.	Curacao.
	%	%	%	%
Calcium sulphate according to usual method of stating analysis	36·61	39·36	31·77	43·01

To make a ton of superphosphate in each of these cases would, according to the SO_3 of this calcium sulphate, require—

	Carolina.	Sombrero.	Spanish.	Curaçao.
Of O.V.	5¼cwt.	5⅝cwt.	5cwt.	6½cwt.

amounts which the practical man will at once recognise as hopelessly insufficient.

For the "combined water and organic matters" of an analysis it is usual to burn a portion in a platinum dish; from this deduct the loss found at 212° F., and the remainder, minus one half of the "biphosphate," is the amount put down. But as the monocalcium salt is not present as assumed, the "half of the biphosphate" is quite unwarrantable. Further, the heating drives off the soluble P_2O_5, so that this method is without any good basis and totally unfit to be put forward as a chemical determination of these constituents.

To show the results obtained by this method the figures in Table V. (p. 493) are quoted, being those obtained by this method on the prepared superphosphates.

Superphosphates as a manure are valuable on account of the calcium sulphate and the soluble P_2O_5 they contain, but owing to the low money value of calcium sulphate and high money value of the soluble P_2O_5 they are sold wholly on the percentage of soluble P_2O_5 present, without any regard to its existence as monocalcium phosphate or any other form. There is therefore no necessity to attempt to state the monocalcium salt; let this then be abandoned, and only the amount of soluble P_2O_5 be specially stated, as this important item can be arrived at accurately.

TABLE V.

	Carolina.	Sombrero.	Spanish.	Curaçao.
Total water and organic matter (page 329).................	21·30	21·87	21·66	23·99
Loss at 212° F.	20·16	18·95	17·71	13·01
Combined water and organic matter left in after 212° F.......	4·20	5·92	6·92	10·98
Combined water and organic matter found by above method	4·51	3·92	3·41	1·62

A simple plan will then be to conduct the analysis thus:—

(a) Moisture.—Estimate by calcium chloride method in vacuum of an air-pump.
(b) Soluble P_2O_5.—By direct determination.
(c) Insoluble Phosphate.—By direct calculation from the amount of insoluble phosphoric acid, after evaporation to dryness with HCl and re-solution with HCl.
(d) Calcium Sulphate.—Determine the whole SO_3 present, and calculate this into calcium sulphate (anhydrous).
(e) Sand.—Matters insoluble after above evaporation to dryness with HCl and re-solution in HCl.
(f) Combined water and organic matters, etc.*—Difference undetermined.
(g) Alkalis, Magnesia.—Amounts as determined.

By this plan no more work will be introduced than is done at present, whilst the statements *a*, *b*, *c*, *d*, *e*, and *g* will be true from direct determination, and the commercially unimportant "combined water and organic matter" will not be attempted, so false statements be avoided.

To show comparison between the old and new methods, the superphosphates, as tabulated on page 329, are put down in Tables VI, and VII., first the old, then the new.

Under the old method the amounts put down under the four heads of moisture, combined water and organic matter, biphosphate, and calcium sulphate are untrue. During the last year or two chemists have endeavoured to shelter themselves from the charge of inaccuracy on the heading of "Moisture," by writing it "Moisture (loss at 212° F.)," and if questioned, replying that it was "loss at 212° F.," which, as it was to them an unknown quantity, was simply a way of owning their incompetence to determine the moisture correctly; whilst they yet had not the consistency to abandon the term "Moisture." With the other three headings chemists have simply followed each other, without any attempt to check their inaccuracy.

Under Table IV. reference is made to the amount of O.V. presumably used. Now the sulphate of lime in Table VII. shows that to make a ton of these superphosphates there were used respectively of:—

	Carolina.		Sombrero.		Spanish.	Curaçao.
O.V.	6½cwt.	..	6¾cwt.	..	6½cwt.	7½cwt.

amounts which a manufacturer will see is practically correct, producing exactly one ton, and, making allowance for the small mixings made for this research and the small quantities of acid such will carry as compared with the usual wholesale mixings, and very different to the quantities (cwts.) of Table IV.

USUAL WAY OF SHOWING THE COMPOSITION OF SUPERPHOSPHATES.

TABLE VI.

	Carolina	Sombrero.	Spanish.	Curacao.
Moisture (loss at 212° F.)	20·22	18·95	17·71	13·61
*Combined Water and Organic Matter........................	1·51	3·92	3·41	1·62
Biphosphate....................	19·07	23·25	21·22	25·50
Equal to Bone Earth made Soluble	(29·86)	(36·11)	(33·22)	(39·92)
Insoluble Phosphate	0·98	1·59	1·59	0·19
Calcium Sulphate (anhydrous)	36·64	39·36	31·77	43·01
Alkalis, etc	12·85	11·92	13 21	5·54
Insoluble Silicious Matters....	5 83	1·01	8·03	0·53
	100·00	100·00	100·00	100·00
*On page 331 it is shown that the Combined Water alone was respectively	10·50	11·22	11·50	12·68

NEW WAY OF SHOWING COMPOSITION OF SUPERPHOSPHATES.

TABLE VII.

	Carolina	Sombrero.	Spanish.	Curacao
Moisture (by Calcium Chloride method)	13·17	14·79	13·46	11·81
Combined Water and Organic Matters, etc	21·16	19·03	16·47	17·81
*Soluble P_2O_5	13·68	16·68	15·22	18·29
Insoluble Phosphate	0·98	1·59	1·59	0·19
Calcium Sulphate (anhydrous)	44·88	46·90	45·23	51·34
Alkalis and Magnesia can be stated as determined, but were not specially estimated for this paper.				
Insoluble Silicious Matters	5·83	1·01	8·03	0·53
	100·00	100·00	100·00	100 00
*Equal to Tricalcium Phosphate made soluble..........	29·86	36·41	33·22	39·92

AMMONIATED SUPERPHOSPHATE.

A striking difference exists between plain and ammoniated superphosphates, in that the latter contain in proportion to the soluble P_2O_5 much less soluble CaO than the plain.

Thus the plain contain of soluble P_2O_5 and soluble CaO, calculated from second table, page 330:—

---

* This will also include the uncombined CaO, etc.

TABLE VIII.

	Carolina. per cent	Sombrero. per cent.	Spanish. per cent.	Curaçao. per cent
Soluble P_2O_5	13·68	16·68	15·22	18·29
,, CaO	1·97	4·01	0·72	3·25

Whilst the ammoniated superphosphates, calculated in the same way from second table, page 332, have:—

TABLE IX.

	3 per cent.	6 per cent.	9 per cent
Soluble P_2O_5	15·02	13 05	11·66
,, CaO	0·38	0·09	0·13

Owing to the sulphuric acid combined with the ammonia, it is impossible to calculate the calcium sulphate from the total SO_3, as this would give results in excess of the truth.

This objection would hold good not only in the special instances here quoted, but be equally valid in all cases where a nitrogenous material is put through the mixer with O.V. and a phosphate, because more O.V. is used than is needed for the phosphate alone, whilst if ammonium sulphate be added, such calculation would of course become inadmissible, and it must be borne in mind that the addition of ammonium sulphate is a very usual and valuable procedure.

The soluble CaO, even if all combined off as monosalt, is so small that it could be ignored, as shown by table on page 333. Small as it is, some of it is without doubt due to dissolved calcium sulphate, so that from this double consideration the existence of CaO as monocalcium phosphate can in these manures be wholly passed over, and the total CaO, less the CaO of the insoluble phosphate, be calculated out to calcium sulphate.

TABLE X.

	3 per cent.	6 per cent.	9 per cent.
Calcium sulphate as usually arrived at as in Table XI.	37·66	32·30	29·27
Calcium sulphate by total CaO, less CaO of insoluble phosphate	45·17	39·70	36·31

For the other items proceed as with plain superphosphates.

Ammoniated superphosphates are valuable on account of the soluble P_2O_5, the nitrogen and the calcium sulphate they contain. The high value of the first two regulates the selling price. All chemical manures being for analytical purposes usually treated and stated the same way as a plain superphosphate, the results in those ammoniated as obtained in the usual way, and by methods as now proposed, are put in next column in Tables XI. and XII., for comparison.

Chemical analysis, whilst stating the accurate amount of the important items which regulate the price, should also state the other constituents as near as can be done, and if there be any glaring discrepancies between the amounts stated and the true percentage, any method enabling this to be overcome should be accepted and acted upon. Table XII. illustrates a plan superior to that of Table XI., by showing clearly, readily and accurately those components for which the manure is valued, and being much nearer the very rigid truth.

USUAL WAY.

TABLE XI.

	3 per cent.	6 per cent.	9 per cent.
Moisture (loss at 212° F)	11·66	12·15	9·18
Biphosphate..........	20·94	18·19	16·11
Equal to Bone Earth made soluble	(32·79)	(28·48)	(25·45)
Insoluble Phosphate..	5·23	3·86	2·19
Sulphate of Lime, anhydrous	37·66	32·30	29 79
*Alkalis, Combined Water, Organic Matter, etc.	20·97	33·06	42·40
(†Alkalis were not specially determined for this paper.)			
Insoluble Silicious Matters	0·51	0·41	0·33
	100 00	100·00	100·00
*Containing Nitrogen	2·45	5·06	7·30
Equal to Ammonia ..	2·98	6·15	8·87

NEW WAY OF SHOWING THE COMPOSITION OF AMMONIATED SUPERPHOSPHATE.

TABLE XII.

	3 per cent.	6 per cent.	9 per cent.
Moisture by calcium chloride method. ..	7·90	4 58	4·31
Soluble P_2O_5	15·02	13·05	11·66
Insoluble Phosphate..	5·23	3·86	2·19
Calcium Sulphate, anhydrous	45·17	39 70	36·31
*†Combined Water & Organic Matter, Alkalis, etc.	26·14	38·37	45·20
Insoluble Silicious Matters	0·51	0·44	0·33
	100 00	100·00	100·00
*Containing Nitrogen	2·45	5·06	7·30
Equal to Ammonia ..	2·98	6·15	8·87
Equal to Tricalcium Phosphate rendered soluble	32·79	28·48	25·45

† NOTE.—The alkalis, magnesia, and any other item can be put down as determined, and leave all the "etc." to be included with the commercially unimportant "combined water and organic matters."

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EXPERIMENTS ON HEISCH'S METHOD FOR DETECTING SEWAGE CONTAMINATION IN WATER.

BY FRANK E. LOTT, F.I.C.,

Associate of the Royal School of Mines.

HAVING in 1877 commenced a series of experiments for the purpose of testing the value of the so-called "sugar test" for sewage contamination, introduced by Mr. Heisch in 1870, and having followed out one or two special experiments which I have not seen before mentioned, I have taken advantage of our Association to make them public, hoping that my imperfect work may induce others with more time at their command to further investigate this interesting subject.

I will first explain the test as originally introduced by Mr. Heisch :—He says : "A mixture of 6oz. of sewage-contaminated water with 10gr. of crystalline cane sugar kept in a warm place developed a turbidity containing small spherical cells with, in most cases, a very bright nucleus. After the lapse of some days these cells gradually grouped themselves together in bunches, something like grapes ; they next spread out into strings with a surrounding wall connecting the cells together ; the original cell walls then seemed to break and leave apparently tubular sort of threads branched together." He also says : "The cells of these germs when thus developed are distinct evidence of sewage contamination, and the germs producing these cells are not removed by filtration through the finest Swedish filter-paper, neither are they destroyed by boiling for half-an-hour."

Shortly after this paper appeared Professor Frankland replied at some length in a paper on "The Development of Fungi in Potable Water," proving the fallacy of the above conclusion. He says, according to a paper in the *Journal of the Chemical Society* on "Fungi and Fermentation," by Mr. Bell : "My own experiments completely confirm Mr. Heisch's observations, with two important exceptions—viz., that the fungoid growths were not peculiar to water contaminated with sewage, and secondly, the germs from which they originate are present in all waters which have been even momentarily in contact with the air."

He then explained a series of very interesting experiments from which he concludes as follows :—"It is thus evident that the addition of minute traces of a phosphate, either as sodic phosphate, white of egg, or animal charcoal, at once determines these fungoid growths in saccharine water, which before exhibited no tendency to develop them." It was the consideration of Dr. Frankland's experiments, together with the knowledge that this method of examining waters was considerably practised, that led me to undertake the following experiments :—

My first experiments consisted in simply following out this test with waters from shallow and deep wells, and I had the good, or perhaps I ought to say the bad, fortune to have the water from several sewage-contaminated wells to experiment upon, and several samples of waters from wells which there was good reason to believe were directly connected with cases of fever—as an example, one shallow well-water (marked 18) yielded in two days a vigorous fermentation and strong odour of sulphuretted hydrogen, which on the third day was hidden by the disgusting odour usually accompanying butyric acid ; a considerable accumulation of flocculent masses of zoogl∞ated bacilli proved to be almost entirely clostridium butyricum, or, according to Van Tieghem, bacillus amylobacter. As this organism is of considerable interest in connection with these experiments, the following will not be out of place :—In a paper on "Glycerin Ferment," in the *Ber. Deut. Chem. Ges.*, Fitz thus describes what he names "butyl bacillus" : "They are cylindrical cells which increase by elongation and fission ; at one end of the cell a bright spot is formed, which is surrounded by a membrane constantly becoming more indistinct ; the rest of the mother cell grows paler and paler, and finally disappears entirely, only the short cylindrical resting spores with broad dim outlines and shining contents remain. It is two micro-millimeters in diameter and five or six long, and forms almost pure butyric alcohol when grown in glycerine. The contents of the cells are partly coloured by iodine of a violet approaching black, either the whole contents or single isolated patches of it (two or three), or sometimes only one small spot." I might add that this reaction with iodine does not take place at all stages of the growth of this organism. It depends also, to a great extent, upon the nourishing medium.

The results of these experiments will be seen on reference to Table I. on next page, in which I have given a few estimations of some waters experimented upon and the reactions of these waters when submitted to this test. It will be at once seen that the majority of these waters are very seriously contaminated. I would more especially ask you to follow the lines marked P_2O_5, and butyric fermentation, and see how far I am justified in saying the results corroborate Dr. Frankland's.

In the first place, I have a very hard Burton water taken from a tube 150ft. deep in the marl marked D.B., side by side with a fairly soft one, S.W., which is the South Staffordshire Water Works Company's supply to Burton, and in each case the P_2O_5 occurs only in traces and the butyric fermentation is absent. Under the head shallow wells are a number of samples mostly of Burton waters. The water marked N_2 is from a Burton shallow well carefully made, drawing water only from the surface of the impervious strata. The two columns A and B are analyses at different dates showing a very considerable variation and increased contamination in the latter sample marked A ; here we find the butyric fermentation and amount of phosphoric acid agreeing. L is a somewhat similar sample, though in this case as in the next two samples N, A and B, the wells were not carefully constructed, as they collected water at various points throughout their depth, and the well from which these two latter samples were taken was known to be contaminated by sewage.

The next two columns, 18, are samples of the contaminated shallow-well water before referred to, and it will be noted that there is a considerable variation in the analyses at different dates as regards the contamination. No. 274 is a deep well at an old country house, and the quantity of chlorine indicates a very extraordinary amount of contamination ; here, as in the other cases, the phosphoric acid and butyric fermentation agree together. The next three samples are from Burton shallow wells all seriously contaminated, but containing only traces of phosphoric acid. They exhibit no butyric fermentation.

In connection with the analysis 280, I would draw attention to a note on the free ammonia.

Four weeks after taking this sample, which was quite bright and clear, the free ammonia was reduced to less than 0·1, and nitrites before absent were present in considerable quantity. Two months later the free ammonia was 0·05, nitric acid 23·5, and nitrites entirely absent, proving the presence of the nitrifying organism or organisms in full activity in a sample which remained quite bright.

TABLE I.

ANALYSES EXPRESSED IN PARTS PER 100,000.

	Deep Bore.	Spring.	Shallow Wells.													Mixed.	Tube.
Number of Analysis—	50	30	25.		10.	25.		5.		1.	1.	1.	1.	1.	1.	1.
Mark in Journal—	D. B.	S. W.	N. 2.		L.	N.		18.		274.	23.	263.	280.	53.	60.	162.
			A.	B.		A.	B.	A.	B.							
Total Solids at 110° C	212·0	29·0	180·0	136·0	150 0	112·0	70·0	80·5	80·5	134·5	125·0	185·0	151·5	226·5	190·0	135·6
Free NH_3	9·001	0·001	0·06	0·002	0·025	0·001	0·002	0·001	0·001	0·001	0·10	0·06	0·15	0·10	0·007	0 025
Alb. NH_3	0·005	0·005	0·02	0·005	0·013	0·007	0·015	0·005	0·015	0·025	0·03	0·015	0·017	0 05	0·007	0·015
Cl	8·2	1·5	12·0	9·5	11·5	8·0	10·0	3·9	6·0	12·8	8·5	7·5	11·3	15·2	11·8	9·5
N_2O_5	8·5	1·6	27·0	20·0	31·5	16·5	4·0	6·0	10·5	8·5	33·5	11·5	22·5	40·5	6·5	21·5
P_2O_5	Merest Trace.	Traces.	Distinct Traces.	Merest Trace.	Traces.	Estimable Amount.	Estimable Amount.	Estimable Amount.	Estimable Amount.	Estimable Amount.	Traces.	Traces.	Traces.	Distinct Traces.	Merest Trace.	Traces.
Butyric Fermentation	None. Note 1.	None.	Slight.	None.	None.	Active.	Active.	Active.	Active.	Active.	None.	None.	None.	Slight.	None.	None.
Butyric after adding 0·5grm. $POHONaO_2$ Note 5.	Active. Note 2.	Active.	Active.	Active. Note 4.	Active.	— Note 3.	—	—	—	—	—	—	— Note 1.	—	Active.	—
CaO	78·0	6·7	32·0	23·0	31·0	29·5	20·0	—	—	—	—	—	—	—	—	—
MgO	11·8	2·1	12·5	10·0	10·0	6·3	5·0	—	—	—	—	—	—	—	—	—
Na_2O	6·9	2·5	3·5	7·5	8·0	9·2	5·1	—	—	—	—	—	—	—	—	—
CO_2	10·0	5·5	11·0	9·8	10·2	10·5	7·8	—	—	—	—	—	—	—	—	—
SO_3	101·5	3·0	12·5	41·0	39·5	27·0	15 0	—	—	—	—	—	—	—	—	—

NOTES.

1. See Paper.
2. +0·1 P_2O_5 = active Butyric Fermentation in 2 days.
3. After boiling, Butyric Fermentation 24 hours later.
4. + 0·5 $P_2O_2CaO_3$ = active Butyric Fermentation in 2 days.
5. Distilled Water with $POHONaO_2$ gave no Fermentative action.
6. See Paper.

ON THE GROWTH OF THE BUTYRIC FERMENT.

EXPERIMENT VI.

(Three Quarter-Litre Bottles of Deep Bore Water, D.B.)

Date. 16–2–'78	A.	B.	C.
16–2	+ 1·3grms. cane sugar. + 0·2grm. $POHONaO_2$ —	+ 1·3grms. cane sugar. + 0·2grm. $POHONaO_2$ + 0·5grm. NO_2KO	+ 1·3grms. cane sugar. + 0·1grm. $P_2O_2NH_4O_2$ + 0·5grm. NO_2KO
19–2	Gas evolved, acid smell active M. Aceti.	Acid smell. Short rod bacteria.	Acid smell, very active B. Subtilis. Long wavy leptothryx forms.
20–2	Butyric fermentation chains of oval cells.	—	M. Aceti in single cells. Irregular large Sacc. Pastorianus.
21–2	Chains of nucleated cells Clos. Butyricum.	—	No B. Subtilis forms, but a few Clos. Butyricum.
26–2	Large number of nuclei alone.	Jointed bacteria.	Large amount of nucleated S. Minor. A few cells of Clos. Butyricum.
4–3	Masses and rows of bright nuclei.	Thick granular bacteria.	Granular Sacc. Minor. A few bacilli forms.
7–3	Chains of nuclei. Groups of empty sacs, very transparent.	A few bright nuclei. Leptothryx forms of bacilli.	Healthy Sacc. Minor. [Grew well as a bottom ferment in beer wort. Exp. XII.]

EXPERIMENT VII.

(Two 100cc. Pasteur flasks with distilled water. 0·5grm. Cane Sugar and 0·1 $POHONaO_2$ sterilised.)

21–2–'78	1.	2.
21–2	+ 2 drops of solution, A, Exp. VI.	+ 2 drops of a putrid beer containing thick deposit of "chain vibrios."
26–2	Active butyric fermentation, healthy growth of Clos. Butyricum. NOTE 6.	No sign of Clos. Butyricum.

22–2–'78

EXPERIMENT VIII.

Deposit from A, Exp. VI., placed in two small Pasteur flasks containing 1 beer, 2 wort, examined at intervals during the following month. No butyric fermentation, all cells of Clos. Butyricum dead.

EXPERIMENT IX.

23–2–'78.	I.	I.*a*
23–2	250cc. bottle + water No. 18 + 1·3grms. cane sugar + 0·2grm. salicylic acid.	100cc. bottle + water No. 18 + 0·5grm. sugar.
25–2	—	Slight deposit.
4–3	—	Healthy growth; Clos. Butyricum 10% nucleated; free nuclei SH_2 and butyric fermentation.
8–3	—	Fermentation very active; 70% cells nucleated.
11–3	Slight dimness.	No further activity; cells less regular, all nucleated, lengthy and bent.
18–3	Milky; no smell.	—
30–3	Poured off liquid and added 1% solution of glycerin.	—
10–4	No growth of Clos. Butyricum.	—

6–3–78

EXPERIMENT X.

(A Quarter Litre Bottle of Water, D.B. + 1·3grm. Cane Sugar + 2cc. liquid, and deposit from A, VI.)

8–3 Gas evolved. Growth of Clos. Butyricum.

11–3 Butyric fermentation over, SH_2 in bottle. Full of shrunken zooglœated Clos. Butyricum. Added 0·5grm. $POHONaO_2$. Little further activity.

NOTE 6.

6-3-'78. EXPERIMENT XI. NOTE 6.

6-3 A 100cc. Pasteur flask, with 50cc. distilled water, 0·5grm. of cane sugar and 3cc. of solution and deposit 1.*a*, Exp. IX.

8-3 Cells of Clos. Butyricum spores, etc.; large number of irregular-sized circular nucleated cells.

11-3 Zooglœa of short thick bacteria; spores of Clos. Butyricum. Added 0·5grm. $POHONao_2$ + 1grm. sugar.

11-3 Further growth chiefly nucleated circular cells = saccharomyces.

EXPERIMENT XV.

(Three Quarter-Litre Bottles.)

26-3-'78	3.	2.	1.
26-3	Water No. 18 + 1·2grms. cane sugar. Kept neutralised with lime water.	Distilled water + 0·2grm. fused $P_2O_5Amo_2$, boiled and added 1grm. sugar.	Distilled water + 0·2 $POHONao_2$, fused, boiled and added 1grm. sugar.
27-3	Dim.	—	—
28-3	Cloudy, film on surface and at bottom consisting of zoogleated masses of short bacteria, bright spores and minute transparent sacs.	—	—
30-3	Active butyric fermentation. Thick deposit of short, straight bacilli, 70 per cent. nucleated indistinct cells, turned blue with iodine not the nuclei. Neutralised.	Slight dimness and deposit of small circular (Sacc. minor) and oval cells.	Clear.
1-4	Active butyric fermentation, worn crystals, long nucleated cells coloured by iodine. Neutralised.	Zooglæa of Clos. Butyricum non-nucleated, and not coloured by iodine, granular saccharomyces; acid.	Clear.
3-4	Nuclei more distinct.	—	—
5-4	Cell walls fading; nuclei very bright. Faded cells not acted on by iodine.	S. minor in quantity, budding. Zooglæa of bacilli; no reaction with iodine.	Clear. NOTE 6.

TABLE III.

Of 40 samples of water taken by the Rural Sanitary Inspector (Burton-on-Trent) from wells used at houses in which fever or some other zymotic disease had been prevalent, when submitted to the sugar test:—

6 Remained unchanged.

8 Became dim within six days, but underwent no further change.

5 " " with some peculiar woody, sweet or sour smell.

5 Became dim on the second day, and turbid or milky, with a sour smell on the fourth or fifth day.

3 Became dim on the second day, with butyric smell.

7 Dim within 24 hours, and butyric smell and gas on fourth or fifth day.

6 Dim within 24 hours, and butyric smell and gas on second day.

I much regret having been unable at the time to isolate the organism and submit it to further investigation.

I failed to detect any organism with a microscope magnifying 400 diameters.

I might observe that these three wells are, in all probability, contaminated by garden drainage, and draw a large amount of their supply from an old river course, largely filled by peaty matter and partly built over.

53 is a somewhat similar sample, but from a locality nearer the old river course above referred to, and contaminated by surface drainage. The amounts of chlorine and nitric acid in this sample are both excessive.

60 is a mixed sample of deep and shallow well waters; the amount of chlorine is considerable.

162 is a tube drawing water only from the surface of the impervious marly strata, and, therefore, not likely to be contaminated by *fresh* surface drainage, though evidently seriously contaminated.

My second series of experiments was on the action of various mineral salts on the growth of different bacteria, and more especially on clostridium butyricum. The results will be found in Table I. on the line below the one marked butyric fermentation,—from which it will be seen that the simple addition of phosphate of soda to almost any quality of well water set up active butyric fermentation,—in Notes 2, 4 and 5 on the same table, and in the tables of experiments.

NOTE 6.—The difference of the reaction in the cases (Experiments 7, 10 and 11) from that quoted in Note 5 and Experiment 15, I attribute to the fact that in these cases the cells of the butyric ferment were added in a state of full activity, whereas in the latter cases only the dry spores would probably gain access; though possibly the amount of the liquid added (2 drops, 2cc. and 3cc) may have been sufficient to alter the composition of the whole and enable the organism to grow.

A third series of experiments on waters thought to be impure by the Rural Sanitary Inspector of Burton, is also added as throwing some light on this subject. (See Table III.)

I have no doubt that the last four classes, including 21 out of the 40 samples, were very bad; and in some cases, in the two last classes, subsequent investigation proved the direct contamination of the wells by closet drainage.

All these experiments are entirely in accord with Dr. Frankland's, and my only reason for bringing them forward is, that being applied to potable waters, they are of some interest as indicating how far this test may be looked upon for information as regards the purity of such waters; on this head my experiments would lead me to conclude that—

(1.) Any water undergoing butyric fermentation when simply treated with cane sugar and kept at a temperature of about 80° F., may be at once condemned as unfit for domestic use.

(2.) The single fact of a water not undergoing butyric fermentation is no proof of its purity.

(3.) A water which remains *clear* under this treatment would be certainly less likely to be contaminated by sewage than one which became milky, and I doubt the possibility of unoxidised sewage matter being in a water which remained quite clear.

(4.) The butyric ferment is not perceptibly influenced by the presence of abnormal amounts of chlorine, free ammonia, albuminoid ammonia, sulphates and nitrates in a water, but is a very accurate indicator of the presence of phosphoric acid.

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ON THE SEPARATION OF ZINC FROM NICKEL AND MANGANESE, AND THE ESTIMATION OF NICKEL.

BY THOMAS BAYLEY.

A good separation of zinc from nickel and from manganese may be made in a hot solution containing free phosphoric acid. The liquid is mixed with ammonia till a precipitate forms, and a fairly large excess of di-sodium hydrogen phosphate is then added. The solution is next cleared with hydrochloric acid added in drops, saturated with sulphuretted hydrogen, and allowed to stand a considerable time, the gas still passing through it. Zinc sulphide falls as a heavy granular powder and the mixture filters very rapidly. Manganese and nickel appear to be perfectly separated, and no trace of the former can be detected by fusion with oxidising flux. Cobalt has a tendency to go down in small quantity, and if zinc sulphide so contaminated be burnt directly to oxide, the cobalt imparts a green tint to the roasted product. In this way cobalt betrays its presence in many samples of German silver, not only in the phosphate separation, but in cases where the zinc is separated from nickel by precipitation in presence of a large excess of acetic acid. The co-precipitated sulphide of cobalt imparts a pale yellow tint to the sulphide of zinc in the method by phosphoric acid, a dark tint in the other case. Iron is partially precipitated by sulphuretted hydrogen in presence of phosphoric acid. In order to precipitate nickel from solutions (containing phosphoric acid or otherwise), I have found it advantageous to add ammonium sulphide till the last drop renders the liquid alkaline ; this is followed by ammonium benzoate and afterwards by a few drops of hydrochloric acid. In this solution (acidulated with a *feeble* acid) the nickel is completely precipitated. A constant current of sulphuretted hydrogen should be passed through the boiling liquid, and filtration should take place at the same temperature as nearly as possible. In one experiment where boracic acid replaced the benzoic acid a good result was obtained. The precipitated sulphide of nickel may be brought down to Ni_2S by prolonged ignition for an hour with sulphur in a closed crucible, the sulphur being replenished from time to time. But a better plan is to roast the precipitate in a porcelain dish, dissolve it in nitric acid, evaporate, ignite, and weigh as sulphate. The ignition should be effected at very low redness and the dish allowed to cool. The sulphate is then remoisted with sulphuric acid and submitted to a further *short* ignition. Success would appear to depend upon the shortness of the second ignition. Heating to a lower temperature for a longer time, and in the absence of free sulphuric acid has been said to yield a basic sulphate of nickel. This method of weighing nickel has been successfully employed by other chemists.

ON A REACTION OF IRON WITH NITRIC OXIDE.

BY THOMAS BAYLEY.

When an assay of "nitre" in vitriol is made in the nitrometer, an error is caused by absorption of nitric oxide when the vitriol contains iron. The absorption is due to the well-known reaction of ferrous salts with nitric oxide, but the result is the same whether the iron be originally present in the ferrous, or, as is more usual, in the ferric condition. Nitric oxide shaken with mercury and pure sulphuric acid, suffers no absorption, nor does mercury pass into solution in the acid. If, however, a little ferric sulphate be contained in the vitriol, mercury becomes dissolved and the iron is reduced to the form of a proto-salt. Upon copiously diluting the vitriol by admission of air-free water, and subsequently adding a solution of a ferricyanide to the cooled acid liquid, the blue reaction can easily be obtained. That the colouration is not caused by any action of nitric oxide upon the ferricyanide may be demonstrated by boiling off the gas (with suitable precautions) before applying the test. The mercury appears to take no part in the reduction of ferric salt, since the results can be equally well obtained if pure nitric oxide (prepared from $FeSO_4$ and HNO_3) be passed through a set of Geissler bulbs, charged with sulphuric acid containing ferric sulphate. The sulphuric acid in this case, as in the nitrometer experiment, assumes a purple or "raspberry" tint, which is characteristic of the reaction when it takes place in the acid, but not in the aqueous solution. Care must of course be taken to remove air from the apparatus by a current of carbon dioxide. The experiment may also be made in the absence of mercury by means of a nitrometer slightly modified as in Fig. 1.

Fig. 1.

Fig. 2.

The instrument is filled with mercury, and sufficient sulphuric acid admitted to depress the mercury below the lower tap. A little acid containing iron is next passed in, and this is followed by nitric oxide. The lower tap is turned off, and the nitrometer shaken, when the purple tint immediately appears. Even for ordinary experiments the second tap is useful, but it must then be placed at the bottom of the measuring tube, Fig. 2. By turning it, the pressure of the mercury in the ungraduated limb is cut off, and the three-way tap can be manipulated without any danger of drawing in air through the axial channel. The formation of the purple solution referred to above was demonstrated at the meeting by passing NO through bulbs containing sulphuric acid in which a little pure ferric hydrate had recently been dissolved.

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DISCUSSION ON MR. TERVET'S PAPER ON "AN IMPROVED APPARATUS FOR THE MANUFACTURE OF REFINED PARAFFIN WAX" (THIS JOURNAL, VI. 355).

MR. GRAY asked if Mr. Tervet considered it an advantage to use the apparatus two or three storeys high, as in the ordinary method of refining paraffin scale it was considered advisable to re-melt and cool the scale between each operation, thereby ensuring better crystallisation of the scale or semi-refined wax. By this means also better sweating was obtained, and the impurities bled out more freely; whereas by Mr. Tervet's apparatus it was simply dropped from one chamber to the other without re-crystallising.

Mr. TERVET, replying, said from the construction of his apparatus it was intended to complete the operation of refining with one crystallisation. As had been explained, the present method was divided into two or three stages. The several cells in this apparatus represented those stages, and it only required that the heat should be properly regulated to obtain a result in all respects equal in quality, and with greatly increased quantity, at a single crystallising. So far as he had been able to find, there was no advantage of re-crystallising at two or three successive stages, as paraffin, long before it reached the "sweating" temperature, lost its crystalline structure, and assumed a fibrous nature which greatly favoured the process of sweating. From the diagrams in the Journal it would be seen that in making refined wax a certain quantity of intermediate paraffin had to be added before the last crystallising. With this apparatus those fractions originally present in the paraffin scale were retained until the material reached the lowest cell of the apparatus, or the point at which the refined article is produced.

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DISCUSSION ON MR. DAVIDSON'S PAPER ON "THE ESTIMATION OF IRON IN CHARS" (THIS JOURNAL, VI. 421).

DR. MILNE said he was glad to find that Mr. Davidson had gone into this matter, as, to the sugar refiner, the exact amount of char was a matter of the first importance, and of course a correct method was a *desideratum.* Twenty years ago he had large practice in the analysis of animal charcoals, pan even then the permanganate and bi-chromate processes were rather discarded as being unfitted for the determination of minute quantities of iron. At that time the stannous chloride process was also used, and his own impression was that for the determination of small quantities of iron it was everything that could be desired. He was also glad to find that Mr. Davidson had adopted an extremely classical method of oxidising by means of peroxide of hydrogen, as this was, in his opinion, one of the most elegant oxidising agents that could be wished for, and perhaps the oxidising agent of the future.

Mr. TERVET asked in what condition did the iron exist in chars? He had understood, from a correspondence which appeared in the *Chemical News* some years ago, that a certain proportion of the iron was supposed to exist in the form of sulphide, FeS. But the proportions found were so small, and the interest in the question so great, he should be pleased to know what action the sulphides had upon the sugar or upon the operations of the refinery.

Mr. DAVIDSON, in reply, said that so far as his knowledge went the "tin" process was discredited by some, and he knew of several in the trade who preferred either the "permanganate" or "bichrome" processes to the above-mentioned. Tucker also spoke only of the permanganate process in his book, which was almost the only one in English on sugar analysis. With reference to Mr. Tervet's remarks as to the existence of iron sulphide in chars, he believed it would be difficult to demonstrate its presence. The sulphur was assumed to be in combination with calcium, which was a more likely thing. The objection to the presence of iron in chars was that it passed into the sugars, thus deteriorating infusions of tea with which they would be used.

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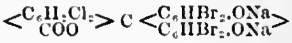
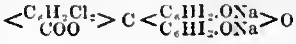
ERRATA.—In Mr. Bothamley's paper, in the June issue, p. 428, 1st column, 9th and 11th lines from bottom, *for* "B" *read* "*b.*" P. 428, 2nd column, in the wood-cut, *for* "B" *read* "*b.*" P. 430, 1st column, the formula for phloxin should be—



$$<\begin{matrix}C_6H_2Cl_2\\COO\end{matrix}>C<\begin{matrix}C_6HBr_2.ONa\\C_6HBr_2.ONa\end{matrix}>O$$

The formula for rose Bengal should be—



$$<\begin{matrix}C_6H_2Cl_2\\COO\end{matrix}>C<\begin{matrix}C_6HI_2.ONa\\C_6HI_2.ONa\end{matrix}>O$$

Journal and Patent[*] Literature.

I.—GENERAL PLANT, APPARATUS AND MACHINERY.

Invention to Purify Water for Steam Boilers by Filtering the same under pressure of Steam through Mineral, Vegetable, or Animal Charcoal. W. Cotton, London. Eng. Pat. 5963, May 3, 1886. 8d.

THE water is forced by a steam injector into the lower part of a vertical cylindrical vessel, where it deposits the carbonates precipitated by the heat. A diaphragm in the upper part of the cylinder carries a filtering material —*e.g.*, coke—through which it passes on its way to the boiler. An escape for steam is provided at the highest part of the vessel.—C. C. H.

Improvements in Filtration. J. G. Lorrain, London. Eng. Pat. 6813, May 20, 1886. 8d.

THE improved filter consists of a number of spherical balls of an elastic substance, such as rubber, and preferably hollow, placed in a vessel of suitable shape between two plates. When the plates are pressed together the spaces between the balls are diminished, and thus the degree of fineness of filtration can be adjusted between that attainable when the balls rest on each other without pressure and the complete cessation of the operation when the interstices between the balls completely disappear. Such a filter admits of being cleansed rapidly and completely.—C. C. H.

Improvements in Filters. G. F. Marshall, Battersea. Eng. Pat. 7088, May 26, 1886. 8d.

THE filters to which the improvements are applicable are the domestic water filters of the carbon block type, and the novelty consists in enclosing the carbon filtering block in a case or cover so as to contain air. Each time the water is renewed in the filter, this space is refilled with air, and it is forced through the block along with the filtered water, which is thus thoroughly aerated.
—C. C. H.

Improvements in Means for Softening and Purifying Water. J. S. Sawrey, London. Eng. Pat. 9227, July 15, 1886. 8d.

THE mixture of the hard or impure water with the reagents, used either in a solid or liquid form, is thoroughly agitated by means of a mechanical agitator, steam or compressed air; in some cases it may be found convenient to combine certain or all of these methods of agitating.—C. C. H.

Improvements in Filter-presses. A. W. Anderson, London. Eng. Pat. 11,244, Sept. 4, 1886. 8d.

THE improvements specified relate to the older form of wooden filter-presses. They consist of (1) forming the cloth like a sack or bag, which covers entirely the filter plate; (2) the combination of this form of cloth with a ribbed filter plate; (3) the use of a screw clip nut of the ordinary form securing the cloth round the central orifice which serves as a passage between the chambers.
—C. C. H.

Improvements in Filter Presses. H. E. Newton, London. From W. Baur, Brooklyn, U.S.A. Eng. Pat. 4425, March 24, 1887. 8d.

THE improvements make provision for the use in a filter-press of such materials as sawdust, animal charcoal or other granular material, as a filtering medium. The chambers are constructed, in the well-known manner, by means of ribbed plates and distance frames. Hoppers are formed on the upper part of the distance frame, for the introduction of the filtering material, and similar provision is made for its removal from the lower part of the frame.—C. C. H.

II.—FUEL, GAS AND LIGHT.

The Influence of the Length of the Photometer on the Resulting Measurements. D. Coglievina. Journ. f. Gasbel. u. Wasservers. **30**, 88.

THE author agrees with Krüss (*Chem. Zeit. Rep.* **10**, 265) that the length of the photometer influences the results, but points out the necessity of taking into consideration the varying quality of the gas in different parts of the same circuit, due to minute and unavoidable leakages. He recommends a round burner in place of a fish-tail flame and the use of a long photometer.
—C. A. K.

Improvements in the Methods and Appliances for obtaining and Cleansing Gas from Coal. T. Nicholson, Abergele. Eng. Pat. 5727, April 27, 1886. 8d.

THE retorts are made airtight, and dried steam is passed through the charge. This is to hasten the process of gasification and increase the yield of gas. A scrubber is dispensed with by passing the gas through a series of small chambers divided by horizontal partitions into three compartments. The topmost of these compartments has a perforated floor, through which water trickles on to the gas passing below. The lowest chamber is for the tar, etc., deposited with the water. The flow of gas is aided by a steam jet.—A. R. D.

Improvements in and applicable to Gas Producers. W. S. Sutherland, Birmingham. Eng. Pat. 7112, May 27, 1886. 8d.

THESE improvements relate to producers of the type described in Eng. Pat. 1784 of 1874, Eng. Pat. 8053 of 1884, and Eng. Pat. 5915 of 1886. The producer is to be provided with a grate which can be moved both circularly and to and fro by means of a lever. Below the grate is placed a wind chest for the introduction of an air blast, and arrangements are also made for a steam supply if desired. A check-valve prevents the gas from being drawn back into the air mains and passages, while a safety valve, consisting of a canvas-rubber disc secured over the open end of a straight lead in the air supply pipe, relieves the pressure by being easily ruptured in case of an explosion.—A. R. D.

Improvements in the Purification of Coal Gas. C. F. Claus, South Wimbledon. Eng. Pat. 7580, June 5, 1886. 11d.

THESE improvements refer to a process for purifying coal gas in close vessels with ammonia only. The gas, previously freed from tar, is passed through a series of scrubbers, consisting of towers packed with porous material, down which trickles the spent liquor to be mentioned hereafter. When the gas has passed through two of the series of say five scrubbers, a quantity of ammonia gas is introduced into the current sufficient to combine with the impurities that the gas is estimated to contain. As the washing liquor is pumped from scrubber to scrubber in a direction contrary to the flow of the gas, it will be seen that the whole of the ammonia (both introduced and originally present in the

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[*] Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.........	½d.
Above 8d., and not exceeding 1s. 6d...	1d.
,, 1s. 6d., ,, ,, 2s. 4d...	1½d.
,, 2s. 4d., ,, ,, 3s. 4d...	2d.

gas) is contained into the liquor flowing from the bottom of the last tower. This liquor is carried away to another series of towers forming an ammonia regenerating plant. Here the liquor is first heated to about 200 F., whereby the carbonic acid and sulphuretted hydrogen are driven off, as is also a little free ammonia. This last is absorbed in a tower fed with spent liquor or dilute sulphuric acid, and the two first-named gases go forward to sulphur recovery plant. After the removal of the carbonic acid and sulphuretted hydrogen the liquor is treated with naked steam, which drives off all free ammonia and that existing as carbonate and sulphide. This ammonia is recovered in a condensing or catch-tower, and is available for re-introduction into the scrubbing system as above described. The residual liquor, charged with fixed salts of ammonia, is partly used for feeding the scrubbers, and is partly removed to be dealt with as ammoniacal liquor in any ordinary way.—A. R. D.

Improvements in the Preparation of Ammonia Compounds from Coal Gas. C. F. Claus, South Wimbledon. Eng. Pat. 7582, June 5, 1886. 8d.

In purifying coal gas by ammonia as described by the inventor in patents 7580 and 7584 (see abstracts) the ammonia contained in the crude gas is constantly withdrawn for sale, whilst a quantity or stock of ammonia is kept in circulation for the purpose of purification. The present invention has for its object the convenient and economical removal of this surplus ammonia. This is effected by converting the same without distillation either into ammonium carbonate or ammonium sulphate. The requisite surplus ammonia equal to that contained in the crude gas may be withdrawn either from one of the heating towers or from the tower next it in the form of nearly pure carbonate, whilst for the purpose of recovering the ammonia as sulphate, the first wash-tower or the equivalent sulphuric acid catch-tower may be replaced by one or more lead-lined towers filled with pebbles or the like, down which a regulated quantity of sulphuric acid trickles, or an acid saturator may be interposed between the second wash-tower and the first acid catch-tower.

—D. B.

Improvements in the Purification of Coal Gas. C. F. Claus, South Wimbledon. Eng. Pat. 7584, June 5, 1886. 11d.

This system of purification resembles, in its main features, that described in Eng. Pat. 7580 (see abstract above). The ammonia vapours produced in the distilling apparatus by the action of naked steam upon the scrubber liquors (from which the sulphuretted hydrogen and carbonic acid have been eliminated by a previous heating) are condensed and used for washing the gas in the scrubbers. The two scrubbers last traversed by the gas are served solely by the spent liquor resulting from the distilling plant. Their special function is to recover the ammonia contained in the gas after it leaves the other three scrubbers. In these latter are used the condensed ammonia liquors above mentioned, together with the liquor coming from the two first-named scrubbers.

—A. R. D.

Improvements in the Purification of Coal Gas. C. F. Claus, South Wimbledon. Eng. Pat. 7585, June 5, 1886. 8d.

At the top of one of the scrubbers described in Patents 7580 and 7584 (see preceding abstracts), a quantity of finely-ground sulphur is introduced, more than can be dissolved by the ammonium sulphide present in the scrubber. The advantage claimed is the elimination of carbon bisulphide from the gas.—A. R. D.

An Improved Vapour Lamp for use with Incandescent Mantles. S. Siemang, Vienna, Austria. Eng. Pat. 8097, June 18, 1886. 8d.

This is a lamp for converting liquid hydrocarbon into gas and burning it as such The hydrocarbon is conveyed from its store receptacle by a wick to a gasifying chamber, where it is heated by the combustion of a small quantity of the gas made in the apparatus, and from which it passes in the gaseous form to the burner. Air is allowed to mix with the gas before it reaches the burner. For details the specification must be consulted.—A. R. D.

Improvements relating to the Purification of Gas and the Impregnation of the same with Hydrocarbon or other Vapour, and to Apparatus therefor. G. Symes, Limehouse Eng. Pat. 8484, June 28, 1886. 8d.

The apparatus consists of a casing divided into two chambers by a vertical partition. In the one is placed a series of oxidised iron plates, supported by pivots or trunnions resting in bearings formed in the casing. In the other chamber, perforated iron plates are arranged one above the other, and the spaces between filled with cotton waste or other absorbent material. Upon the topmost plate is situated a perforated receptacle for camphor or other suitable volatile disinfectant. At the top of the casing is a dome with a self-acting valve for regulating the passage of the gas through the apparatus. The gas passes downwards through the first-named chamber, and is freed from sulphur compounds by contact with the oxidised iron surfaces. It is then purified from ammonia, etc., by passing upwards through the cotton waste in the second chamber, at the top of which it mingles with the vapours given off by the camphor in the perforated receptacle.—A. R. D.

An Improvement in Apparatus for Enriching Gas by Admixture of Hydrocarbon Vapour. J. Livesey, London; and W. Whitehouse, Birmingham. Eng. Pat. 9473, July 21, 1886. 8d.

The carburetter is a vessel partly filled with naphthalene and heated by radiation from the burner in the usual way. The aperture by which the naphthalene is charged is closed by a seating carrying a plug. The gas passage from the service pipe lies through this seating, and the plug is so perforated that when in one position the gas passes directly to the burner without entering the carburetter, while, when the plug is in another position, the gas passes through the carburetter. Intermediate positions allow the gas to go both ways in such proportions as may be desired.—A. R. D.

Improvements in Apparatus for Carburetting Air. J. H. Johnson, London. From E. D. Debouteville and L. P. C. Malandin, Fontaine-le-Bourg, France. Eng. Pat. 9598, July 24, 1886. 8d.

The leading feature here is the simultaneous introduction of a jet of hydrocarbon and a thin stream of hot water. The two play upon a dividing surface which distributes the liquid in a thin film over a helical brush, which completes the mixing and assists the evaporation. This introduction of hot water prevents the excessive cooling otherwise produced by the evaporation of the hydrocarbon, and causes the retention of much solid matter, which would otherwise go forward with the gas and limit its field of application.—A. R. D.

An Atmospheric Gas Burner. O. Imray, London. From C. A. von Welsbach, Vienna, Austria. Eng. Pat. 9755, July 28, 1886. 8d.

This burner consists of a tube having its lower portion constructed like that of a Bunsen burner, whilst its upper end spreads out into a chamber of hemispherical form. This chamber is provided with a cover that does not quite extend to the periphery, so that an annular slit is left for the passage of the mixture of air and gas, which forms, when burning, an annular flame. The hemispherical shell is connected with the cover by a number of tubes. These are open at both ends and admit a further supply of air to the interior of the annular flame. As this burner affords very little luminosity but an intense heat, the flame is particularly suitable for an incandescence system of lighting.—A. R. D.

Improvements connected with the Manufacture of Water Gas and other Gases for Lighting, Heating and Manufacturing Purposes, and in Apparatus therefor. S. Levy, London. From G. H. Kohn, Denver, U.S.A. Eng. Pat. 927, Jan. 20, 1887. 8d.

THE apparatus consists mainly of three cylinders. An air blast is forced through fuel contained in the middle one of these, the generator; and the products of combustion are used to heat the other two, which are packed with brickwork. When these are sufficiently heated, steam is forced into one of them, and passes superheated through the still incandescent fuel in the generator. The gas on leaving here may be mixed with a spray of oil, the whole being fixed and rendered homogeneous in the third cylinder.—A. R. D.

Improvements in the Manufacture of Steam and Oil Gas for Fuel and for Illuminating Purposes. A. J. Boult, London. From H. W. Brooks, Philadelphia, U.S.A. Eng. Pat. 2749, Feb. 22, 1887. 8d.

A MIXTURE of steam and oil is injected into a series of retorts built in sections of such shape as to form a serpentine passage. These retorts are provided at intervals with disintegrators consisting of cylinders with perforated sides, having the end opposite to the steam and oil inlet closed. By this means the stream of gas or mixture of oil and steam, passing along the retort is constantly broken up and made to impinge upon the sides of the retort, the result being a fixed gas of great purity and uniform quality.—A. R. D.

Improvements in Apparatus for Enriching Gas. H. J. Siebel, jun., Reading, Penn., U.S.A. Eng. Pat. 2752, Feb. 22, 1887. 6d.

THE gas supply-pipe passes upwards through a box of sheet metal which is partly filled with sticks of naphthalene. The upper portion of this pipe is enclosed within another pipe with an enlarged head, and the burners are placed so near that this is heated by the flames. The gas passes upwards through the supply pipe into the enlarged head of the outer pipe, where it is heated to such a degree that, passing down through the annular space between the two pipes into the carburetting chamber, it causes the disengagement of naphthalene vapours and passes away, mingled with these, by any suitable outlet to the burners.—A. R. D.

Improvements in the Purification of Coal Gas and Apparatus therefor. C. W. Watts, London. Eng. Pat. 3267, March 3, 1887 8d.

IN Eng. Pat. 7585 of 1886 (see abstract, p. 502), C. F. Claus proposes to eliminate carbon bisulphide from coal gas by scrubbing with ammoniacal liquor that has been in contact with solid sulphur. The present invention provides for such sulphurisation of ammoniacal liquor by allowing it to percolate through a mass of sulphur on its way to the scrubber. The sulphur is contained in a tank, and the liquor may be drawn off at various depths, the height at which it stands in the tank determining the sulphur surface exposed and hence, the degree of sulphurisation. —A. R. D.

Improvements in Apparatus for Vaporising and Burning Liquid Hydrocarbons. W. G. Bussey, New York, U.S.A. Eng. Pat. 5026, April 5, 1887. 8d.

THE vaporising chamber, preferably of not less than 25 cubic inches capacity, is made of any suitable metal and is provided with an inlet pipe for the admission of liquid hydrocarbon. Pipes from the upper part of this chamber conduct the vapours to mixing tubes so disposed that the flames proceeding from the tube tops impinge upon the chamber walls. These mixing tubes are simply pipes in which the hydrocarbon vapours mix with air admitted by an aperture in the side or bottom. They may be provided with gauze caps to prevent the return of the flame. When starting the apparatus, oil is admitted to the vaporising chamber, which is then heated by any suitable means. The vapours evolved burn at the tops of the mixing tubes and, besides heating the vaporising chamber, give off heat available for other purposes. The high tension of the gases in the vaporising chambers makes it essential that the hydrocarbon be admitted under pressure.—A. R. D.

Improvements in the Purifying of Hydrocarbon Oils. A. J. Boult, London. From D. M. Kennedy, Petrolia, Canada. Eng. Pat. 6018, April 25, 1887. 4d.

ONE POUND of sulphate of copper, one pound of caustic soda and one pound of common salt are dissolved in two gallons of water and added to forty gallons of the oil to be treated. The mixture is then kept at the boiling temperature in a still for about an hour. By this treatment the oil is rendered pure and free from sulphur, so that it neither encrusts a wick nor gives an offensive smell when burning.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Decolorisation of Carbolic Acid S. Demant. Zeits. österr. Apoth. Ver. **25**, 150.

CARBOLIC ACID which has turned red may be decolorised by mixing it, after melting, with alcohol in the proportion of 89 parts to 11 of alcohol. The mixture is then crystallised and the red liquid drained from the colourless crystals.—C. A. K.

Influence of Mineral Substances, especially of Lime, on the Dry Distillation of Coal. Knublauch. Journ. für Gas. u. Wasservers, **30**, 55 and 96.

GAS COAL was mixed with 2½ per cent., 5 per cent. and 10 per cent. of ordinary powdered and burnt lime, and in one case with 5 per cent. of silica. The table below shows the difference in yield of the various products per 1000kilos. of coal burnt :—

1000kilos. Coal yielded:		Lime added.			Silica added.
		2·5 p.c.	5 p.c.	10 p.c.	5 p.c.
Gas	cc. more	14·7	20·1	35·3	21·5
Coke	kilos. more	16·8	18·2	17·5	27·4
Tar	„ less	5·2	7·9	9·0	11·8
Ammonia	„ more	0·483	0·608	0·929	0·15
Sulphate	„ more	2·02	2·53	3·88	0·67
Sulphuretted hydrogen.	„ less	1·42	1·58	1·81	0·21

The yields of the various products do not appear to bear any proportion to the amount of admixed substance. The increase in the yield of coke being greater than the decrease in that of tar, it is clear that the gas will contain less carbon, and therefore possess less illuminating power, than when the coal is distilled alone. With 2½ per cent. of lime added, the yield of gas is increased 5 per cent., but its illuminating power diminished 5 per cent. Further, although the yield of coke is increased, it still contains the lime or silica mixed with it, which considerably lessens its value. An increase in the amount of carbon dioxide in the crude gas and a slight decrease in the quantity of cyanogen compounds was observed. The advisability of the addition of lime or silica in the distillation of coal can only be determined by the relative values of the products obtained. —C. A. K.

Preparation of Light Hydrocarbons from Heavy, Dark Residual Oils. F. Redl. Chem. Zeit. **11**, 347.

RIEBECK'S method (this Journal, 1887, 282) for preparing light hydrocarbons from heavy oils consists in the distillation of the latter under pressure. The same result is obtained, without employing pressure, by using a dephlegmator. This is connected with the exit tube of the still and is provided with a tube at its lowest point which leads back to the bottom of the still. By repeated rectification mixtures of liquid hydrocarbons can be separated by this means into light and heavy oils. The draught in the dephlegmator must be adjusted to the surface of evaporation of the still. The yield of light oils is good; the medium oils, for instance, which are too heavy for lighting purposes, being thus completely decomposed into light oils. Paraffin free from oil is not decomposed. The results are greatly influenced by the temperatures and the duration of the distillation.—C. A. K.

New Method for Refining Mineral Oils, Paraffin, Ozokerite and allied Hydrocarbons. F. Redl. Chem. Zeit. **11**, 415—416.

THE oils obtained by the fractionation of crude Russian petroleum are brought into an agitator, where they are well mixed by mechanical means (an air blast cannot be employed) and treated with 20—40 per cent. of petroleum naphtha, of sp. gr. 0·670—0·690. The whole is agitated until thoroughly mixed, when sulphuric acid is added and the agitation continued. The acid separates completely and quickly, and the impurities are readily removed, while no emulsion is formed with the oil, whereby the loss is considerably less than when the old method of purifying by means of acid is used. The oil, after twenty minutes' standing, is then neutralised, in a second mixing apparatus connected with a cooling worm, with caustic soda at 25°, whence it is pumped into a still and the petroleum naphtha distilled off by direct and indirect steam. The last portions of light oil are got rid of by distilling with superheated steam at 180° in a shallow still. The petroleum naphtha used must not consist of a mixture of oils of low and high boiling points, but must be taken from a constant fraction, while the quantity employed depends upon the degree of the purity of the oils treated. The greater the proportion of the naphtha added the less acid is required. Fuming sulphuric acid gives the best results, of which 4 to 7 per cent. is added, at a temperature of 18—24° C. The loss of naphtha is 3½ per cent., but is greater when it consists of several fractions. Oils thus purified can be further decolourised far more readily than when the old method is used, lubricating oils and vaseline being bleached with less loss and by only a fraction of the quantity of the decolouriser generally necessary. The products obtained by this process, which has been tried with crude oils of various kinds, as well as with resins, are purer and lighter coloured than can be obtained by the old method. The purification of ozokerite is effected similarly. It is previously heated, however, to 120°, to remove water and light oils, and after cooling to 75° is treated with 50 per cent. naphtha of sp. gr. 0·700—0·720. The mixture is gently agitated and then the sulphuric acid added. With 10 per cent. of fuming acid an almost white product results, which can be completely decolourised by charcoal. The apparatus employed is similar to that already described. The neutralisation with alkali is effected at 70°. The resulting paraffin forms a shining white mass; the yield of pure substance is 83 per cent., against 60 per cent by the old process.—C. A. K.

The Relation of Petroleum to the Hydrocarbons from Lignite and Coal. G. Kraemer and W. Bottcher. Ber. **20**, 595—609.

THE German petroleum, like the petroleum from Pennsylvannia, Russia and Galicia, consists of two classes of bodies, one of which is not acted upon by concentrated H_2SO_4 or HNO_3 in the cold, whereas the other, with the exception of a small quantity which is polymerised or completely destroyed, dissolves with the formation of sulphonic acids and nitro-products. Besides the hydrocarbons, small quantities of organic acids and sulphur compounds are found, but no bodies containing nitrogen. The hydrocarbons unacted on by acids have a comparatively low specific gravity, not exceeding 0·850 for fractions boiling up to 300°. These form the chief portion of the petroleum and until recently were considered to be paraffins. Later experimenters have shown that, in addition to these, hexahydrides of benzene hydrocarbons occur. To these Markownikow has given the name naphthenes. The authors have found that German petroleum also contains naphthenes. Several of these have been analysed, but with some difficulty, as the bodies readily split off acetylene, which is not oxidised with red-hot copper oxide. The naphthenes, unlike the olefines, do not absorb bromine nor dissolve in concentrated H_2SO_4. Of the existence of these naphthenes the authors cite several proofs. The occurrence of petrolic acid, which is isomeric with the oleic acids, must be regarded as the carboxylic acid of naphthene. This body has the formula $C_{15}H_{28}O_2$. A whole series of homologues of these acids containing smaller or larger quantities of hydrogen occur. On heating the lime salt with soda lime, and distilling under diminished pressure, a hydrocarbon is obtained, boiling at 180° to 230°. It has the formula $C_{14}H_{26}$, and absorbs bromine readily; it is, therefore, no naphthene, but an olefine. From the fact that Perkin's tetramethylenecarboxylic acid yields, under similar conditions, ethylene, it appears to indicate that the latter acid is a lower homologue of petrolic acid.

With regard to the second class of hydrocarbons, the action of sulphuric acid upon them gives a means of separating them quantitatively from the other hydrocarbons. In the oils from Tegern See, 8·7 per cent.; from Pechelbronn, 7·64 per cent.; from Oelheim, 9·37 per cent. of these hydrocarbons were found. The presence of naphthalene was also identified. In the higher boiling fractions, in addition to naphthalene, hydrocarbons with the formula $C_{10}H_{10}$, $C_{11}H_{12}$ and $C_{12}H_{14}$ were isolated by Markownikow. Although apparently related to naphthalene, they cannot be oxidised without undergoing complete decomposition. On reviewing the series of hydrocarbons which occur in petroleum, it is a curious fact that exactly the same are constituents of coal tar, although in different proportions; whereas, in the fraction of petroleum boiling up to 150° only 8 per cent. are dissolved by concentrated H_2SO_4, nearly the whole of the same fraction dissolves in the case of coal tar. Although the indifferent hydrocarbons found in coal-tar cumene are stated by Jacobsen to be paraffins, this class of compounds in coal tar requires further investigation. There is little doubt however, that they are similar to those occurring in certain petroleums. Of the higher boiling hydrocarbons occurring in coal tar—viz., naphthalene, acenaphthene, fluorene, anthracene, phenanthrene, etc., only naphthalene has been found in petroleum. A hydrocarbon, with the formula $C_{10}H_{10}$, supposed to be dihydronaphthalene and its homologues, have been found by Berthelot in coal tar. In the oil obtained by the distillation of lignite, the same series of bodies has been found, although in different proportions to those occurring in petroleum and coal tar, the proportion of the different constituents standing about midway between the two. In view of the fact that the tar from lignite is obtained at a much lower temperature than that from coal, the high percentage of naphthene in certain petroleums might probably be due to the high temperature at which they are formed. Experiment has not confirmed this. In the first place, hydrocarbons soluble in acids can be obtained by heating the insoluble hydrocarbons in closed tubes under pressure, so that the presence of the former may be ascribed to subsequent rise in temperature. But it is otherwise with naphthene. By passing petroleum from Tegern See through a red-hot tube a distillate is obtained which, after absorbing the soluble hydrocarbons by acids, possesses the same composition as previously to heating, so that naphthene was not formed from the paraffin. The authors regard the hydrocarbons absorbed by acids as derived from naphthalene, much in the same way as naphthalene, anthracene, etc., are built up from the benzene nucleus, the latter being obtained by heating the paraffin under pressure.—J. B. C.

Improvements in Apparatus for the Distillation of Coal Shale and other Materials. O. Rose, London. Eng. Pat. 9550, July 23, 1886. 8d.

In this apparatus the description, which does not admit of useful abridgment without the drawings which accompany the specification, (1) the volatile products are removed in accordance with the varying temperatures that the substances to be treated are subjected to; (2) the material is first broken up into convenient and somewhat uniform sizes before it passes into the retort, and that during the time it is being propelled through the retort it is continuously broken up so as to prevent as much as possible its being carried forward in a caked mass; and (3) the objection found, that the receptacle and the gas-tight door as generally used are inconvenient, and, where the machine is automatic in its action, difficult to keep gas and air tight, is removed.—D. B.

Improvements in obtaining Hydrocarbons from Gases. F. Friedländer, Gleivitz; and G. Quaglio, Berlin, Germany. Eng. Pat. 4888, April 1, 1887. 4d.

These consist in an improved mode of recovering the benzene, toluene and naphthalene contained in the gases from the destructive distillation of fossil-coal, shale, petroleum and tar oils and residues. The gases are conducted through thin or very liquid tar in a scrubber, the tar being used for washing until it is completely saturated with hydrocarbons. The absorbed oils are then distilled off, the residual tar being used for painting or roofing purposes, whilst fresh tar is used for washing the gas.—D. B.

Purification of Crude Anthracene. A. A. Vale, London. From the Chemische Fabriks Actien Gesellschaft, Hamburg, Germany. Eng. Pat. 5785, April 20, 1887. 4d.

This invention is based upon the fact, hitherto unknown, that the impurities of crude anthracene, including carbazol, are much more readily soluble in pyridine, quinoline and aniline bases than anthracene. The power of these bases to "enrich" anthracene is so great that they may be used in conjunction with the solvents ordinarily employed for the purification of crude anthracene. Thus, in using a mixture of equal parts of naphtha and tar bases in the proportion of 1 part of anthracene to 2 parts of this solvent, anthracene of about 80 per cent. purity is said to be obtained.—D. B.

IV.—COLOURING MATTERS AND DYES.

Thiophen Green. L. E. Levi. Ber. **20**, 513—517.

Tetramethyldiamidodiphenylthienylmethane $C_4SH_3.CH:[C_6H_4N(CH_3)_2]_2$.—This body is obtained in a similar manner to leucomalachite green by heating 1 part thiophenaldehyde, 2 parts dimethylaniline with a little alcohol, and 3—4 parts $ZnCl_2$, for six hours. The $ZnCl_2$ is added gradually, and if the mass becomes thick, water is added. When the smell of the aldehyde has disappeared, the mass is made alkaline with caustic soda. The product is treated with steam, extracted with ether, and the ethereal solution evaporated. The crystalline residue is recrystallised from alcohol. It combines with HCl, and forms a double salt with $PtCl_4$. The leuco-base combines with picric acid. On oxidation with MnO_2 and dilute H_2SO_4, the leuco-base changes to green. The colouring matter is extracted with hot water, filtered from MnO_2, precipitated with NH_4Cl and NH_3, and the precipitate extracted with ether. This compound is the basis of the colouring matter thiophen green and is a "carbinol" compound of the formula $C_4SH_3COH[C_6H_4N(CH_3)_2]_2$.

Like malachite green, it forms a double salt with $ZnCl_2$. The author has also prepared and analysed the picrate, sulphate and oxalate.—J. B. C.

Mono- and Ditolylamine. V. Merz and P. Müller. Ber. **20**, 544—550.

By the action of zinc bromide, ammonia and ammonium bromide upon *p*-cresol, the authors obtain mono- and di-*p*-tolylamine. Ammoniacal zinc chloride and NH_4Cl serve equally well. Paracresol was heated with three times the weight of ammoniacal zinc bromide, and an equal weight of ammonium bromide, for three hours to 300—310°. The product was repeatedly extracted with dilute HCl, the residue with ether, and finally with water acidified with HCl. The ethereal extract consisted of *p*-toluidine and di-*p*-tolylamine.

The following determinations were made with 20grms. of *p*-cresol, in I. and II. with 60grms. of ammoniacal zinc bromide and 20grms. of NH_4Br, and in the IV. and V. with 80grms. of ammoniacal zinc chloride, and 20grms. of NH_4Cl. The temperature in the case of I. and II. was 300—310°, and in other cases 330—340°; duration of experiment 40 hours.

	I.	II.	III.	IV.	V.
p-Toluidine	25	25	24·5	45	41·5 per cent.
Di-*p*-tolylamine	40	37·5	41	31·5	30 „
Carbonaceous matter	2·5	3	5·5	6	8 „
Unchanged *p*-cresol..	27·5	30	22	11	10·5 „

By similar treatment of *o*-cresol, the following results were obtained. (Temperature of I. 300—310°; II. 315—320°; III. and IV. 330—340°):—

	I.	II.	III.	IV.
o-Toluidine	28	50·3	48	55 per cent.
Di-*o*-tolylamine	2·5	10	7	7·5 „
Carbonaceous matter	2·5	3	6·5	5 „
Unchanged o-cresol......	61	27	32	30 „

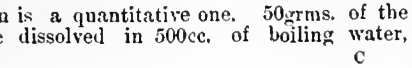
With *m*-cresol the following table is given. (Temperature of I. and II. 300—320°; III. 330—340°);—

	I.	II.	III.
m-Toluidine	29	27	25 per cent.
Di-*m*-tolylamine	53	51	47·5 „
Carbonaceous matter	2·5	4	5 „
Unchanged *m*-cresol	10·5	10	16 „

A quicker method for extracting the bases from the sealed tubes is to bring the product directly into a distilling flask and heat to 180—200° in ammoniacal steam. Primary and secondary bases, as well as the unchanged cresol, distil over.—J. B. C.

A New Method for the Preparation of the Azines. O. N. Witt. Ber. **20**, 571—577.

The author finds that certain azo derivatives of naphthylamine, obtained by the action of diazobenzene and diazotoluene-sulphonic acids on phenyl-, tolyl- and xylyl-β-naphthylamine, when heated with mineral acids, split up into the phenazine derivatives of naphthalene and the amido-sulphonic acid, phenyl-β-naphthylamineazobenzene sulphonic acid yields sulphanilic acid and naphthophenazine—$SO_3H.C_6H_4.N:N.C_{10}H_6.NH.C_6H_5$ ($SO_2H:N$ and $N:NH = 1:4$ and $1:2$)



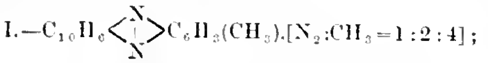
$$= C_6H_4.NH_2.SO_3H + C_{16}H_6\left<\begin{matrix}N\\|\\N\end{matrix}\right>C_6H_4.$$

The reaction is a quantitative one. 50grms. of the azo-colour are dissolved in 500cc. of boiling water, and 125cc. of concentrated H_2SO_4 are added drop by drop and well shaken. The free acid at first separates as a tarry mass, but re-dissolves gradually, and the sulphate of the azo base crystallises from the orange coloured liquid in cinnabar-red needles. On boiling the product with water, the free azine is obtained in the form of white crystals (m.p. 142·5°). Naphthophenazine forms well crystallised salts with mineral acids, which are dimorphous.

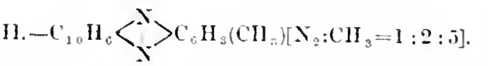
The author thinks that the dimorphism is due to the existence of two different salts, and that both nitrogen atoms are pentavalent, and combine with acids. Concentrated HNO_3 forms a nitroderivative. In order to determine the constitution of naphthophenazine, the same compound was prepared from β-naphthoquinone and *o*-phenylenediamine, and by the oxidation of a mixture of *o*-phenylenediamine and β-naphthol. This new method for preparing azine compounds indicates in the first place that with suitable re-agents there is a strong tendency to form the azine group, so that it is produced even when the para position is free.—J. B. C.

On the Isomeric Tolunaphthazines and the Black Dye for Wool. O. N. Witt. Ber. **20**, 577–581.

ACCORDING to theory, two α-β-tolunaphthazines are possible with the formulæ I. and II.:—



$$\text{I.}—C_{10}H_6<\overset{N}{\underset{N}{|}}>C_6H_3(CH_3).[N_2:CH_3=1:2:4];$$



$$\text{II.}—C_{10}H_6<\overset{N}{\underset{N}{|}}>C_6H_3(CH_3)[N_2:CH_3=1:2:5].$$

The nitrogen atoms are situated in the 3 : 4 position as regards the naphthalene nucleus.

In order to determine the constitution of Hinsberg's tolunaphthazine obtained from toluylenediamine and β-naphthoquinone, the author prepared an azine compound from paratolyl-β-naphthylamine according to the method given in the previous abstract, and obtained a naphthazine differing in its properties from that of Hinsberg. By the action of mineral acids upon the black dye for wool, which is prepared by the action of diazo-azobenzenedisulphonic acid on paratolyl-β-naphthylamine, a tolunaphthazine is obtained, which is distinct from the other two. The author shows further that Hinsberg's compound is a molecular mixture of the two other isomeric tolunaphthazines. According to this, the compound prepared from paratolyl-β-naphthylamine has formula I. that from the black dye formula II.—J. B. C.

Acenaphthene. F. Quincke. Ber. **20**, 609–611.

THE author, by nitrating acenaphthene with concentrated HNO_3 in glacial acetic acid, obtained a mononitro derivative, which on reduction yields an amido-compound.—J. B. C.

β-α-Azonaphthalene. R. Nietzki and J. Göttig. Ber. **20**, 612–613.

β-α-AMIDOAZONAPHTHALENE is first obtained as follows: A solution of β-diazonaphthalene is prepared from 1mol. β-naphthylamine, 5mols. HCl, and 1mol. $NaNO_2$. As soon as the naphthylamine is dissolved, 1mol. α-naphthylamine hydrochloride dissolved in water is added. After 12 hours, β-α-amidoazonaphthalene separates out as the violet-brown hydrochloride. The corresponding azonaphthalene is obtained by dissolving 1 part of the amidoazo-compound in 50 parts of alcohol, to which 3 parts of concentrated H_2SO_4 are added. Then a sufficient quantity of a concentrated solution of $NaNO_2$ is added, until the violet colour of the liquid changes to a yellow-brown. The mass is boiled for a time, and in case the violet colour reappears, more nitrite is added. The crude azonaphthalene is precipitated with water, and crystallised from glacial acetic acid. It is a dark-brown crystalline body, with a steel blue lustre. It melts at 136°, much lower than the α-compounds (190°). It has the formula :—$C_{10}H_7\overset{\beta}{N}:\overset{\alpha}{N}.C_{10}H_7$.—J. B. C.

Derivatives of Diphenylethane. K. Heumann and J. Wiernik. Ber. **20**, 909–915.

THE authors point out that in order to produce a colouring matter, it is necessary, in the case of methane, that at least two amido-phenyl groups should be attached to the methane carbon atom. Diamidodibenzyl, prepared according to Fittig and Stelling's method, gives no colouring matter on oxidation, and is therefore not a leuco-base. Tetramethyldiamidodiphenylethane, contrary to Schoop's statement, gives no pure colouring matter on oxidation. It follows then that the introduction of two symmetrical methylamidophenyl groups into the ethane molecule gives, on oxidation, no colouring matter; whereas, in the case of methane, with two groups attached to the same carbon atom, colouring matters are produced. The same result is obtained if the amido group is replaced by hydroxyl—*i.e.*, if two phenol groups are introduced symmetrically into the ethane molecule. Wislicenus has shown that ethane containing three phenol groups, or triphenolethane $C_6H_4(OH).CH_2.CH:(C_6H_4OH)_2$, on oxidation gives a colour which dyes wool.—J. B. C.

Monomethylorange and Monoethylorange—their Conversion into Dimethyl- and Diethylthionin. A. Bernthsen and A. Goske. Ber. **20**, 924–934.

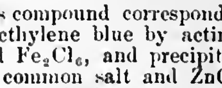
Monomethylorange is prepared as follows :—220grms. of sodium sulphanilate, 74grms. of $NaNO_2$, and 100grms. of concentrated H_2SO_4, in about 1½ litres of water, are mixed together. The resulting diazobenzene sulphonic acid is filtered and added to 80grms. of pure monomethylaniline, 80grms. of concentrated HCl and 300cc. of water, and heated to 30°. The mass becomes thick from separation of needles of the azo-acid. It is filtered and converted, by the addition of caustic soda, into the sodium salt, which crystallises in orange-red tablets. It may be distinguished from helianthin by its somewhat redder shade. The free azo-compound has the formula $C_6H_4(SO_3H).N_2.C_6H_4NH(CH_3)$, and consists of violet, needle-shaped crystals. The isomeric diazo-compound, $C_6H_4(SO_3H)N:N.N(CH_3)C_6H_5$, is often formed at the same time. It may be separated by treating the product with $(NH_4)_2S$, which decomposes the azo compound, but leaves the diazo-compound unaltered. With dilute acids it is converted into monomethylorange, while with strong HCl it is split up into methylaniline and *p*-phenolsulphonic acid.

Monoethylorange is obtained, though less rapidly, under the same conditions as described for methylorange. It is better to use the diazobenzene sulphonic acid in solution, and to neutralise the free acid formed by gradually adding NaOH so that the sodium salt separates out. This compound has the formula $C_6H_4(SO_3Na).N:N.C_6H_4NH(C_2H_6)$.

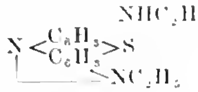
Monomethyl-p-phenylenediamine.—Methylorange is split up with warm $(NH_4)_2S$ into sulphanilic acid and methylphenylenediamine. The latter is extracted with ether, the base dissolved out with the calculated quantity of H_2SO_4 (1 : 4), which separates out, on digesting with alcohol, as a voluminous crystalline mass. Solutions of its salts are coloured deep red with Fe_2Cl_6 or Br. Acidified with HCl the solution is decolourised, but changes to blue on the addition of H_2S.

Monoethyl-p-phenylenediamine.—Ethylorange is decomposed with $(NH_4)_2S$ similarly to the methyl compound, ethylphenylenediamine being formed.

Dimethylthionin



—The production of this compound corresponds exactly to the formation of methylene blue by acting on the diamine with H_2S and Fe_2Cl_6, and precipitating the colouring matter with common salt and $ZnCl_2$. The hydrochloride dissolves readily in water with a blue colour and reddish-brown fluorescence. The neutral solution is precipitated by mineral acids. Like thionin, it exchanges one imido group for oxygen, and forms methylthionoline, and by further replacing the amido group by hydroxyl gives thionol.

Diethylthionin


$$N<\begin{matrix}C_6H_3\\C_6H_3\end{matrix}>S \quad NHC_2H_5 \quad NC_2H_5$$

—This body is formed in the same manner as the methyl compound, which it closely resembles in appearance and properties.—J. B. C.

Action of Carbonic Acid on Ultramarine Blue. Dr. E. Büchner. Chem. Zeit. 11, 314.

If carbonic acid is allowed to act on ultramarine blue suspended in water, a liberation of sulphuretted hydrogen takes place. If the reaction continue till the evolution of H_2S ceases, the water, frequently changed and decanted, is found to contain an appreciable amount of sodium carbonate. The explanation of this reaction is that the carbonic acid decomposes the Na_2S of the ultramarine blue. The presence of Na_2S, however, cannot be shown by the nitro-prusside test. If well-washed ultramarine be used, the same reaction takes place. The disengagement of H_2S also takes place if carbonic acid be led over dry lump ultramarine, and in larger quantity if the pieces are somewhat moistened. If ultramarine, treated as above, be dried and compared with the normal ultramarine, it is found that the blue has become quite dull and reddish, owing to the loss of Na_2S.

Prepared ultramarine blue shows similar reactions, but these are not so strongly marked.—J. F. C. S.

New Green Colouring Matter. W. Krause. Internat. Monatsschr. f. Anat. u. Physiol, 4, 2.

The zinc double salt of thiophen green (see page 505), tetramethyldiamidodiphenylthiënylcarbinol, is well adapted for staining sections, etc., especially as a complementary colour to carmine. It dissolves readily in water, alcohol and chloroform, but is insoluble in benzene.—C. A. K.

Indian Yellow and Glycuronic Acid. E. Külz. Zeit. für Biol. 33, 475—485.

Euxanthic acid is, according to Spiegel, decomposed by hydrochloric acid into glycuronic acid and euxanthone. The author, in order to prove the animal origin of euxanthic acid, gave euxanthone to rabbits and dogs, and was able to detect euxanthic acid in the urine. Like that obtained from *purree* (a combination of euxanthic acid and magnesia), it rotated polarised light to the left. While the experiments show that Indian yellow may be of animal origin, they in no way disprove that it may also be produced by the action of plants. The author's experiments did not corroborate Schmid's statement that mangostin (obtained from *Garcinia mangostana*) is similarly converted into euxanthic acid by animals.
—C. A. K.

Improvements in and relating to the Manufacture of Colouring Matters. H. H. Lake, London. From Wirth & Co., for A. Leonhardt & Co., Mühlheim, Germany. Eng. Pat. 4387, March 29, 1886. 6d.

Paranitrotoluene is sulphonated by being heated with one part of sulphuric acid (66° B.) and two parts of fuming acid containing 35 per cent. of anhydride. The heating is continued for 12—24 hours at 120° C., and the nitro-sulphonic acid treated with caustic soda and zinc dust, or, preferably, first with soda and then afterwards reduced in alkaline solution with zinc dust. The resulting compound is said not to be tolidinedisulphonic acid, but a "new amidosulpho-acid," which yields tetrazo-salts, from which secondary azo-colours can be prepared. A list of the amines, phenols, sulphonic and carboxylic acids is given in the specification, the three following examples being illustrative of the manufacture of the azo-colours:—(1.) The sodium salt of the new amidosulphonic acid is diazotised by sodium nitrite and hydrochloric acid in the usual way, and then combined with two molecules of β-naphthylaminemonosulphonic acid (Brönner's). The colour thus produced is a red dyestuff. (2.) A yellow colour is formed by the action of the tetrazo-salt upon salicylic acid in alkaline solution. (3.) A violet colour is produced by the action of the tetrazo-salt upon α-naphthol in alkaline solution.—R. M.

Improvements in the Production of Indole Derivatives from the Compounds of the Aromatic Hydrazines with the Ketones and Aldehydes. C. D. Abel, London. From the "Farbwerke vorm. Meister Lucius & Brüning," Hoechst a Main, Germany. Eng. Pat. 7137, May 27, 1886. 6d.

The process described in the present specification depends upon the formation of condensation products between primary or secondary hydrazines and ketones or aldehydes, and the treatment of these products with anhydrous acids or with metallic chlorides, by which means ammonia is withdrawn and the indole derivative synthetised. The following typical equations illustrate the method:—

$$C_6H_5.N_2H_3+CH_3.CO.CH_3=C_6H_5.N_2H{:}C(CH_3)_2+H_2O.$$

$$C_6H_5.N(CH_3).NH_2+CH_3.CO.CH_3=C_6H_5.N(CH_3).N{:}C(CH_3)_2+H_2O.$$

$$C_6H_5.N_2H_3+OCH.C_2H_5=C_6H_5.N_2H{:}CH.C_2H_5+H_2O.$$

Ammonia can be withdrawn from the condensation products by heating with sulphuric or hydrochloric acids, but the best results are obtained by the use of solid zinc chloride—

$$C_6H_5.N_2H{:}C(CH_3)_2=NH_3+C_6H_4<\begin{matrix}CH\\NH\end{matrix}>C.CH_3$$

(Methylketole.)

In the preceding case the condensation product is heated to 170—180° C. with 4—5 times its weight of solid zinc chloride, the reaction being complete in a few minutes and the yield of methylketole over 60 per cent. of the theoretical quantity. By a similar process acetonemethylphenylhydrazine yields dimethylindole—

$$C_6H_4<\begin{matrix}CH\\N(CH_3)\end{matrix}>C.CH_3$$

With propylidenephenylhydrazine the reaction sometimes sets in spontaneously with an equal weight of zinc chloride, the product being skatole. Aromatic derivatives are similarly obtained from the condensation products of hydrazines with aromatic ketones and aldehydes. Thus the following compounds are given as examples:—

(1.)

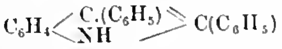

$$C_6H_4<\begin{matrix}CH\\NH\end{matrix}>C.C_6H_5$$

(Phenylindole from acetophenonephenylhydrazine.)

(2.)


$$C_6H_4<\begin{matrix}CH\\N(CH_3)\end{matrix}>C.C_6H_5$$

(Methylphenylindole from acetophenonemethylphenylhydrazine.)

(3.)


$$C_6H_4<\begin{matrix}C.(C_6H_5)\\NH\end{matrix}>C(C_6H_5)$$

(Diphenylindole from "de-oxybenzoinphenylhydrazine.")

(4.)


$$C_{10}H_6<\begin{matrix}CH\\NH\end{matrix}>C.CH_3$$

(Methyl-β-naphthyiindole from acetone-β-naphthylhydrazine.)

Examples are also given in which the carboxylic acids of aldehydes and ketones are first employed to form condensation products with the hydrazines. The indole derivatives, obtained according to the processes described in the specification, are intended to be employed for the preparation of colouring matters and as antiseptics.
—R. M.

Improvements in the Production of Green Colouring Matters or Dyestuffs. C. D. Abel, London. From the "Farbwerke vorm. Meister Lucius & Brüning," Hoechst a/Main, Germany. Eng. Pat. 8992, July 9, 1886. 4d.

These colouring matters are prepared by the action of nitrous acid upon an acid solution of methylene or ethylene blue or other alkyl thionines. The solution of the colouring matter in water is acidified by sulphuric acid and sodium nitrite (eight parts to ten of methylene blue) added by degrees. The mixture is allowed to stand for several days and the green colouring matter salted out. The mother-liquor contains a compound which is precipitated by zinc chloride and reduced again to methylene blue.—R. M.

Improvements relating to Substances chiefly designed for use in the Preparation of Colouring Matters, and to the Manufacture of Colouring Matters therefrom. A. Kern, Basle, Switzerland. Eng. Pat. 12,022, Sept. 21, 1886. 6d.

The reagent employed by the author is carbon sulphodichloride $CSCl_2$. The compounds obtained are derivatives of thiobenzoic acid and thiobenzophenone, and are classified as follows:—(1.) Alkylised amido derivatives of the chloride of thiobenzoic acid and derivatives of this acid by the action of the reagent upon tertiary aromatic amines. (2.) Alkylised amido derivatives of thiobenzophenone by the action of alkylised amido derivatives of the chloride of thiobenzoic acid or by the direct action of the reagent upon tertiary aromatic amines. (3.) The formation of colouring matters by the condensation of the new compounds produced in the two preceding groups with amido-compounds or phenols. (4.) The formation of colouring matters by the action of the reagent upon tertiary aromatic amines. Seven examples illustrative of the manufacturing processes are given:—(1.) Dimethylaniline diluted with CS_2 and cooled to 0° C. is gradually mixed with the necessary quantity of the reagent, also diluted with CS_2. The product is dimethylamidothiobenzoic acid, $C_6H_4.CSOH.N(CH_3)_2$. (2.) By using the above materials in the correct proportions, and finishing the reaction at 35° C., tetramethyldiamidothiobenzophenone is produced. (3.) A yellow colouring matter is prepared by passing ammonia gas into a solution of tetramethyldiamidothiobenzophenone in naphthalene at 150° C. (4.) An orange colouring matter is formed by heating the thiophenone with aniline as long as SH_2 is evolved. (5.) To prepare a blue colouring matter the thiophenone is heated with phenyl-α-naphthylamine, toluene and carbon sulphodichloride. (6.) A violet colouring matter is obtained by mixing the thiophenone with dimethylaniline and the reagent. The reaction is completed at 100° C. (7.) The violet dye can be prepared directly by the action of carbon sulphodichloride upon dimethylaniline in the presence of dry zinc chloride at 25—30° C., and finishing at 100° C. as in the last example.—R. M.

VI.—DYEING, CALICO PRINTING, PAPER STAINING AND BLEACHING.

A Process of Treating Woven and other Fabrics, Yarns, Ropes and Cordage for the Purpose of rendering the same Non-Putrefactive and Antiseptic. A. M. Clark, London. From L. P. Audouard, France. Eng. Pat. 7927, June 12, 1886. 6d.

The method consists in exposing the materials to wood smoke.—E. J. B.

Improvements in Dyeing Blue, especially adapted for Wool. C. Lohmann, Cologne, Prussia. Eng. Pat. 8065, June 17, 1886. 4d.

This invention consists in dyeing wool or other animal fibrous materials in a bath containing azo-diphenyl blue, extract of logwood, sulphate of copper, sulphate of iron, an alkaline bisulphate and oxalic acid.—E. J. B.

Improvements in Dyeing Tissue and other Papers, and in Apparatus therefor. J. Fletcher, Stoneclough. Eng. Pat. 13,598, Oct. 25, 1886. 6d. (Amended Specification.)

The amendment consists in the deletion of the third claim—viz., "the endless felt or cloth for supporting the dyed paper in its wet state and carrying it through the machine." (See this Journal, 1887, 139.)—H. A. R.

Improvements relating to the Drying, Bleaching and Disinfecting of Wool, Cotton, Paper Pulp or other Textile or Fibrous Materials and to Apparatus therefor. J. H. Lorimer, Philadelphia, U.S.A. Eng. Pat. 16,765, Dec. 21, 1886. 8d.

The operation is conducted in a chamber of special construction, and the bleaching or disinfecting compound (bleaching liquor, sulphurous acid, etc.) is applied in the form of a fine spray. The drying is effected in the same chamber.—E. J. B.

Improvements relating to the Treatment of Wool, Cotton, Paper Pulp or other Textile or Fibrous Materials for effecting the Bleaching, Colouring, Disinfecting and Drying or other Operations, and to Apparatus therefor. J. H. Lorimer, Philadelphia, U.S.A. Eng. Pat. 16,780, Dec. 21, 1886. 8d.

This patent relates to certain slight improvements in the apparatus described in Eng. Pat. 16,765.—E. J. B.

An Improved Compound for producing Designs upon Textile Fabrics and for similar Purposes. H. H. Lake, London. From L. Whitefield, Reading, Mass., U.S.A. Eng. Pat. 2123, Feb. 10, 1887. 4d.

The improved compound consists of a mixture of benzene, naphtha or turpentine and a suitable pigment of any desired colour, such, for example, as chrome yellow or Chinese blue, with a little bronze powder and kerosene oil. It is used for transferring patterns to fabrics, the former being perforated and acting as a stencil.—E. J. B.

Improvements in Apparatus for Dyeing Loose or Spun Cotton and other Fibres. E. Booth, Manchester. From W. A. Fourness, Brussels, Belgium. Eng. Pat. 4365, March 23, 1887. 6d.

The apparatus consists of a strong copper or iron vessel, which can be hermetically sealed. It is in connection with an arrangement for producing a vacuum. The inventor claims the use of the vessel for the purpose of dyeing materials with any other colour but black, a similar apparatus having been previously patented for dyeing that colour.—E. J. B.

An Improved Mode of and Apparatus for Mordanting, Dyeing and Bleaching Raw Cotton. G. Jagenburg, Rydboholm, Sweden. Eng. Pat. 4764, March 30, 1887. 8d.

The inventor conducts the operations, usually bleaching, dyeing and mordanting operations, either in the cold or at low temperatures in vacuo. Drawings of the necessary apparatus are given in the specification.—E. J. B.

VII.—ACIDS, ALKALIS AND SALTS.

On the Determination of some High-melting and Decomposition Temperatures. H. Le Chatelier. Bull. Soc. Chim. **47**, 300.

In his investigations the author made use of the electric pyrometer described by him, which permits of the quick and exact determination of high temperatures. The following melting points were ascertained:—KCl 740°, NaCl 775°, $CaCl_2$ 755°, $BaCl_2$ 847°, $SnCl_2$ 840°, Na_2CO_3 810°, $BaCO_3$ 795°, K_2CO_3 885°, Na_2SO_4 867°, $Ba(NO_3)_2$ 592°, K_2SO_4 1015°, $K_2Cr_2O_4$ 975°, $Na_4P_2O_7$ 957°, $KClO_3$ 37°0, Cu_2S 1100°, very pure white pig-iron 1135°, grey cast-iron 1240°, nickel 1420°. The temperatures of decomposition of the following salts were ascertained:—$MgCO_3$ 680°, $CaCO_3$ 890°, $FeSO_4$ 700°, $MnSO_4$ 990°, $MgSO_4$ 1160°. The oxides of Al, Cr, and Fe, as is commonly known, by gradual heating are subjected to a change which is accompanied by a considerable production of heat, and in consequence of which they become insoluble in acids. These precise temperatures are:—Al_2O_3 850°, Cr_2O_3 900°, Fe_2O_3 950°. The method of observation followed consisted in placing the salt to be studied in a little platinum cone 5mm. in diameter, and covering it with an envelope of magnesia and refractory earth. The whole was heated in a Forquignon's furnace, which was fed by a blast pipe. This arrangement was for the purpose of assuring as complete a uniformity of temperature as possible throughout the mass of the salt experimented on. The progress of heating of the thermocouple placed in the middle of the salt was registered by the photographic method by means of induction sparks, which passed from second to second. At the moment of fusion there was a momentary arrest in the heating, which manifested itself in the approach and superposition of the images of the slit in front of which the spark played.—W. R.

A New Hydrate of Caustic Soda. C. Göltig. Ber. **20**, 543—544.

On carefully heating a concentrated solution of caustic soda in strong alcohol a slow separation of fine crystals occurs, the amount of which, on continued heating, increases. These crystals, which disappear on cooling the alcoholic solution, are very unstable and difficult to isolate. If the alcoholic solution is further heated the crystals redissolve, but after a time, as the alcohol evaporates, aggregated masses of crystals appear, which have the formula $NaOH + 2H_2O$. This compound is not very hygroscopic, but readily absorbs CO_2 from the air. Part of the water of crystallisation evaporates over $CaCl_2$ in a desiccator.—J. B. C.

General Method for the Preparation of Manganites from Permanganates. G. Rousseau. Compt. Rend. **104**, 785.

Potassium permanganate heated to 240° yields potassium manganate, manganese dioxide and oxygen, but if the heating be continued the dioxide disappears and manganites are formed, and these the more readily the higher the temperature. A pentamanganite $K_2Mn_5O_{11}$, and a heptamanganite $K_2Mn_7O_{15}$ are obtained. The latter is also formed when potassium permanganate is heated to 800° in a bath of potassium chloride. The author suggests that the formation of manganites is due to the action of the manganese dioxide on the manganate formed, whereby a further liberation of manganese dioxide takes place, and this combines with free alkali present, forming a manganite:—$MnO_2 + 3K_2MnO_4 = 2KMnO_4 + 2MnO_2 + 2K_2O$. This action accounts for the loss experienced in preparing potassium manganate from the permanganate when too high a temperature is employed. The permanganates of barium and strontium also yield polymanganites on heating to 350°, while calcium permanganate behaves similarly at 200°.
—C. A. K.

Antimony Tartrate. Guntz. Compt. Rend. **104**, 850.

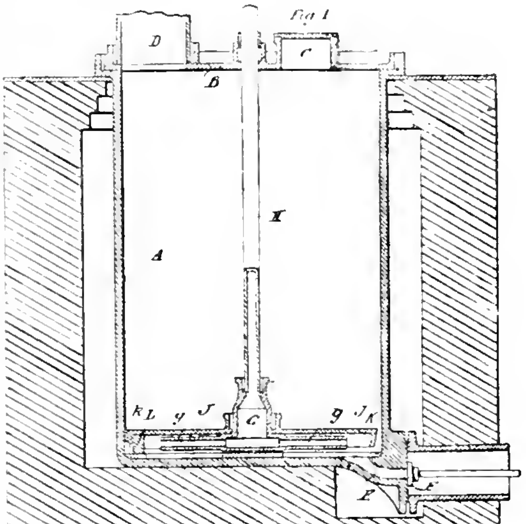
Peligot's method for obtaining acid antimony tartrate by precipitating a solution of antimony oxide in tartaric acid with alcohol, yields an amorphous product which contains varying amounts of antimony, according to the method of precipitation. The acid antimony tartrate ($C_4H_5O_6.SbO$) may be obtained in a pure state by boiling a solution of tartaric acid with an excess of antimony oxide for several hours and concentrating the solution obtained on the water-bath, when a crystalline precipitate is obtained, which is purified by washing with absolute alcohol.—C. A. K.

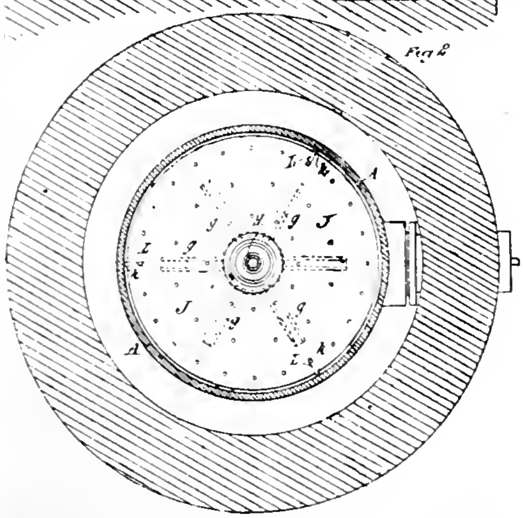
An Improved Apparatus for the Manufacture or Production of Carbonic Acid and other Gases. P. Farinaux Lille, France. Eng. Pat. 8312, June 23, 1886. 8d.

This invention relates to an apparatus for regularly producing, in proportion as they are consumed, carbonic acid or other gases resulting from chemical decomposition. The apparatus also discharges the gases at a constant pressure. The gas liberated by the action of an acid on the solid material passes through a purifier and subsequently leaves the apparatus through a loaded valve.—S. H.

Improvements in Apparatus for Producing Ammonia from Sulphate of Ammonia. H. W. Deacon and F. Hurter, Widnes. Eng. Pat. 9208, July 15, 1886. 8d.

This invention relates to apparatus for carrying out th,' process described in Eng. Pat. 2118, 1884 (this Journa 1885, 281), which consists in heating to a high temperature in an atmosphere of steam, a mixture of ammonium and sodium sulphates. A cylindrical cast-iron pot A (Figs. 1 and 2) is provided with a closely-fitting lid B, having a charging hole C and an outlet pipe D for the escape of gaseous ammonia and steam. An aperture E, closed by a plug F near the bottom, allows of the withdrawal of the contents when the operation is completed. Close to the bottom there is a small central chamber G provided with a number of radiating pipes g which serve for the distribution of superheated steam supplied thereto by the pipe H. Immediately over the pipes g a false





bottom J is placed, the perforations of which distribute the steam equally throughout the charge. The false bottom J, which is of less diameter than the pot A, is also fitted with a downward flange K having several projections L by which it rests on the bottom of the pot. The false bottom thus forms a shallow vessel surrounding the steam chamber. When the charge is first introduced it blocks up the perforations of the false bottom, and the steam is therefore compelled to pass through the annular space between the flange and the interior of the pot, at which part it is first required, as the charge first fuses at these places. Gradually the fusion proceeds through the whole mass, freeing the perforations and allowing the steam to issue through the false bottom, as the liquid formed lutes the space at the circumference near the flange. The pot is set in brickwork and provided with a fireplace and flues, so that it may be heated from the outside.—S. H.

New or Improved Process for the Simultaneous Manufacture of Assimilable Phosphates and of Sulphate of Ammonia. E. Solvay, Brussels, Belgium. Eng. Pat. 8723, July 3, 1886. 6d.

If phosphate of lime be treated with sulphuric acid, almost insoluble calcium sulphate and soluble monobasic calcium phosphate are produced. The object of this invention is to economise a portion of the acid employed by combining the manufacture of superphosphates with that of ammoniacal salts. Ammonia is allowed to act on monobasic calcium phosphate, thereby forming dibasic calcium phosphate and ammonium phosphate, both of which have a high agricultural value. If it be preferred to obtain all the phosphoric acid as ammonium phosphate, the dibasic calcium phosphate is treated over again with sulphuric acid. Even more ammonia may be fixed in the finished article, as calcium sulphate effects double decomposition with ammonium carbonate, yielding ammonium sulphate and calcium carbonate.

—S. H.

VIII.—GLASS, POTTERY AND EARTHENWARE.

An Improved Potter's Filter-press. J. Critchlow, T. Forrester, W. Forrester, H. Forrester and L. Forrester, Hanton. Eng. Pat. 1941, Feb. 8, 1887. 8d.

The filtering cloths usually employed are replaced by porous drainage tiles fixed on the surfaces of the ribbed or corrugated plates.—C. C. H.

IX.—BUILDING MATERIALS, CLAYS, MORTARS AND CEMENTS.

An Improved Compound for Plastering and for Preventing the Radiation and Transmission of Heat. R. W. Hitchins, Stoke Newington. Eng. Pat. 6804, May 20, 1886. 6d.

About equal proportions of slag-wool and plaster of Paris or cement in a dry state are mixed intimately together. The product obtained is lighter than ordinary plaster, more porous and capable of resisting a greater amount of heat.—E. G. C.

Treatment of Slate, Schist and Waste thereof for the Production of Material applicable for Structures, Vessels and other Uses. J. B. F. Frédureau, Paris. Eng. Pat. 7285, May 31, 1886. 6d.

Powdered schist or slate is made up into a paste with a solution of silicate of potash or of soda, the paste is moulded into the desired forms, and the moulded pieces are dried, preferably with the aid of a little heat. The material so made ("Ardoisite") is at once applicable for structural purposes, or for making tanks, vessels, pipes, etc.; it is readily worked by saws, planes or other tools, and is especially useful in laboratories and chemical works, as it is not subject to corrosion by acids. If impregnated with paraffin, tar, petroleum, etc., the material can be used as an electrical insulator. If dried "ardoisite" be gradually heated up to a white heat, it is brought into the condition of a refractory stone of great durability, particularly applicable for furnaces or furnace vessels.—E. G. C.

Improvements in the Manufacture of Portland Cement. S. Lowden, London. Eng. Pat. 8120, June 18, 1886. 6d.

The inventor manufactures what may be termed the "nucleus" of the cement, by thoroughly mixing, drying and kilning one part by weight of Medway blue clay, in its natural state, and five parts of chalk or limestone. The material so prepared is fit for transport to any part where chalk or limestone abounds and where the finished product is intended to be employed. To complete the manufacture, chalk or limestone is pulverised, dried at about 210° F. and mixed with the prepared "nucleus" in the proportion of one part by weight of the chalk or limestone to three parts of the "nucleus"—an excellent Portland cement being thus obtained.

—E. G. C.

Method of and Apparatus for Desiccating Wood and other Porous Substances. A. Flamache and E. Picard, Brussels, Belgium. Eng. Pat. 10,595, Aug. 1886. 8d.

The object of the patentees is to effect the desiccation of wood simultaneously throughout the whole mass, instead of its commencement at the exterior and its gradual progress inwards. They effect this by placing the material in an air-tight vessel, in which a partial vacuum is formed, the air thus expelled from the pores of the wood carrying with it moisture; this is followed by the admission of dry atmospheric air either heated or cooled, which takes up a further quantity of moisture and is again expelled as before. In some cases, instead of a reduction of pressure below that of the atmosphere, air at atmospheric pressure and compressed air alternately operate; the effect is practically the same. Hot air may be employed and the interior of the vessel heated, dependent upon the nature of the material operated on.

—C. C. H.

Improvements in the Manufacture of Building Materials from Glass and in the Application of the same. S. Pitt, Sutton, Surrey. From G. Falconnier, Nyon, Switzerland. Eng. Pat. 5723, April 19, 1887. 6d.

The patentee claims the employment of bricks formed from blown glass of various shapes and secured in the manner shown in the drawing attached to the specification, for use in building. Such hollow bricks may be employed in almost every instance in which ordinary bricks or tiles are used. The interior of the glass brick may be decorated or painted with any devices.

—C. C. H.

A Novel Artificial Cement. W. E. Gedge, London. From J. Thorrand, V. Nicolet and A. Bonnet, Grenoble, France. Eng. Pat. 979, Jan. 21, 1887. 4d.

This cement consists of "an intimate mixture, in contact with water, of dried and pulverised chloride of magnesium, with or without the addition of inert matters or calcareous powder, with magnesia also pulverised and mixed with calcareous powder or inert matters." This product is white like plaster and is capable of receiving various tints by the addition of coloured earths.

—E. G. C.

X.—METALLURGY, Etc.

On Certain Metals. V. Meyer. Ber. **20**, 497—500.

The Melting Point of Magnesium is usually given in the text-books as about 500° C. Experiments have shown that the melting point lies above that of sodium bromide (700°), and just below that of sodium carbonate (800°).

The Purification of Mercury may be very readily performed by repeated distillation. All impurities are left behind in the retort. After twelve successive distillations the author found that no residue remained on heating, and that the metal was chemically pure. A quicker method is that usually adopted—viz., recrystallisation of mercurous nitrite.

Volatility of Germanium.—The author finds that germanium does not volatilise sensibly when heated to 1350° C. in an atmosphere of hydrogen or nitrogen. This agrees with Nilson and Petterson's observations, who heated germanium to 1300° with a similar result. The author attempted, without success, to determine the vapour density of magnesium. He intends shortly to determine that of antimony.—J. B. C.

An Improved Manufacture of Alloy or Alloys of Nickel, Copper and Aluminium. J. Y. Johnson, London. From La Société Anonyme Le Ferro-Nickel, Paris, France. Eng. Pat. 5832, April 29, 1886. 6d.

To the melted nickel the charge of copper is stirred in, and subsequently, at a somewhat higher temperature, a proportion of aluminium varying, according to the percentage of nickel, from 1·75 of aluminium per 1000 of the mixture in the case of an alloy with 10 per cent. of nickel, down to 0·5 of aluminium per 1000 for one with 40 per cent. of that metal. The fused mass is then raised almost to its boiling point, and poured rapidly and regularly. Malleable nickel may in part be substituted for aluminium but with less satisfactory result.

—W. G. M.

Improvements relating to the Extraction or Separation of Gold, Silver and Platinum from Ores and other Substances or Products containing such Metals. J. Noad, East Ham. Eng. Pat. 6810, May 10, 1886. 6d.

See page 516.

Process and Apparatus for the Treatment of Iron Ores for the Manufacture of Steel. A. M. Clark, London. From La Société Anonyme des Produits Chimiques de St. Denis, France. Eng. Pat. 6747, May 19, 1886. 8d.

This is a process for treating iron oxides in pulverulent condition, and is especially applicable to the spent pyrites of the vitriol maker. The reduction is effected in an upright furnace with nine or more superposed hearths. Running axially through the furnace is a vertical water-cooled rotating shaft, carrying rakes for stirring the ore on each hearth. The ore is fed on to the uppermost hearth and is gradually discharged (by the action of the rake) through channels in the bed, sloping inwards so as to deliver the ore into the centre of the next; thence it passes to the next hearth, in a like manner, and is then conducted to the next and so on, until it is finally discharged directly on to the bed of a regenerative melting furnace. Since the complete removal of sulphur previous to reduction is essential to success, the charcoal is not added to the charge at first, but is introduced at about the sixth stage. Moreover the atmosphere, which is of a reducing character on the lower hearths, is rendered oxidising in the upper portion in order to roast the ore more fully; this is accomplished by passing into the lowest hearth, producer gas which is thence led upwards by channels in the walls in a zig-zag direction over the higher stages until, nearer to the top, an excess of air from the regenerator of the melting furnace is mixed with it, the gases ultimately passing into a dust chamber. The pyrophoric iron dust falls into a space on the hearth of the melting furnace, where it is protected from oxidation by an inner perforated wall of refractory material. The furnace is heated by gas, which passes direct from a producer and mingles in a combustion chamber with the air from the regenerator and thence, before entering the furnace, passes over a screen of charcoal lumps to guard effectually against the presence of free oxygen or carbonic acid. When copper is present, the removal of the sulphur must be effected in a separate chamber; the residue being then freed from copper by extraction with acid and by subsequent washing, is reduced and melted as described.

—W. G. M.

Improvements in the Method of and Apparatus employed in Galvanising (Coating with Spelter) Sheet Metal. J. Thomas, Bradley; H. Lewis, Handsworth; and E. W. Lewis, Compton. Eng. Pat. 6786, May 20, 1886. 8d.

To obviate the necessity of straightening the galvanised plates, which are usually delivered from the rollers more or less curved, and to ensure uniformity of coating on both sides of the sheet, they are brought out from the zinc bath in a vertical position. The trough is rectangular in shape and has, working within it, two pairs of horizontal rollers geared outside the trough, one pair being placed immediately above the other with the upper pair at a slight distance beneath the surface of the molten metal. In the same horizontal plane with the lower pair is a third roller taking its motion only by contact with that which is next to it. Through a flux-box the plate to be coated is pressed between the loose roller and the adjacent roller of the lower pair, and by the motion of the latter is drawn down to a cradle beneath where, kept in position by a series of fingers, it is brought by means of a lever beneath the two geared rollers, and through them is carried upwards and finally delivered above.—W. G. M.

An Improved Process for the Separation of Metallic Tin from Tinned Plates or from Alloys or Salts of Tin. E. Edwards, London. From M. Ramos-Garcia, Paris, France. Eng. Pat. 6803, May 20, 1886. 6d.

If tinned iron be the substance treated, it must be stripped by agitation in a bath of hydrochloric acid with a small proportion of nitric acid or of ferric chloride and heated by steam. From the solution of the tin salt obtained the metal is precipitated on tin cathodes by galvanic batteries.—W. G. M.

Manufacture of Ferro-manganese, Silico-spiegel, Spiegeleisen and Chrome Iron. C. J. Sandahl, Trimsaran, South Wales; G. Bargate, Barrow-in-Furness; and C. B. Phillips, Chester. Eng. Pat. 6977, May 25, 1886. 6d.

In order to avoid the great loss of manganese or chromium owing to the large amount of slag formed in the manufacture of the above alloys, pig or scrap iron is substituted for iron ore in the furnace charge, so that the quantity of slag is much reduced. The charge, therefore, consists of broken pig or scrap-iron, fuel, manganese (or chrome) ores and the flux necessary for them.—W. G. M.

Improvements relating to the Extraction of Gold, Silver and Copper from Ores and other Substances or Products containing such Metals. J. Noad, East Ham. Eng. Pat. 8130, June 18, 1886. 6d.

The ore in a finely divided condition is allowed to remain in contact for 24 hours and afterwards roasted at a blood-red heat with a mixture of sodium chloride and sulphuric acid. The product is then ground and washed. The insoluble lead and silver chlorides are placed in a depositing tank with a suitable solution and electrolysed. The solution in the case of silver would be saturated with potassium cyanide containing ammonium carbonate and boric acid; for gold it would be ferrous sulphate; and for copper, cupric sulphate. The bath, after precipitation, is again available for the same purpose.—W. G. M.

Improvements in and connected with Refractory Linings particularly adapted for Metallurgical Furnaces, but applicable also for other Purposes. T. Twynam, London. Eng. Pat. 8359, June 24, 1886. 6d.

To render chrome-lining less susceptible of mechanical abrasion the chrome-iron ore, which must not be too silicious, is mixed with from 1 to 5 per cent. of an alkaline salt according as it will be required to withstand an intense or only a moderately high temperature. The salt should be dissolved in just sufficient water to

thoroughly moisten the ore, and the mixture may then be used directly as a lining, or it may be moulded into bricks, tuyères or the like, and be well burnt before use.
—W. G. M.

Improvements in Apparatus used for Coating Sheet Iron with Zinc or Alloys of Zinc or other Coating Metal or Alloy. R. Heathfield, Birmingham. Eng. Pat. 8390, June 25, 1886. 8d.

FROM the horizontal rolls of the galvaniser's bath, or by preference from the additional half-immersed rolls described in Eng. Pat. 2243, of 1877, the coated plate is passed between a pair of revolving brushes and finally through a pair of finishing rolls placed above the bath. The brushes are slightly longer than the length or breadth of the plate under treatment and may have a slight reciprocating motion in addition to rotation; the distance between them may also be regulated by suitable mechanism.—W. G. M.

Improvements in and connected with the Manufacture of Aluminium, and other Light Metals. F. J. Leaver, London. From Dr. E. C. Kleiner-Fiertz, Zurich, Switzerland. Eng. Pat. 8531, June 29, 1886. 8d.

SEE page 517.

Improvements relating to the Production of Aluminium and Alloys thereof. L. Grabau, Hanover, Germany. Eng. Pat. 9486, July 22, 1886. 6d.

IN order to economise the sodium or potassium, which is to a large extent volatilised when used for the reduction of aluminium chloride, and to prevent contamination of the reduced metal by contact with the walls of the heating vessel, the reduction is effected in a carbon crucible contained within a hermetically-closed chamber. The crucible, if small, is fashioned in one piece, or if large may be built up of carbon blocks cemented by tar; the cover is also lined with carbon and is joined by a magnesia lute, which is not attacked, at the temperature employed, by the alkali metal. The whole arrangement is heated to dull redness; when partial volatilisation of the sodium occurs, a most intimate mixture is produced, reduction commences attended by a copious evolution of heat and the reaction is finally completed with practically the theoretical quantity of sodium. The finely-divided aluminium is fused together with suitable flux in carbon crucibles. If alloys are required they may be made by mixing the alloying metal with the original charge or by introducing it during the subsequent fusion; or they may be made by forming the reducing crucible of the alloy metal, and melting together both crucible and contents with the requisite fluxes.—W. G. M.

Improvements in the Treatment of Ores containing Sulphide of Antimony for the Purpose of obtaining the said Sulphide in a Concentrated Form with any Gold or Silver that may be present. E. W. Parnell, Chester; and J. Simpson, Liverpool. Eng. Pat. 9919, August 3, 1886. 6d.

THE object of this invention is the concentration of sulphide of antimony in poor sulphide ores. It is effected by treating the finely-divided ore with a solution of sodium monosulphide, by which means the antimony becomes converted into a light red sulphide which remains for the most part in suspension in the sodium sulphide solution, the latter being practically unaltered. This solution is drawn off from the heavier gangue and the suspended sulphide allowed to settle, the solution being then available for treating a further quantity of raw ore. The gangue, from which the liquid has been drawn off, is washed free from any red sulphide intermixed with it and is available for the extraction of any gold and silver it may contain. Or it may be treated according to Eng. Pats. 11,828 and 13,074 of 1884 (this Journal, 1885, 352).—W. G. M.

Improvements in Linings of Copper, Lead and other Similar Furnaces, as well as Steel or Siemens Furnaces and Steel Converters. A. E. Tucker, Smethwick. Eng. Pat. 11,600, Sept. 13, 1886. 4d.

IN carrying out Eng. Pats. 7571 and 14,507 of 1885 (this Journal, 1886, 329), the inventor finds that basic slag, whether from the converter (by preference) or from the open hearth furnace, may be advantageously used either in the form of bricks for the sides and bottom, or by ramming for the latter. Cast slag bricks are made by melting the slag in a cupola or furnace with basic or neutral lining.—W. G. M.

Improvements in the Method of and Apparatus for the Smelting or Refining of Copper. D. McKechnie, St. Helens. Eng. Pat. 12,053, Sept. 22, 1886. 8d.

THROUGH the sides of a reverberatory (copper) furnace, a series of steam injectors cause a current of air and steam—if necessary mixed with powdered nitre—to be blown into or over the molten matter on the hearth, thereby greatly facilitating the removal of foreign substances from the metal.—W. G. M.

Improvements in Extracting Gold and other Precious Metals from their Ores, and Apparatus therefor. C. D. Abel, London. From E. Fischer and M. W. Weber, Berlin, Germany. Eng. Pat. 921, Jan. 20, 1887. 8d.

THE finely-crushed ore is charged together with six or eight times its volume of water and if necessary, sodium chloride or other chlorine or bromine compound and potassium permanganate, into a vat, the sides of which are partially lined with an amalgamated metal, and the bottom covered with mercury, both being connected with the negative pole of an electric generator. Here it is agitated for 2—2½ hours by a stirring apparatus, with shovels of amalgamated metal connected with the positive pole of the generator, which is maintained in operation for the whole period. When, by the action of the chlorides, the precious metals have been rendered soluble and have been deposited by the current, and taken up by the mercury, the whole charge is drawn off by a cock and run into an iron trough, in which a series of grooved wooden rollers, carrying carbons in the grooves as anodes, rotate at different speeds above the mercury, which is made the cathode, and retains any amalgam particles remaining in the water and sand. The tailings are discharged by means of india-rubber plates attached radially to the last roller.
—W. G. M.

An Improved Process for the Extraction of Gold, Silver, and other Metals from Ferriferous Ores containing the same. M. Constable and J. R. Bingle, Sydney, N.S.W. Eng. Pat. 2740, Feb. 22, 1887. 4d.

THE ore is wet crushed, if necessary first roasted, the mud treated with sulphuric acid and boiled; metallic iron or zinc is added to commence the reaction and the heating prolonged until solution of iron compounds is complete. The residue contains the precious metals, which may be extracted by any known method. The solution is evaporated and roasted, the acid vapours evolved being used to treat a fresh portion of raw material; the residue from this calcination consists of valuable oxides.—W. G. M.

Improvements in the Construction and Manufacture of Zincs for Galvanic Batteries. W. E. Heys, Manchester. From J. Beattie, jun., Westport, Mass., U.S.A. Eng. Pat. 4571, March 28, 1887. 4d.

SEE page 519.

Process for Extracting Aluminium from Alumina. D. G. Reillon and S. C. Montagne, Nantes; and O. L. B. L. Bourgerel, Paris, France. Eng. Pat. 4576, March 28, 1887. 4d.

ALUMINIUM sulphide is obtained by mixing alumina into a paste with tar or with charcoal (40 per cent.) and oil, heating the mixture to a red heat in a closed vessel and treating with carbon bisulphide vapour thus :—

$$2Al_2O_3 + 3C + 3CS_2 = 2Al_2S_3 + 6CO.$$

The sulphide is then heated in a current of a gaseous hydrocarbon, whereby the sulphur is removed and pure aluminium is left.—W. G. M.

Improvements relating to the Galvanising or Tinning of Wire Cloth, Wire Netting, or other Articles or Materials, and to Apparatus therefor. H. H. Lake, London. From C. Swinscoe, Clinton, U.S.A. Eng. Pat. 6042, April 25, 1887. 8d.

INSTEAD of using sand or asbestos as a scrubber, after the metal to be tinned has passed through the bath of molten metal, the inventor uses a layer of coke placed upon the surface of the bath.—B. T.

XII.—PAINTS, VARNISHES AND RESINS.

Improvements in Anti-fouling Compositions for Ships. J. Cameron, Renfrew. Eng. Pat. 7497, June 4, 1886. 4d.

CARBOLATES of mercury, copper, iron or zinc, alone or mixed with one another or with the carbolate of an alkaline earth, such as carbolate of barium, are combined with the ordinary dry pigment or material used in forming the paint or composition for coating ships' bottoms. —E. G. C.

Improvements in Gutta-percha Compounds and in the Manufacture thereof. R. Dick, Glasgow. Eng. Pat. 7524, June 4, 1886. 8d.

THE principal constituents used in the manufacture of these compounds are the several kinds of gutta-percha, or "crumb"—ground good old vulcanised indiarubber—ground veneer dust, sulphur, zinc oxide, French chalk, flocking, or the cut fibre of cotton textile fabrics, and ground alum.—E. G. C.

Improvements in the Process for preserving Iron and Steel Structures from Oxidation. W. Briggs, Arbroath. Eng. Pat. 7777, June 10, 1886. 4d.

THE surface to be preserved is first cleansed and then coated with a varnish composed of about 11lb. of coal-tar pitch, 4lb. of tar oil and 8½lb. of coal-tar naphtha. Before the varnish is quite dry, a coating of coal-tar pitch is applied with a brush.—E. G. C.

Improvements in the Manufacture of Pigments. J. M. Bennett, Ruchill, N.B. Eng. Pat. 8725, July 3, 1886. 8d.

IN place of crushing or grinding the pigments in pan mills, burr mills, edge runners, or the like, the inventor adopts a process which consists in breaking, disintegrating or compacting; the particles of the substances being treated in the dry state by a series of sudden impacts or shocks, in one or a series of breakers, disintegrators or compacters, enclosed within a chamber or chambers through which currents of dried or heated air may be passed.—E. G. C.

An Improved Process for Preparing a Metallic Covering for giving a Non-oxidising or only slightly oxidising Coating to Wood and other Materials or Objects. E. Schröder and H. Perner, Berlin, Germany. Eng. Pat. 10,127. August 7, 1886. 6d.

FOILS of any required shape and of extreme tenuity are made by depositing electrolytically a thin metallic coat upon a slightly varnished metal or other electrode of suitable form, from which they may be withdrawn, alone or strengthened by a backing material, and may then be glued upon the wood or object to be decorated. —W. G. M.

A Process for Preserving the Surface of Copper or its Alloys. E. de Pass, London. From La Société Industrielle et Commerciale des Metaux, Paris. Eng. Pat. 16,935, Dec. 24, 1886. 6d.

THE copper or brass to be protected is coated with cuprous sulpho-cyanate or cyanate, or rhodanide, either by dipping it into an ammoniacal solution of the salt, by electrolytic means, by incorporating the dried salt with lacquer or varnish, or by any other suitable method. —W. G. M.

A Novel Transparent Protective Enamel or Varnish. F. Garton, London. Eng. Pat. 3794, March 12, 1887. 4d.

THIS enamel is produced by the incorporation of the following ingredients :—10 parts of transparent "grains" mastic (*Pistacia Lentiscus*), seven parts camphor, 16 parts sandarach, 5 parts genuine elemi, together with Canada balsam and spirits of turpentine in equal parts. The whole is dissolved in alcohol, filtered and kept in a closed vessel until required for use.—E. G. C.

Improvements in the Preparation of Pigments, and in the Manufacture and Treatment of By-Products therefrom. T. Kenyon, Manchester. Eng. Pat. 4334, March 23, 1887. 4d.

THE inventor claims "(1.) The oxidation of iron and other impurities in zinc solutions (either containing ammonia salts or not) by means of air blown through the said solutions, either with or without steam at the ordinary pressure, or in closed boilers, which can be submitted to greater pressure. (2.) The precipitation of sulphate of barium by means of sulphate of ammonia, either from the liquors left after precipitation of the sulphide of zinc by means of sulphide of barium, or at the same time as the sulphide of zinc is precipitated, and together with it ; in either case producing a solution of chloride of ammonium of greater relative value than the sulphate of ammonia used. (3.) The combination of the ammonium sulphide produced by the distillation of the recovered ammonium chloride with vat waste from alkali works, for the preparation of sulphide of zinc from zinc solutions as described. (4.) The combination with the furnace in which the sulphide of zinc pigment is roasted, of an iron, brick or other condenser, for the purpose of recovering any chloride of ammonium which may be left adhering to it and which would otherwise be lost." —E. G. C.

XIII.—TANNING, LEATHER, GLUE AND SIZE.

Improvements in Manufacturing Leather from Seal Splits. R. and W. Baker, Bermondsey. Eng. Pat. 6438, May 13, 1886. 4d.

THE invention consists in the joint combination of the following processes :—The shaved and scoured skin is (1) "set" on a table and a composition made up of one-third French chalk and two-thirds Irish moss, starch or other similar body is worked on the skin to produce a face; (2) "strained nailed" on boards ; (3) dyed ; (4) softened by stoning ; (5) grained ; (6) a solution of moss or size, etc., applied to the surface ; and (7) polished by friction with suitable pads.—R. L. W.

An Improvement in Tanning. E. P. Nesbit, London. Eng. Pat. 7744, June 9, 1886. 4d.

THE patentee proposes to remove lime from unhaired hides or skins by placing them in a closed vessel with water and forcing carbonic acid gas into the water whilst keeping the hides agitated. The excess of the gas dissolves out the lime.—R. L. W.

Improvements in Tanning. A. J. Boult, London. From Count Vitold de Nydprück, Brussels, Belgium. Eng. Pat. 8582, June 30, 1886. 4d.

THE hides are tanned in a liquor made by boiling 1kilo. of catechu and 25grms. of tallow or other grease in a small quantity of water and diluting to 100 litres. The strength of this liquor is gradually increased during the tanning process till the tanning is complete. The colour of the hides is improved by finishing them in a bath made by boiling together 25grms. of divi-divi and 10grms. of grease and diluting to 100 litres. Other tanning matters may replace the catechu or divi-divi.—R. L. W.

An Improved Method of Tanning Hides and Skins. J. W. Abom and J. Landin, Stockholm, Sweden. Eng. Pat. 14,683, Nov. 12, 1886. 4d.

The patentees claim to hasten the tanning process by placing the hides or skins in tanning solutions through which an electric current is passed alternately in opposite directions.—R. L. W.

An Improved Method of Making Leather Waterproof or Flexible. E. and A. Dunkley, Northampton. Eng. Pat. 1562, Feb. 1, 1887. 6d.

The fat from twelve parts of mutton suet is heated to 100° C. with eight parts of wax, four parts of vinegar and one part of turpentine, and the leather is caused by suitable machinery to revolve slowly in the mixture. After this it is thoroughly kneaded till it is flexible and waterproof.—R. L. W.

XIV.—AGRICULTURE, MANURE, Etc.

Crude Phosphates of North Carolina. W. B. Phillips. Chem. Zeit. **11**, 417.

The form in which the phosphoric acid, amounting on the average to 20 per cent., is combined does not prevent their use in the manufacture of superphosphate, as the material is readily decomposed. The cost of extraction and transport is, however, so great that these deposits will only very slowly be brought into use.

—C. A. K.

Manufacture of Phospho Guano. L. A. Chevalet, Paris, France. Eng. Pat. 9636, July 26, 1886. 6d.

Instead of mixing sulphate of ammonia with superphosphate, as hitherto practised, the inventor uses carbonate of ammonia, either in the solid form or in the form of strong solutions, containing 24 or 25 per cent. of NH_3, and prepared according to his previous patent (Eng. Pat. 8819, 1886). The mixing is performed in any suitable manner, and the resulting manure, even when prepared from very acid and moist superphosphates, is neutral, dry and easily pulverised.—J. M. H. M.

Erratum.—In the June issue, p. 443, line 12 from foot of second column, *for* "2—3," *read* "2·3."

XV.—SUGAR, GUMS, STARCHES, Etc.

Improvements in the Manufacture of Sugar by Electrolysis. E. Fahrig, Eccles. Eng. Pat. 3556, March 13, 1886. 8d.

By means of a high-tension dynamo, electric sparks are passed through the raw sugar, the ozone thus formed bleaching the sugar and also loosening all base and mineral matters contained in it. Low-tension currents are then sent through the bleached mass and these produce a deposition of the impurities, which may be washed away by a stream of water.—B. T.

XVI.—BREWING, WINES, SPIRITS, Etc.

Removal of Fusel Oil from Crude Spirit. E. Pfeiffer. Chem Zeit. **11**, 347.

Potassium permanganate was tried in 1869 for the purpose of removing fusel oil from crude spirit. As the result of one experiment only, the yield of pure spirit seemed to be greater than with charcoal filters, but the use of the latter was considered more practical.

—C. A. K.

Improvements in the Manufacture of Yeast. W. S. Squire, London. Eng. Pat. 8082, June 17, 1886. 4d.

This is a modification of former patents by the same inventor. (Compare this Journal, 1886, 542, and 1887, 297.) It consists in sparging the solid substance from a malt mash with the spent wash from a previous operation, instead of adding the wash direct to the strong worts.—G. H. M.

Improvements in Means or Apparatus Employed in the Preparation of Finings for the Use of Brewers and Others. A. W. Gillman and S. Spencer, Southwark. Eng. Pat. 9090, July 12, 1886. 8d.

This consists of an apparatus by means of which the operation of passing finings through a sieve is greatly facilitated. The most important part of the apparatus is a brush which has both a rotary, as well as a rising and falling, motion.—G. H. M.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(A) CHEMISTRY OF FOODS.

Improvements in the Manufacture of Articles of Food made from the Kernels of Almonds and other Fruits. E. R. Allen and W. C. Allen, London. Eng. Pat. 9712, July 27, 1886. 4d.

The kernels are decorticated, crushed and the oil expressed, the last traces of the essential oil being removed by prolonged boiling or distillation. The dried meal so obtained is made into biscuits in the usual way.—C. C. H.

Improvements in Treating Milk for Preserving it. A. Brin, Paris, France. Eng. Pat. 9738, July 28, 1886. 6d.

The milk is saturated with pure oxygen under pressure, and bottled in a manner similar to the preparation of ordinary aërated waters.—C. C. H.

(B) SANITARY CHEMISTRY.

The Physiological Action of Sulphuretted Hydrogen and the Alkaline Sulphides. J. Pohl. Arch. f. Exper. Pathol. u. Pharm. **22**, 1.

The author considers that the poisonous effects produced by sulphuretted hydrogen are not due to its reducing the oxyhæmoglobin of the blood, for, according to his experiments, death can ensue before any reduction has taken place, but to the formation of alkaline sulphides with the alkaline salts of the blood. The alkaline sulphides possess specific poisonous properties.—C. A. K.

The Purification of Waste Water by Means of Iron Salts. Dingl. Polyt. J. **263**, 484—485.

In November, 1886, G. Wolff made a communication to the *Verein Deutscher Ingenieure* regarding the special advantages of employing iron salts in the purification of waste water; a method which until now has been impracticable on account of the expense. Puddle slag, with as much as 54 per cent. of iron, and mill furnace slag, containing 48 per cent. of iron, when ground with acids yield bodies which contain about 30 per cent. of iron, a small amount of silicic acid, a variable quantity of phosphoric acid and a deposit of mud, which, in combination with chalk, serve as a substitute for expensive purifying agents. Waste water when mixed with this prepared slag gives a dense precipitate, which quickly settles and leaves a perfectly clear water, which does not putrefy even after several months storage in open or closed vessels. If the water is alkaline or contains earthy alkaline carbonates, an addition of lime is often necessary, and even in drainage water which is slightly acid (through presence of organic acids), when phosphoric acid is present it is unnecessary to add lime on account of the insolubility of phosphate of iron solutions of organic acids. To make the precipitate more useful for agricultural purposes, prepared Thomas slag is used along with either of the above-mentioned slags. If it is necessary to reduce the amount of lime, the Thomas slag is treated with sulphuric acid, when the lime separates out as gypsum. The gypsum mud, which still contains some phosphoric acid, can, after the purification of the water, be added to the deposited mud, and so made useful. The presence of the iron does not, of course, detract from its employment as manure. Wolff states that for one cubic metre of waste water (*e.g.*, from paper works) a few grms. of iron in the form of prepared slag is sufficient.—W. M. G.

Improvements in the Disinfection of Sewage, Waste Liquors, and the like. F. Petre, Berlin, Germany. Eng. Pat. 4512, March 31, 1886. 6d.

This process for the purification of sewage and other such liquids consists in treating the liquid with caustic lime and subsequently with magnesium or barium salts, or both. The effluent from this defecation is further purified by filtration through gravel, charcoal, sawdust and tan or any material containing tannic acid. The process may be made more effective by treating the effluent with an alkaline phosphate and chloride of magnesium prior to the filtration.—C. C. H.

An Improved Means of Purifying, Precipitating, and Filtering Sewage, Drainage, and the like matters. J. Fenton, Batley. Eng. Pat. 7333, June 1, 1886. 6d.

The sewage is passed through a box or tank containing alum and admitted into settling tanks, the effluent passing therefrom being filtered through a series of strainers composed of straw or reeds.—C. C. H.

The Employment of Certain Substances for Antiseptic Purposes. W. Thomson, Manchester. Eng. Pat. 6819, May 21, 1886. 4d.

The patentee claims the employment of the neutral and acid fluorides and silico-fluorides of the alkalis, either alone or mixed with the free acids as general antiseptic. In some cases the proportion used may be as low as one part of the salt or salts to 1000 of the substance to be preserved and in others as high as two parts to 100.
—C. C. H.

Improvement in Disinfectants. A. Boake and F. G. Roberts, Stratford. Eng. Pat. 8509, June 29, 1886. 4d.

The patentees claim the employment of acid sulphite of zinc as a disinfectant; also a mixture of any of the following dry salts:—Calcium, magnesium, sodium, potassium and zinc sulphites or sodium and potassium bisulphites, with dry anhydrous sodium bisulphate sufficient in quantity that when wetted its free acid will decompose the sulphite with which it is mixed.—C. C. H.

Improvements in the Manufacture of Depurating and Decolourising Charcoal for Purifying Sewage and other Foul Liquids, and for Decolourising Syrups. W. Burns, Leith. Eng. Pat. 9569, July 24, 1886. 8d.

Sixteen parts of dried chalk and 6 parts of clay are ground to a fine powder with 12 parts of coal; 20 parts of wood sawdust are also added. The finely powdered mixture is then well incorporated with 40 parts of animal dung, 4 parts of blood and 2 parts of iron borings; the whole is moulded into bricks and these are calcined in a closed retort at a low temperature and at about 2lb. per square inch air pressure; a second stage of calcining at a high temperature and a lower pressure follows. Hydrochloric acid gas is then injected into the retort, afterwards superheated steam to absorb the acid, and finally after cooling, the charred mass is ground fine. The substitution of blood for the iron borings, and one half of the chalk and clay by ground bones, and proceeding as before, yields a carbon having a high decolourising as well as depurating effect. The specification gives drawings of the apparatus in which the calcination is effected.—C. C. H.

Improvements in Compositions for Treating Matters having an Offensive Smell. A. D. Hunter, Melbourne. Eng. Pat. 6037, April 25, 1887. 4d.

The object of the patentee is the production of a deodorant which shall not impair the valuable fertilising properties of any offensive matter to which it is added. The mixture described consists of 1 ton of dry lignite dust, 6 bushels of dried powdered leaves of the gum tree, 1cwt. of sulphate of iron, ¼cwt. of salt and 2 gallons of kerosene.—C. C. H.

XVIII.—ELECTRO-CHEMISTRY.

Pocket Form of Daniell's Dry Cell. Edelmann. Centralbl. f. Electrotech, **9**, 145.

Two plates of copper and two of zinc are separated from one another by sheets of filter paper. The paper is soaked in a hot mixture of gelatine and powdered copper sulphate on one side, and gelatine and powdered zinc sulphate on the other. Before fitting up the battery the sheets thus prepared are soaked in water and the plates are held together by indiarubber bands. With a resistance of 1 ohm, the battery has an electro-motive force of 2·04 volts, and the strength of the current, which is sufficiently constant, is 0·5 ampère.—C. A. K.

Crystals from Leclanché Cells. H. Thoms, Pharm. Zeit. **32**, 171.

Rhombic crystals of the formula $ZnCl_2.2NH_3$ were found in a Leclanché battery. They are insoluble in water but on boiling, ammonia is evolved. They can be obtained by dissolving freshly precipitated zinc hydroxide in a solution of ammonium chloride and evaporating till the solution commences to crystallise.
—C. A. K.

Improvements relating to the Application and Utilisation of Magnetism or Electro-Magnetism for the Separation of Metals and for other purposes, and to Apparatus therefor. H. S. Maxim, London. Eng. Pat. 4751, April 5, 1886. 1s. 1d.

This invention relates to the separation of non-magnetic metals from non-metallic substances, the separation being effected by allowing the mixture to fall between the poles of rapidly revolving magnets, the polarity of which is subject to continual reversals. The metals move in the direction of rotation of the magnets, and can be collected in a suitable chute, while the non-metallic substances fall straight down between the poles. This apparatus can also be used for assaying, by weighing ores in an ordinary balance and also when suspended between the magnet poles. The quantity of salts, saccharine matter, or acids in a solution can be ascertained by the same method. The larger the quantity of salts the greater the deflection.—B. T.

The Regeneration or Production of Chromic Acid from Exhausted Battery and other Solutions. D. G. Fitzgerald, London. Eng. Pat. 5542, April 21, 1886. 6d.

In batteries in which chromic acid or an acid solution of a chromate or bichromate is used, there is generally left a chromic salt and some sulphate of zinc. For convenience, this solution is poured into a tank, and the oxides of zinc and chromium are precipitated by lime or other base. The precipitate can then be easily transported to the regenerating works. Here it is redissolved by a dilute mineral acid or other suitable solvent and placed in a vessel, in which it is separated by a porous partition from a solution of zinc sulphate or of oxide of zinc in ammonia-alum. Into these two compartments dip electrodes that are not acted on by the solution. A current is then passed through, which liberates the acid of the chromium salt and oxidises its oxide of chromium into chromic acid. Zinc is deposited in the cathode compartments and may be separated by fusion from the oxide of chromium deposited with it.—E. T.

Improvements in Galvanic Batteries. S. F. Walker, Cardiff. Eng. Pat. 5817, April 29, 1886. 4d.

THE inventor proposes to use sulphur instead of manganese dioxide in a Leclanche cell. In the action which he believes takes place, the exciting liquid used at one stage of the action is renewed at another. The battery gives notice when nearly worked out by the liberation of sulphuretted hydrogen into the air.—E. T.

Improved Galvanic Battery. F. W. Branson, Leeds. Eng. Pat. 5855, April 30, 1886. 6d.

PLATES of carbon, which are placed generally in the outer vessel of the battery and surround the porous cell, are immersed in a solution, of which the essential components are chromic acid, sulphuric or nitric acid, and water. The zinc electrode is immersed in a solution of dilute sulphuric acid and any soluble mercury salt, but preferably sulphate of mercury.—E. T.

Improvements in the Mode of Vulcanising the Insulating Covering of Electrical Conductors. B. J. B. Mills, London. From J. J. C. Smith, New Jersey, U.S.A. Eng. Pat. 5828, May 12, 1885. 6d. (Amended Specification.)

IN the process of vulcanisation it is found of great importance to protect the wires from moisture and at the same time to subject them to pressure. This is at present done by packing in soapstone, or covering them with a tape impervious to moisture, and then subjecting them to the heat and pressure of steam. By this vulcanising process, however, the insulation resistance is found to be lowered and to fall farther when immersed in water. The inventor, therefore, covers the insulating material with tinfoil, thus completely protecting from moisture, and then subjects the cable to the direct action of high-pressure steam. Experiments show that by this process of vulcanisation the resistance is very much increased and is not affected by a long immersion in water.—E. T.

Improvements relating to the Extraction or Separation of Gold, Silver, and Platinum from Ores and other Substances or Products containing such Metals. J. Noad, East Ham. Eng. Pat. 6810, May 20, 1886. 6d.

THE finely pulverised material is allowed to subside in a bath consisting of a mixture of a saturated solution of any suitable iron salt with one of tungstate of iron. Into the deposit a cathode is introduced, the iron anode being in the solution and out of contact with the precipitate, and an electric current is passed, with the object of coating the particles of noble metals with iron, when they may be extracted from the residual matter by a magnetic separator. The iron may be subsequently removed by acid or by roasting.—W. G. M.

Improvements in the Transformation of Heat into Electricity, and in Apparatus for that Purpose. C. Clamond, Paris, France. Eng. Pat. 6869, May 21, 1886. 11d.

THE inventor connects an alloy of antimony and zinc with a substance such as galena or sulphide of lead by "intercontacts" of copper or other suitable metal. If one of these intercontacts connects the substances at one part and another at another part, then, when one intercontact is heated and the other cooled, a current of electricity is produced in the circuit. This principle is made use of in the improved apparatus.—B. T.

Improvements in obtaining Copper from Solutions of its Salts. E. Hunt, Glasgow. From G. Thomson, New Jersey, U.S.A. Eng. Pat. 6974, May 25, 1886. 4d.

COPPER PLATES, to serve as the positive electrode, and carbon contained in a porous vessel, to serve as the negative electrode, are immersed in the copper solutions. A current of electricity is passed through the cell until 90 per cent. of the copper has been deposited on the copper plates. The solution is then agitated with sulphide of iron, and afterwards allowed to settle; the clear liquor remaining is strongly acid, and may be used to dissolve fresh copper from oxides, etc.—B. T.

Improvements in Primary Voltaic Batteries. J. E. Pearce, Maidenhead. Eng. Pat. 7189, May 28, 1886. 8d.

THIS improvement relates to a battery similar to that described in Eng. Pat. 7461 of 1885, in which a current of chlorine gas is used as the excitant. A slab of carbon corrugated, or otherwise, and placed horizontally, serves as a porous partition and also as one of the electrodes; below and parallel with it is a slab of zinc immersed in zinc chloride. The whole is covered in by an earthenware cover or by the carbon element used as a cover, suitable passages being provided for the entrance and exit of the chlorine.—B. T.

Improvements in the Manufacture of Carbon Filaments or other Conductors for Incandescent Electric Lamps. W. Maxwell, London. Eng. Pat. 7251, May 31, 1886. 6d.

IN the usual methods of flashing, the hydrocarbon begins to decompose before the filament has become very hot and before the occluded gases have been expelled; the rate of deposit is also rapid and not easily controlled. The deposits are, on this account, only slightly adherent and not homogeneous. The inventor therefore encloses the filaments in a vessel through which a stream of neutral gas, such as nitrogen or hydrogen, is passing and heats them electrically as a preliminary purifying process. A continual stream of hydrocarbon gas or vapour, diluted with nitrogen or hydrogen in such proportions as will give the required rate of deposit, is then passed through and the flashing operation carried on at a much higher temperature than is usual. The gas is preferred at a low temperature and pressure. As the condition of the atmosphere round the filament remains practically constant, a very homogeneous deposit is obtained.—E. T.

Improvements in Galvanic Batteries. P. R. de F. d'Humy, London. Eng. Pat. 7353, June 1, 1886. 11d.

BY means of a lever the electrodes can be raised completely or only partially out of the liquid, according to the current required. The vessels containing the exciting fluid are arranged in trays, so as to be easily removed for renewing the liquid; each cell contains a porous vessel filled with the electrolyte, which gradually passes through the pores to renovate the liquid in the outer vessel.—B. T.

A New or Improved Electro-chemical Etching Process. H. E. P. Dorn, Leipzig, Germany. Eng. Pat. 7463, June 3, 1886. 4d.

THE parts of the metal plate which are to remain elevated are coated with a thin layer of some insulating substance; the plate is then connected by a wire to the positive pole of a battery and immersed in a bath of dilute acid sufficiently strong to chemically attack the metal of the plate; opposite to it is placed a plate of carbon or some negative metal connected to the negative pole of the battery.—B. T.

An Improvement in the Construction of Elements for Secondary Batteries or Accumulators. J. Pitkin, London. Eng. Pat. 7596, June 5, 1886. 8d.

THE frame of lead is cast with a flange along all four sides, and with studs at suitable intervals over both faces of the plate; these studs are cast taper, but are afterwards burred over by hammering so as to hold the active material of the plate; for the same purpose the flanges are either bent inwards or are undercut.—B. T.

Improvements in Secondary Batteries. C. Smith, London. Eng. Pat. 7848, June 11, 1886. 11d.

The electrodes are made of shallow leaden trays, divided by partitions into numerous compartments. Into these are packed strips of thin lead, alternated with either strips of asbestos paper or of some such substance as peroxide of lead. These plates are packed in a suitable containing vessel, with a thin plate of perforated vulcanite or such material between each pair and supported in such a way as not to touch either of the plates when the cell is in good order: this prevents any chance of a short circuit by buckling.—E. T.

An Improved Process for Producing Metallic Drawings or Designs, and Ornaments of all kinds on Metallic Surfaces. H. J. Haddan, London. From Johann von Chelmicki, Warsaw, Russia. Eng. Pat. 8078, June 17, 1886. 6d.

On the metallic surface to be treated, the parts to be left unaffected are painted over with an insulating ink or mass and then whatever metal is desired is electrodeposited on the exposed part of the metal surface. To produce a design in three metals—*e.g.*, gold, silver and nickel—the surface is first gilded, then nickeled, painted to the required design and silvered on the parts left exposed. The paint is removed from those parts that are to appear in gold and the nickel dissolved by a suitable acid.—E. T.

Improvements relating to the Extraction of Gold, Silver and Copper from Ores and other Substances or Products containing such Metals. J. Noad, East Ham. Eng. Pat. 8130, June 18, 1886. 6d.

See page 511.

Improvements in Secondary Batteries or Accumulators. A. M. Clark, London. From A. E. Peyrusson, Paris, France. Eng. Pat. 8226, June 22, 1886. 8d.

An electrode is employed, consisting of a block of peroxide of lead with vanes or wires of lead distributed through it and all connected to a central vertical lead rod. This electrode is placed in a porous vessel, the opposite electrode of lead or other suitable metal being placed round it, containing a solution made up of water, sulphuric acid and sulphate of tin or cadmium. When charging, either tin or cadmium is deposited on the lead plate; when discharging, this deposit is redissolved. For this electrode are claimed, great storage capacity, freedom from local action and the preliminary operation of "forming," and the possibility of seeing by the deposit of metal whether the accumulator is charged or run down. For the whole battery are claimed, freedom from short-circuiting, greater durability and an unusually high electromotive force and discharge current.—E. T.

Improvements in the Process of Pickling or Cleaning the Surface of Iron or other Metal previous to Coating such Surface with Tin or other Metal. A. Gutensohn and J. M. James, London. Eng. Pat. 8324, July 23, 1886. 6d.

A wooden bath is made of suitable form and size and lined with sheet iron; it is filled with an acid or alkaline solution, according to convenience. In it the metal sheets to be cleaned are suspended, and a current is passed from them through the liquid to the iron lining. The sheets become beautifully clean, while the iron which is removed, is deposited on the metal lining or, if the current be very strong, is deposited as oxide and may in either case be made use of. The "pickling" solution may be used for a long time and, being cold, gives off no noxious fumes. The inventor claims greater economy by this process.—E. T.

Improvements in Secondary Batteries or Electrical Accumulators. A. Reckenzaun, London. Eng. Pat. 8379, June 25, 1886. 6d.

In the usual forms of accumulator plates the active material is liable to be detached. The inventor therefore pours melted lead into a heated shallow tray, and distributes equally, by a continuous vibration or other suitable means, small pieces of active material of any chosen shape, placing a cover over to prevent them floating. By its contraction the lead binds them closely, decreases the above-mentioned defects and moreover gives great mechanical strength.—E. T.

Improvements in Incandescent Electric Lamps. J. G. Lorrain, London. Eng. Pat. 8413, June 25, 1886. 6d.

To overcome the well-known objections to thick leading-in wires in low-resistance lamps, the inventor substitutes several smaller wires, each wire being fused separately in the glass and joined together inside and outside for each of the larger ones.—E. T.

Improvements in the Manufacture of Carbon Filaments or other Conductors for Incandescent Electric Lamps. W. Maxwell, London. Eng. Pat. 8513, June 29, 1886. 6d.

The inventor "flashes" his filaments in the manner described in Eng. Pat. 7251, of 1886 (see abstract). The extent of the deposit is determined by the strength of current required to produce standard incandescence, and for the purpose of easily comparing the light with a standard, it is obscured by suitable means. The point at which the desired strength of current has been reached, may be indicated by a glow lamp placed in series, which then assumes a certain state of incandescence or just begins to glow; at this point, if desired, the current may be broken automatically by a "cut-out." To make lamps that will glow equally, whether in series or in parallel, filaments are chosen of exactly similar quality and size and, after flashing as above, are cut to the same length and mounted.—E. T.

Improvements in and connected with the Manufacture of Aluminium, and other Light Metals. F. J. R. Seaver, London. From Dr. E. C. Kleiner-Fiertz, Zurich, Switzerland. Eng. Pat. 8531, June 29, 1886. 8d.

Dry powdered cryolite is packed around and between carbon electrodes in a bauxite-lined furnace; on passing the current from a dynamo-electric machine, the heat of the arc formed between the carbons causes the fusion and simultaneously, the decomposition of the cryolite. The evolved fluorine, by attacking the bauxite, maintains the aluminium percentage in the electrolyte constant. When sufficient metal has collected, in the form of fused balls, around the lower or negative carbons, the circuit is broken and, after cooling, the aluminium is collected. Other light metals, such as magnesium or sodium, may be similarly reduced, but since they float upon the bath, the furnace must be closed by a tight-fitting bell cover to exclude oxygen. The form of furnace recommended is rectangular with symmetrically arranged cavities, the bottoms of which are pierced by the negative carbon; the positive electrodes are formed by groups of carbons in order to expose larger surfaces for contact. The various systems in each furnace are arranged in multiple arc and the positions of either sets of carbons may be regulated at will.
—W. G. M.

A Novel Saline Preparation applicable for use in Galvanic Batteries, and the Process for the Manufacture of the same. A. Schanschieff, London. Eng. Pat. 8832, July 6, 1886. 6d.

This preparation is composed of mercury and sulphuric acid, forming "a salt so freely soluble in water that 2lb. of metallic mercury may be held in solution in a gallon of water." Two methods of preparation are described.—B. T.

Improvements in Galvanic Batteries, and in the Application of the same to Electric Lighting and other uses. A. R. Upward and C. W. Pridham, London. Eng. Pat. 9082, July 12, 1886. 1s. 1d.

These are improvements on the gas batteries described in Eng. Pat. 15,567, of 1884, and Eng. Pats. 7461 and 9302, of 1885 (this Journal, 1886, 247 and 331). The inventors now employ extremely large circular cells, containing five cylindrical porous pots and two carbon plates between each pair of pots, all the remaining space being filled with broken carbon. The whole is sealed with marine glue. The porous cells contain the zincs and a solution of chloride of zinc. The gas generator has three openings—one connected to an acid vessel, provided with a gauge-glass to allow measured quantities of acid to be run into the generator; one to deliver the gas; and the third for emptying. The second tube has also a pipe with a tap jointed on, leading to a water reservoir, for cleaning out the generator. The gas when being made, passes first through the cells and then into the gas reservoir, consisting of four or more upright columns of drain pipes, the superior density of chlorine being taken advantage of. When the generator is not working, gas is sucked into the battery from these columns. The gas pipes that enter at the bottom of the cells may be connected with a trap to the drain, so as to get rid of any accumulation of liquid. For electric lighting two or more cells are employed, according to the size of the installation. A battery of accumulators is connected in series to the external circuit, and by means of a clock and a mercury switch-board, one, two or more cells, according to the size of the gas battery, can be connected to the latter in turn for regular intervals of time.—E. T.

Improvements in the Process for Treating Auriferous Substances by Electrolysis. H. Liepmann, London. Eng. Pat. 9432, July 20, 1886. 8d.

These improvements have reference to the apparatus described in Eng. Pat. 3873, 1883 (this Journal, 1884, 322) and consist in the addition of a dense porous diaphragm, which can be placed over the more porous partition, so as to prevent the diffusion of the cathode liquors into the anode compartment. Means are provided for putting this diaphragm either into or out of action.—B. T.

Improvements in Galvanic Batteries. E. H. Desolu, Paris, France. Eng. Pat. 9514, July 22, 1886. 8d.

To obtain great constancy, two porous pots are employed, an inner one containing the zinc, and an outer one; the space between the two is filled with a store of acid to replenish the weakened liquids of the active cells. Each vessel is provided with a special tap to enable liquid to be run in or withdrawn. Sometimes a third porous cell is employed, outside the above-mentioned two, containing a second zinc cylinder. This is then joined to the carbon of the next battery, as in the ordinary series arrangement. All the inner zincs are, however, joined together to the negative pole of the battery. It is stated that by this means a double electromotive force may be obtained.—E. T.

Improvements in the Deposition of Platinum by Electricity. W. A. Thoms, London. Eng. Pat. 10,477, Aug. 16, 1886. 6d.

To a solution of platinum chloride is added a weak solution of sodium phosphate and then one of ammonium phosphate. The mixture is boiled for several hours, some sodium chloride solution being added. Through the bath thus prepared a strong current of electricity is passed, and the bath is better if used warm. It must be kept up to strength by the addition of fresh platinum and sodium solutions.—E. T.

Improvements in Electrical Fuses. G. Smith, Polmont, N.B. Eng. Pat. 14,249, Nov. 5, 1886. 4d.

The inventor makes the fuse composition for blasting purposes into a paste by combining it with collodion, or a solution of rubber or shellac; the ends of the conducting wires are then coated with this material, which may be covered with sheep-gut and afterwards treated with shellac varnish.—B. T.

Improvements in and connected with the Manufacture of Aluminium and other Light Metals. E. C. Kleiner-Fiertz, Zurich, Switzerland. Eng. Pat. 15,322, Nov. 24, 1886. 8d.

The object of these improvements is to prevent the rapid destruction of the carbon anode immediately above the bath of melted cryolite, which occurs in the use of the arrangement described in Eng. Pat. 8531, of 1886 (see abstract, p. 517). To effect this, the anodes are moulded into segments, which are so placed as to form a carbon ring, and above this is placed a layer of oxide of aluminium to prevent access of air to the carbon. The bottom of the vessel is made concave, so that the metallic aluminium which is deposited may collect there and not form a short circuit between the carbons. The carbon rings have wings or connections, which extend beyond the furnace, to lead the current from the main circuit. The arc may be started initially by means of a carbon rod.

—W. G. M.

Improvements in Extracting Gold and other Precious Metals from their Ores, and Apparatus therefor. C. D. Abel, London. From E. Fischer and M. W. Weber, Berlin, Germany. Eng. Pat. 921, Jan. 20, 1887. 8d.

See page 512.

Improvements in Galvanic Cells. N. W. Perry, Norwood, Ohio, U.S.A. Eng. Pat. 1337, Jan. 27, 1887. 8d.

The conducting electrode consists of a plate of carbon perforated with small holes and floated horizontally with its upper surface above the level of the battery fluid, and also coated with paraffin or some similar substance. The occluded oxygen of the carbon acts as the depolariser. The zinc electrode passes through a hole in the centre of the carbon and dips in the battery liquid, which may consist of a solution of ammonium chloride.—B. T.

Improvements in Electric Batteries. C. G. Curtis, F. B. Crocker and S. S. Wheeler, New York, U.S.A. Eng. Pat. 2721, Feb. 22, 1887. 8d.

With this battery a mechanical device is provided, whereby the electrodes may be immersed to any required depth or be raised completely out of the battery solution.—B. T.

Improvements relating to Electric Batteries and to means for putting the same into and out of Action. G. V. Lagarde, Paris, France. Eng. Pat. 2835, Feb. 23, 1887. 11d.

By means of mechanism actuated by clockwork, the exciting fluid is constantly circulated, and the carbon electrodes rotated. The current also may be controlled at a distance from the battery.—B. T.

Certain New and Useful Improvements in Accumulators of Electricity or other Primary or Secondary Galvanic Batteries. C. Desmazures, Paris, France. Eng. Pat. 4219, March 21, 1887. 8d.

When a metallic precipitate or powder is subjected to very great pressure, it becomes agglomerated and has then the power of absorbing oxygen and hydrogen to a very large extent. The inventor employs a plate of metal, such as copper or iron prepared in the above way, as one electrode, enclosing it in a parchment envelope. The other electrode is of tinned iron, with tinned iron wire or gauze wrapped round it to give large surface. The electrolyte is a solution of chlorate of soda and zincate of soda or potash. In charging, water is decomposed and the oxygen absorbed by the porous plate; the hydrogen decomposes the zincate and zinc is deposited on the iron. On discharging, the zinc returns to solution by the help of the oxygen of the other electrode. It is claimed that the electromotive force and resistance are very constant, the efficiency is high and that no buckling takes place.—E. T.

Improvements in Electrodes applicable for Use in Primary or Secondary Batteries. L. Epstein, Martinikenfelde, Prussia. Eng. Pat. 4527, March 26, 1887. 8d.

THE inventor's object is to avoid short-circuiting by disintegration or buckling of the electrodes. He therefore employs strips of lead with the active material attached thereto in any of the well-known ways. These are fixed by one or both ends to a stiff lead frame, so that the whole electrode looks like a grid or railing. The distance between each strip is small, so as to prevent the active material if dislodged from falling between two opposite electrodes. In another method the inventor covers a cake of finely-divided "lead compound" with lead, and after varnishing the plate thus formed with some such material as Chatterton's compound, cuts slits or holes to expose the active material. Great capacity, mechanical strength and rate of charge and discharge are claimed for these electrodes, which may be constructed of other metals than lead.—E. T.

Improvements in the Construction and Manufacture of Zincs for Galvanic Batteries. W. E. Heys, Manchester. From J. Beattie, jun., Westport, Mass., U.S.A. Eng. Pat. 4571, March 28, 1887. 4d.

THE object of this invention is to cause mercury to amalgamate with zinc throughout its mass. For this purpose a metal, such as lead, containing a little arsenic, is placed in mercury just hot enough to dissolve it, a little carbonate of soda added and the amalgam poured into moulds and allowed to cool. This lead amalgam is then placed in a pair of perforated tongs, which completely encloses it, and moved vigorously about in molten zinc, or in zinc sufficiently hot to take the form of powder. By this means a thorough amalgamation is obtained, the arsenic helping the union of lead and zinc, and the sodium that of zinc and mercury.—E. T.

Improvements in Means for Supporting or Suspending Elements in Electric Batteries. H. I. Harris, London. Eng. Pat. 4744, March 30, 1887. 6d.

THE zinc or other elements are suspended by hooks passing through holes in their centres, the hooks consisting of either amalgamated copper or some metal similar to that of which the element is composed.—E. T.

XIX.—PAPER, PASTEBOARD, Etc.

A Process and Apparatus for rendering all kinds of Paper Impermeable and Transparent, said Apparatus being likewise applicable for rendering Cotton or other Fabrics Impermeable. E. de Pass, London. From La Société de Lafarge Lèbre et Compagnie, Paris, France. Eng. Pat. 7530, June 4, 1886. 8d.

IN Eng. Pat. 5242 of 1883 and Eng. Pat 15,075 of 1884 (this Journal, 1884, 443), certain processes are described for rendering fabrics, leather, skins, cork and other substances in general, impermeable. The substance used for this purpose is composed as follows :—

Turpentine paste	6kilos.
Tallow	1·5 ,,
Wax	0·5 ,,
Styrax (necessary and not optional)	0·2 ,,

The inventor has since found that a homogeneous substance is obtained. He now proposes to apply this mixture to all kinds of paper in order to make them transparent and impermeable to air or moisture. This transparent material is called styroleum and hydrofage cotton. The apparatus consists of two parts—viz., a sheet iron cistern for containing the above-named substance and a calendering apparatus.—H. A. R.

A New and Improved Process and Apparatus for Manufacturing Sulphite Cellulose in Beton Boilers. L. A. Groth, London. From H. Schnurmann and G. Close, Würtemburg, Germany. Eng. Pat. 7633, June 7, 1886. 8d.

THE object of this invention is to manufacture sulphite cellulose in a quicker, cheaper and more effectual manner in beton boilers by the indirect application of steam for heating in a specially arranged heater. The beton boiler is a fixed vertical cylinder composed of acid-proof masonry and cement enclosed in a leaden mantle and a thick coating of beton, the whole being bound together by iron bands and screws, connecting a crown and base-plate of sheet iron, each being provided with a cast-iron man-hole.

The heater consists of three double copper cylinders with cast-iron lead-lined covers, placed horizontally one above the other. Connecting pipes permit the circulation of the boiling liquid upwards into the boilers containing the material to be acted upon. Steam from a separate boiler circulates round these cylinders by means of outer jackets, which communicate by short tubes, or instead of double cylinders the steam may pass by a series of copper tubes through the heater.

In this way the wood will be entirely disintegrated, and becomes soft and tender, offering greater facility to felt. This kind of boiler has the advantage that loss of heat is reduced to a minimum, and the sulphurous acid cannot act on the iron parts in any way.

By means of the special heater rapid circulation of the boiling liquid will be effected, by which alone it is possible to produce throughout the whole of the boiler a homogeneous product. The heater can also be applied to horizontal boilers, and figures are given showing the same applied to a "Mitscherlich" boiler in which the direction of circulation can be reversed.—H. A. R.

A New or Improved Rotating Vat, principally for the Boiling of Cellulose. H. J. Haddan, London. From W. Woern, Gothenburg, Sweden. Eng. Pat. 8486, June 28, 1886. 6d.

THIS invention relates to rotating "vats," and is principally intended to be applied to those used for the boiling of cellulose. It consists in making the "vat" an elongated oval shape, "by which it is rendered much stronger and adapted to be more completely emptied than a cylindrical vat."—H. A. R.

Improved Method of Treating or Preparing Paper for the Manufacture of Floor and Wall Coverings; applicable also for Wrapping, Packing, and other like uses. John Luke, Denny. Eng. Pat. 8593, June 30, 1886. 4d.

THE inventor prepares a duplex paper by the process described in Eng. Pat. 2409 of 1877, with the addition that before being finished it is passed through a sizing machine in order to give it a coat of size, after which the paper is made waterproof by means of oil, paint, etc., put on by machinery or by hand. The paper may be printed if required and then either air or machine dried.—H. A. R.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

The Fat of the Soja Bean. T. Morawski and J. Stingl. Chem. Zeit. **11**, 82.

THE Soja bean contains 18 per cent. of fat. The oil extracted by ether has a sp. gr. of 0·9270. 0·22 per cent. of the oil does not saponify; when mixed with concentrated sulphuric acid a rise in temperature of 61° is noted. It belongs to the semi-dry oils, and resembles the oil of the pumpkin-kernel in its properties.

The fat of the soja bean contains 95½ per cent. of fatty acids, which in the free state melt at 28° and solidify at 25°.—C. A. K.

The Sugar of the Soja Bean. T. Morawski and J. Stingl. Chem Zeit. **11**, 82.

THE Soja bean contains 12% of sugar, partly saccharose and partly a non-crystallisable sugar. The latter gives mucic acid on oxidation, its specific rotatory power is greater than that of cane sugar and it is more difficult to invert.—C. A. K.

Raiz Pipi, a New Drug. Chem. Zeit. **11**, 348.

RAIZ PIPI is the seed of *Petiveria hexaglochin*, a plant belonging to the order *Phytolacca*, and found in Brazil. The Petiveriæ occur in the south of North America, South America and the West Indies in bare places, meadows, etc., as small bushy plants with clusters of white blossoms and pale green oval leaves. The fruit is of an oval shape and broader at the top than at the bottom. The whole plant, and especially the roots, have a strong garlic-like smell. This is not noticeable in the dried roots but appears again when they are moistened. Little is known either of the chemical or medicinal properties of these roots. They are used to a considerable extent, however, by the natives in the districts where they are found as a febrifuge, as a sudorific and as a remedy for gonorrhœa and toothache; also for washing wounds. One variety, *P. alliacea*, is employed by the Indians of Calderão (Brazil) in the preparation of curare. It is not poisonous.—C. A. K.

The Action of Croton Oil. Kobert. Chem. Zeit. **11**, 416.

THE author considers, in opposition to Senier's views (*Pharm. J. and Trans.*, 1883, 446), that there are two active principles in croton oil, one of which attacks the skin, while the other acts as an aperient: that both these effects are due to crotonolic acid (not to be confounded with crotonic acid), which was discovered by Buchheim in croton oil in 1873. It exists in the oil partly in the free state and partly as a glyceride. Senier also states that croton oil can be separated by means of alcohol into two fractions. This the author also denies, his experiments showing that the solubility of the oil in alcohol depends mainly upon its age. Some varieties are soluble in all proportions; while crotonolic acid itself is readily soluble in alcohol, the solubility of the oil bears no relation to the quantity of free crotonolic acid present. To separate this acid the oil is treated with an excess of a hot saturated solution of baryta water, and the precipitated barium salts washed with cold water and extracted with ether, whereby those of oleic and crotonolic acid are obtained in solution. The residue, after distilling off the ether, is exhausted with alcohol, in which the barium crotonolate dissolves, and from this solution the free acid is liberated by sulphuric acid. Crotonolic acid is liable to decomposition by hot baryta water, and this is the chief difficulty in its preparation.

—C. A. K.

Lobelia Inflata. Prof. Lloyd and G. Lloyd. Pharm. Rundschau, **5**, 32.

LOBELIN, the essential principle of *Lobelia inflata*, forms a colourless, amorphous, brittle mass, having a stroeg smell. The smell is due to a mixture of ethereal oils and inflatin, both of which are removed by washing with carbon bisulphide, when the lobelin is both colourless and odourless. Its salts, which could not be obtained in a crystalline form, are all powerful emetics. It is only sparingly soluble in water. Inflatin, which can also be extracted from the seeds of *L. inflata*, is a colourless body, without smell, insoluble in water, but soluble in carbon bisulphide, benzene and chloroform; it melts at 107° and does not combine with either acids or alkalis.—C. A. K.

Liquid Vaselin as a Solvent for Hypodermic Injections. Meunier-Lyon. Archiv. de Pharm. **3**, 97.

IODOFORM, carbon bisulphide, eucalyptol and other substances which act as irritants when injected subcutaneously, lose this objectionable property when dissolved in liquid vaselin. The vaselin used for this purpose must have a perfectly neutral reaction, and a sp. gr. of 0·870—0·895 at 15°. It should not evolve any vapours when heated to 180° and should possess neither taste nor smell. The fluorescence of liquid vaselin is no objection to its use. It acts as a ready solvent for hydrocarbons, but dissolves few oxygenated compounds. Ether, chloroform, fats, volatile oils, menthol, thymol, etc., are soluble in all proportions, as are large quantities of iodine, bromine and iodoform. According to Bocquillon, sulphuretted hydrogen is more soluble in liquid vaselin than in water; vaselin dissolving four times its own volume of the gas.—C. A. K.

Chia Seeds. L. Soubeiran. J. de Pharm. et de Chim. **15**, 260.

CHIA SEEDS are obtained from a species of Salvia. In taste and smell they resemble linseed. Chia oil, which is of a clear yellow colour, is similar to linseed oil, and like the latter possesses drying properties. The Mexicans consider the oil to be of great therapeutic value, while the seeds are used in the preparation of a refreshing beverage.—C. A. K.

Active Principles of the Alant Root (Inula Helenium). Marpmann. Phar. Centr. H. N. F. **8**, 122.

THE author confirms Korab's results as to the antiseptic properties of the constituents of the alant root against tuberculosis bacilli. By distilling the root with water helenin, alantic acid and alantol (alant camphor) are obtained. Alantic acid $C_{15}H_{22}O_3$ crystallises from alcohol in white crystals which melt at 91°, and sublime forming an anhydride $C_{15}H_{20}O_2$. Both the acid and anhydride are insoluble in water, soluble in alcohol and the fatty oils, and form easily soluble salts with the alkalis. Alantol is an aromatic liquid boiling at 200°. The author concludes from numerous experiments made on both man and animals that neither alantic acid nor alantol have any injurious action on the system.

—C. A. K.

Berberine. E. Schmidt. Arch. Pharm. **25**, 141.

THE author ascribes the formula $C_{20}H_{17}NO_4$ to berberine. It is obtained from the fluid extract of both *Hydrastis canadensis* and of *Berberis aquifolium* by treating with dilute sulphuric acid, the berberine sulphate obtained being washed with alcohol, then dissolved in hot water, and reprecipitated by dilute sulphuric acid.

Berberine forms a crystalline compound with chloroform, $C_{20}H_{17}NO_4CHCl_3$, which is almost insoluble in alcohol and water. It also combines with yellow ammonium sulphide similarly to strychnine, forming a polysulphide of the formula $(C_{20}H_{17}NO_4)_2H_2S_6$, which crystallises in brown needles.—C. A. K.

Ecgonine. W, Gintl and L. Storch. Monatsh. Chem. **8**, 78.

ECGONINE heated with methyl-iodide yields a methiodide addition product and not a hydriodic acid salt, as stated by Lossen. According to Merck, neither methyl-iodide nor hydriodic acid have any action on ecgonine.

—C. A. K.

Process for the Production of the Ethers of Morphinecarbonic Acid. A. Knoll, Ludwigshafen, Germany. Eng. Pat. 10,281, Aug. 11, 1886. 4d.

THE process is based on the reaction of the ethers of chlorocarbonic acid on morphine, on morphine-alkalis or on the morphine-compounds of the alkaline earths. To produce, for instance, the methyl-ether of morphinecarbonic acid, morphine is dissolved in alcohol. Alcoholic potash or soda is then added and afterwards a slight excess of methylchlorocarbonate. The reaction takes place at once and is attended with considerable development of heat. Subsequently, the mixture is neutralised with sulphuric acid, the alcohol distilled off and the residue dissolved in water. An excess of alkali is added and the methyl-ether of morphinecarbonic acid thus formed is taken up by benzene. The latter is evaporated, when the methylether remains behind as a crystalline mass. Other ethers are obtained in an analogous manner.—S. H.

Process for Producing Methyl-Morphine (Codeine), Ethyl-Morphine and Higher Homologues of Morphine. A. Knoll, Ludwigshafen, Germany. Eng. Pat. 10,387, Aug. 13, 1886. 4d.

If morphine or a compound of morphine and an alkali or earthy alkali be heated with methyl or ethyl-sulphate of potash or soda, the alkyl radicle of the latter enters the morphine-molecule in place of an atom of hydrogen or of metal. To produce, for instance, methyl-morphine (codeïne), morphine is dissolved in 90 % alcohol, to which potash or soda lye has been previously added. An excess of methyl-sulphate of potash is then introduced and the whole heated for two hours with the use of a back flow condenser, whereby codeïne is formed, the liquid becoming brown and turbid The separation of the latter and the recovery of the undecomposed morphine are effected in the usual manner. Other homologues of morphine are obtained in a similar manner.—S. H.

The Physiological Action of Acetphenetidine. O. Hindsberg and A. Kast. Centr. Med. Wissensch. 1887, 145.

Ethylated and acetylated *p*-amido-phenols and *p*-acetphenetidine in quantities of 3grms. acted like strong poisons. Experiments made on feverish persons show that the acetphenetidine is an effective antipyretic in doses of 0·2—0·5grm.—W. R.

XXI.—EXPLOSIVES, MATCHES, Etc.

Improvements in and connected with Explosive Cartridges for Blasting Purposes. T. Macnab, London. Eng. Pat. 6222, May 7, 1886. 11d.

This invention consists in part in the combination of and improvements upon certain features of the inventions described in Eng. Pat. 3150 of 1876, and Eng. Pat. 2143 of 1884, and may be briefly described as a combination of the "water cartridge" with the "ammonia cartridge."

"One form of combination cartridge comprises an outer case, which may be formed of cloth or of the material known as 'Willesden paper' or other suitable flexible material. At the far end of the case—that is to say, the extremity which is to occupy the bottom of the bore-hole—is placed a charge of tonite or other suitable explosive agent. Embedded herein may be a closed vessel or vessels containing liquid ammonia, liquefied carbonic acid gas or other similar acting fluid, the tonite being also furnished with an efficient primer or detonator cap, as hereinafter described, or otherwise, and with appliances for firing same. The remainder of the case is filled with water or is occupied by a tube of flexible material charged with water or other liquid adapted for extinguishing the flame resulting from explosion. The two ends of the cartridge case are closed and rendered water-tight; the extremity of the wire or other means for firing the charge being left projecting from the near end of the cartridge case." Arrangements to facilitate the insertion of the cartridge in the bore-hole, also for firing the charge by a mechanical exploder, are described. The use of an obturator, consisting of a cupped disc of compressed paper adapted to expand with the internal pressure generated by the explosion, and to fit the bore-hole tightly in combination with the cartridge described above, forms the subject of one of the claims. Drawings are given.—W. D. B.

Improvements in Electrical Fuses. G. Smith, Polmont, N.B. Eng. Pat. 14,249, Nov. 5, 1886. 4d.

See page 518.

Improvements in or relating to the Igniting of Explosive Charges and Combustibles. A. J. Boult, London. From L. Bagger, Washington, U.S.A. Eng. Pat. 3920, March 15, 1887. 8d.

In order to obtain certain and ready ignition of the explosive charge in shells or torpedoes by the direct action of water, a primer containing metallic potassium is made use of. Details are given of the plans adopted for the protection of the potassium from premature oxidation, and for ensuring its contact with water when required. The potassium or "water primer" may be combined with a percussion primer of any desired construction or with a time fuse. Drawings are given of such combinations. W. D. B.

Improvements in Explosives and in the Manufacture of the same. P. M. E. Audouin, Paris, France. Eng. Pat. 5899, April 22, 1887. 4d.

In the preparation of this explosive, designated by the inventor "Emilite," the portion of coal-tar oil boiling between 185° and 250° C. and soluble in alkalis, is subjected to the action of nitric acid and then converted into an explosive nitro-compound. It is preferred to extract the suitable portion of the coal-tar oils after removal of phenol, by treatment with alkaline solutions and subsequent decomposition of the alkaline compounds by means of any acid. The mixture thus obtained is subjected to rectification, in order to separate resinous matters, and then nitrated.—W. D. B.

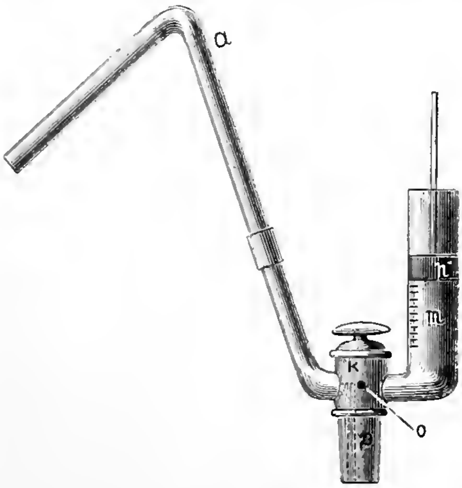
XXII.—GENERAL ANALYTICAL CHEMISTRY.

On a New Pyrometer. J. Mensching and V. Meyer. Ber. **20**, 582—583.

A complete account of this apparatus has appeared in the March number of *Ostwald and van't Hoff's Zeits. f. Phys. Chem.* It allows of the concurrent determination of temperature and vapour density, and has a special piece of apparatus for keeping the pyrometer filled with nitrogen, and excluding all possible traces of air. It is made of platinum. The vapour density of potassium iodide at 1320° was found to be 5·85 instead of the theoretical number 5·75.—J. B. C.

Siphon with a Cock. P. Raikow and N. Prodanow. Chem. Zeit. **11**, 348.

The long leg of an ordinary siphon *a* is connected with the three-way cock *k*, which has a horizontal aperture *o* and a vertical one *p*. To the other side of the cock the cylinder *m* with the piston *n* is fixed. By turning the cock through 90° from the position in the figure, *m* and *a* are connected, and by raising *n* the liquid is drawn through the siphon into the cylinder *m*. If now the cock be turned to its original position *m* is shut off, and the liquid runs out through *p*. To stop the flow the cock is turned through 45°, and thus the liquid can be run off as required. If the cylinder *m* be graduated the volume of liquid run off can be readily measured by first drawing the liquid into *m* by raising the piston and then connecting *p* and *m*, thereby closing the connection with *a*.
—C. A. K.



Improvements in Apparatus for Standardising and Measuring Intensity of Colour in Transparent Bodies. J. W. Lovibond, Salisbury. Eng. Pat. 12,867, Oct. 9, 1886. 8d.

THE principle of this instrument is based on the optical comparison of any liquid with a unit or combination of any number of units of colours of known or established value both viewed under the same conditions by transmitted light. *b* and *c* are two slightly divergent tubes, both viewed through a common eyepiece *d* by means of light transmitted through the ground, opal or darkened glass screen *bl*. The liquid under examination is put into the rectangular clear glass vessel *g* of known thickness in direction g^1g^2. One or more colour units of tinted glass *k* of known depths of shade are put into grooves in the other tube, until the transmitted light on both sides of the field are perfectly even. An exact measure of depth of colour in terms of the colour units can thus be obtained.—C. C. H.

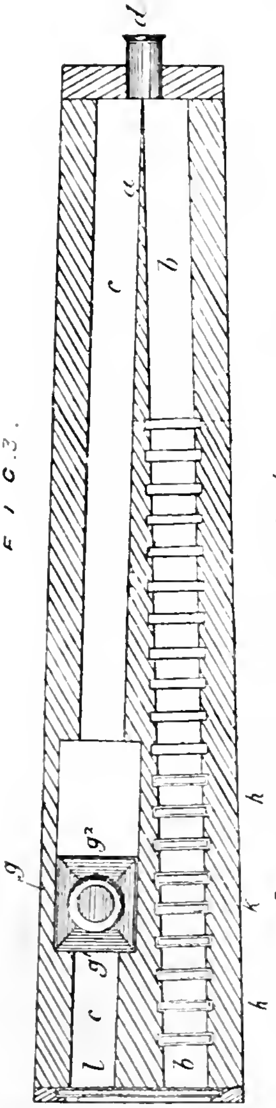


FIG. 3.

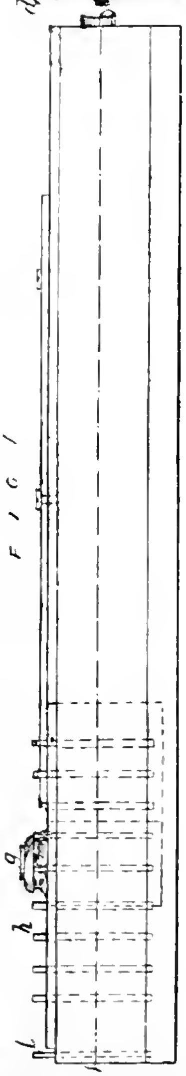


FIG. 1.

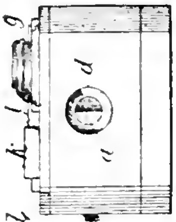


FIG. 2.

An Improved Cream Tester. P. V. P. Berg, Askor, and O. Sörensen, Kolding, Denmark. Eng. Pat. 4480, March 25, 1887. 6d.

TEST GLASSES, containing the milk under examination, are placed in holders, so suspended from the circumference of a rotating disc that, as soon as a high speed of rotation has been attained, the holders with the tubes become horizontal; and thus, by centrifugal action, the cream is rapidly separated from the milk, and their respective volumes are measurable. In the apparatus described, as many as 162 samples may be tested at once. —W. G. M.

Arsenic in Matches. E. Pfeiffer. Chem. Zeit. **11**, 416—417.

ARSENIC was detected in matches obtained in Jena by the characteristic smell of arsenic trioxide, which was evident immediately after striking, and before the sulphur began to burn. The match heads had a black covering with a metallic lustre, and contained much lead, partly present as red lead. The quantity of arsenic was, however, so small, that it could not be detected as sulphide, even by treating 50 match heads with hydrochloric acid and distilling, or by fusion with nitre and sodium carbonate. On the other hand, its presence was confirmed by Gutzeit's reaction. Ten matches were burnt at once under a porcelain dish, and the film treated with bromine water (to remove sulphur dioxide), washed into a flask, and reduced with zinc and hydrochloric acid, when the yellow colouration on a piece of filter-paper, moistened with a drop of nitrate of silver, was obtained.—C. A. K.

Arsenic in Ferric Chloride Solution (*Liquor ferri perchloridi fortior, B.P.*) G. Buchner. Chem. Zeit. **11**, 417.

THE author was able to detect arsenic both by Marsh's test and by the silver nitrate test in 10cc. of a supposed pure sample of ferric chloride solution.—C. A. K.

Notes on the Alkaloids. O. de Coninck. Compt. Rend. **104**, 233.

THE alkyl-iodides of sparteine and nicotine give delicate colour reactions when treated with caustic potash, in a similar manner to the corresponding compounds of the quinoline and pyridine bases. (This Journal, 1887, 59.) —C. A. K.

The Oxalate Test for Quinine Salts. L. Schäfer. Pharm. Zeit. **32**, 170.

THE oxalate test can be used for those neutral quinine salts which are not less soluble in boiling water than quinine sulphate. 1grm. of the quinine hydrochloride (2grms. of the sulphate or hydrobromide) are dissolved in 60grms. of boiling water, a solution containing 0·5grm. of neutral potassium oxalate in 5grms. of water added, and the whole made up to 67·5grms. The solution is allowed to cool at 20° for half an hour, and 10cc. of the filtered solution tested with caustic soda. A turbidity or precipitate shows the presence of admixed alkaloids. —C. A. K.

Detection of Aniline Colours. Curtman. Pharm. Rundsch, 1887, 61.

FURTHER TRIALS have established the utility of Hofman's carbamine reaction for the detection of aniline colours. In a test tube, 4cc. of the red wine or raspberry syrup to be tested, two drops of chloroform and 4cc. of a 10% alcoholic potash solution are mixed together, and the mixture warmed slightly for two minutes. The temperature is rapidly raised to the boil. If aniline colours are present the penetrating smell of carbamine is developed, and is evident even in the presence of the various ethereal odours of the wine. If no result is given, as with acid magenta, then add about 4cc. concentrated H_2SO_4, and the smell of carbamine will be at once formed. The presence of sugar retards the reaction. In this case some of the colour is extracted by means of alcohol, ether, or chloroform, and this solution employed for examination. This reaction can be employed without difficulty for testing small pieces of coloured materials. It is simply necessary to treat the pieces with alcohol or other solvent and examine the solution as before.—W. R.

New Method for Determining the Strength of Iodine Solutions. W. Kalmann. Ber. **20**, 568—571.

THE method is based upon the following reaction: $Na_2SO_3 + 2I + H_2O = Na_2SO_4 + 2HI$. A given volume of the iodine solution is mixed with so much sodium sulphite that the liquid is just decolourised. Methyl orange is used as indicator, and the amount of HI determined with decinormal caustic soda. It is essential that the sulphite should be free from bisulphite. The presence of sulphate is not objectionable. The same method may be used for titrating sulphites in presence of thiosulphates. The reactions are expressed as follows: $Na_2SO_3 + I_2 + H_2O = Na_2SO_4 + 2HI$; $2Na_2S_2O_3 + I_2 = Na_2S_4O_6 + 2NaI$. The application of the method is as follows:—Into a measured volume of standard iodine solution the mixed sulphite and thiosulphate is added until the liquid is decolourised. A few drops of methyl orange are added, and the HI titrated with decinormal caustic solution until the colour changes from reddish yellow to pure yellow.—J. B. C.

Determination of Zinc as Pyrophosphate. L. Jawein. Chem. Zeit. **11**, 347.

THIS method, as described by G. Stone (*Amer. Chem. Soc.* 4, 26), was tried with two samples of brass, the results agreeing well with those obtained by weighing the zinc as oxide. The solution is treated with ammonia and sodium phosphate, and the precipitate thus obtained, which is very difficult to filter, dissolved in an excess of ammonia, and this excess then removed by boiling. The precipitate then separates in a finely granular form, and can be readily filtered and washed. The zinc ammonium phosphate is ignited and weighed as zinc pyrophosphate ($Zn_2P_2O_7$). The method carried out in this way works smoothly, but boiling off the excess of ammonia takes a long time, and the precipitate sticks so fast to the sides of the vessel that it must be dissolved in acid, and reprecipitated by cautious neutralisation with ammonia.—C. A. K.

The Determination of Phosphoric Acid. C. Mohr. Chem. Zeit. **11**, 417—418.

THE author recommends the method suggested by Albert for dissolving phosphates and phosphatic slags, in which 2grms. of the substance are triturated in the cold with 100cc. of 2 per cent. sulphuric acid. 10cc. of the solution thus obtained are then treated after filtration with a 1 per cent. solution of potassium ferrocyanide, to precipitate the iron, and titrated with uranium acetate, after the addition of sodium acetate. The blue colour of the solution does not mask the end reaction.—C. A. K.

Determination of Potassium in Ash, Minerals, etc. M. Kretzschmar. Chem. Zeit. **11**, 418.

THIS method is a shortened form of that proposed by Stohmann. A hydrochloric acid solution of the substance is made if possible, the iron oxidised with nitric acid and the sulphuric acid precipitated by barium chloride. The solution is then treated with ammonia and ammonium carbonate in excess, and the whole (solution and precipitate) evaporated to dryness in a porcelain dish, dried at 110°, and extracted with water after addition of a few drops of ammonia. The solution is made up to 500cc., and 50—100cc. taken for the alkali determination. If much magnesium is present the solution must be again evaporated with oxalic acid, the residue gently ignited, and again extracted as before.

—C. A. K.

ERRATA.—In June issue, p. 457, line 36 from top of first column, *for* "Tetrobasic," *read* "Tetrabasic." Same column, line 48, *for* "tubes," *read* "tables;" and in line 59, *for* "grains," *read* "grammes."

New Books.

THE OWENS COLLEGE COURSE OF PRACTICAL ORGANIC CHEMISTRY. By JULIUS B. COHEN, Ph.D., F.C.S., Assistant Lecturer on Chemistry, Owens College, Manchester, etc. London and New York: Macmillan & Co. 1887.

SMALL 8VO VOLUME bound in cloth, with Preface by Sir Henry E. Roscoe and Prof. C. Schorlemmer, and the Author's Preface. In the latter it is clearly stated that "the book is only intended for the use of students who are undergoing or have undergone a substantial course of instruction in the principles of organic chemistry. Its primary purpose is that of a laboratory guide, and its use should be supplemented by reference to some of the large text-books as well as to the original sources of chemical literature mentioned at the head of each preparation. The little work is essentially a select collection of organic preparations, in which principal stress is laid on those details attention to which is likely to lead to the obtaining of a successful result in the shape of as good a yield of the product sought for as possible, in accordance with the method adopted. In each case, besides that purely chemical name of the preparation in question which expresses the composition and to some extent constitution, is given the special name and also the technological name, then the full formula, and following this the "Literature," where the accounts of the scientific work done on the subject can be read and studied. Dr. Cohen has also given special attention to the standard reactions in organic chemistry, and gives details for the correct methods of applying them; the references, too, with additional notes on these reactions, will be found in the Appendix, which consists principally of "Notes on the Preparations," followed by some useful tables. This portion of the little book is certain to be of great value and assistance to the student of organic chemistry. Exclusive of the Appendix, the subject matter occupies 165 pages, in which eighty-two preparations are described, and the text is embellished with thirty wood engravings. After descriptions of the purification of alcohol, ether and benzene, the study of the preparation and properties of a series of aromatic substances is commenced, and this occupies PART I. of the book. PART II. is devoted to a series of preparations taken from the paraffin or "fatty" series of organic substances. Of this arrangement the author says in his Preface: "The usual arrangement of fatty, before aromatic compounds, has been reversed for the reason that those of the latter which have been selected offer fewer difficulties to the beginner." A useful and wise direction to the student is offered by Dr. Cohen before beginning a preparation: "Read first the recent literature on the subject, reference to which will be found at the head of the preparation, and refer to it in your text-book." The work closes with a useful Alphabetical Index.

DIE KÜNSTLICHEN ORGANISCHEN FARBSTOFFE. Unter Zugrundelegung von sechs Vorlesungen von Prof. Dr. E. NOELTING; Bearbeitet von Dr. PAUL JULIUS. Berlin: R. Gaertner's Verlagsbuchhandlung, Hermann Heyfelder, Schönebergerstrasse 26, S.W. London: H. Grevel & Co., 33, King Street, Covent Garden, London, 1887.

8VO VOLUME bound in cloth. Contains Preface, Table of Contents, 224 pages of subject-matter, and an Alphabetical Index. The subject-matter contains useful tables or tabulated lists of the Coal-tar Colours, and is generally sub-divided into fifteen chapters. These chapters may be briefly headed as follows, thus giving a clear notion of the compass of the work:—CHAPTER I. Coal-tar; Constitution of Benzene and its Derivatives; of Naphthalene and its Derivatives, etc. CHAP II. Intermediate Products of the Colour and Dye-manufacturer. CHAP. III. Coloured and un-coloured Carbon Compounds; Dyestuffs; Witt's Chromophoric Groups; Chromogens, etc. Dyestuffs, themselves mordants. CHAP. IV. Nitro-bodies, etc. CHAP. V. Azo-colours, Diazo-compounds, etc. CHAP. VI. Derivatives of Triphenylmethane; History of the Rosaniline Derivatives, Synthesis and Constitution of Rosaniline, etc. CHAP. VII. Phthaleins, their Synthesis, Constitution and Derivatives, etc. CHAP. VIII. Artificial Indigo; Synthesis of Cinnamic Acid, etc. CHAP. IX. Anthracene Colours. CHAP. X. Pyridine and Quinoline Derivatives, etc. CHAP. XI. Indamine and Indophenols, Bindschedler's Green, Toluylene Blue and the simplest Toluylene Blue. CHAP. XII. Azines; Azonium Bases, etc. CHAP. XIII. Indulins and Nigrosins; Azodiphenyl Blue, etc. CHAP. XIV. Aniline Black. CHAP. XV. Appendix: Galloflavine; Cachou de Lavelle; Kanarin; Murexide, etc.

MODERN HIGH FARMING. A Treatise on Soils, Plants, and Manures. By FRANCIS WYATT, Professor of Agricultural Chemistry, Chemical Analyst, etc. New York: C. E. Bartholomew, 22, College Place. 1886.

8VO VOLUME, bound in cloth, containing Index, or rather a Table of Contents, and 94 pages of subject-matter. This matter is sub-divided into fifteen chapters, which may be briefly summed up as follows:—CHAPTER I. General Introductory Remarks; Influence of Climate; Origin of Scientific Agriculture, etc. CHAP. II. Theory of Scientific Agriculture, etc. CHAP. III. Minerals necessary and injurious to Plant Life. CHAP. IV. Phosphates. CHAP. V. Potash; its Action on the Soil, etc. CHAP. VI. How Soils lose their Nitrogen, etc. CHAP. VII. Physically Perfect Soils. CHAP. VIII. Progress of the Manure Trade in the United States, etc. CHAP. IX. The different kinds of Manure, etc. CHAP. X.

Farm-yard Manures, etc. CHAP. XI. Mineral Manures, etc. CHAP. XII. Sulphur: its occurrence in Nature, etc. CHAP. XIII. Sulphuric Acid Manufacture, etc. CHAP. XIV. Superphosphates, uncertainty of their Composition, etc. CHAP. XV. Chemical Analysis, etc.; how to read and understand Chemists' Certificates, etc.

GENEALOGICAL TREE, showing the more important Compounds existing in, and derived from Coal Tar by Distillation, together with those formed by further Chemical Treatment, the Connecting Links being maintained in continuity. Compiled by BENJ. NICKELS, F.C.S., F.I.C. Lawton & Co., Bank Buildings, 3, Manchester Road, Bradford, Yorks., or 109, Rusholme Road, Manchester. Published by Bemrose & Sons, London and Derby.

THIS scheme takes the form of a kind of Chart, mounted on canvas and glazed. It measures about 35 inches in height, by 26 inches in width. It may also be had with the Coal-tar Colours indicated by suitable colouring of the parts of the tree on which the names of the colours are printed. The price is 10s. 6d. plain, or mounted 12s. 6d. The statistics of Coal carbonised in the United Kingdom, Gas, Ammonia and Coal-tar produced are also given. A Chart of this kind might play a useful part in the Chemical Departments of Colleges and Technical Schools, as a kind of graphic index to the Coal-tar Products and Colours.

Trade Report.

(From the Board of Trade Journal.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

RUSSIA.

Recent Customs Decisions.

(*Note.*—Poud = 36lb. avoirdupois. Gold rouble = 3s. 2d.)

Spar or *terra ponderosa*, or sulphate of baryta, in pieces, Section 11. Duty, 4 copecks per poud.

Heavy spar in a pulverised state and sulphate of baryta, a chemical product in the shape of a kneaded mass corresponding with heavy spar, Section 128. Duty, 55 copecks per poud.

BELGIUM.

Modification of Customs Duties on Vinegar and Acetic Acid.

A despatch, dated the 15th June last, has been received from Mr. M. le M. H. Gosselin, Her Majesty's Chargé d'Affaires at Brussels, transmitting a copy and translation of a decree of the Belgian Government, modifying the rates of Customs duty on vinegar and acetic acid. The duties now charged on these articles are as follow:—

Vinegar or liquid acetic acids containing of pure acetic acid, 8 per cent. or less, 15frs. per hectolitre; more than 8 per cent. and less than 40 per cent., 75frs. per hectolitre; 40 per cent. or more, 187·50frs. per hectolitre. Acetic acid, crystallised, 187·50frs. per 100 kilogrammes.

NEW CUSTOMS TARIFF OF MEXICO.

See also pp. 273 to 295 of the December Number of the Journal.

With reference to the notification on p. 550 of the last number of the *Board of Trade Journal*, the following statement has been prepared, from information supplied by Mr. Lionel Carden, Her Majesty's Consul at Mexico, showing the articles in the new Mexican Customs Tariff, which came into force on the 1st July last, on which the duties have been altered, together with the rates of Customs duties hitherto levied on those articles.

In forwarding these particulars, Mr. Carden says that, in order to avoid being misled by apparent reductions, which, perhaps, really imply increased duties, it is necessary to pay great attention to the alterations in the class of weight on which the duty is leviable. For instance, in the case of cotton thread, which previously paid 1·60 dollars per kilog. *net*, the duty has been altered to 1·20 dollars per kilog. *legal*, the effect of which is to considerably increase the duty, in place of reducing it by 25 per cent., as would appear at first sight to be the case.

Note.—By "net weight," must be understood the actual weight of the merchandise; by "legal weight," that which includes, besides the "net weight," that of the interior bottles, boxes, winders, wrappers, etc., in which the articles are imported; and by gross weight, the total weight of the packages. When merchandise which pays according to the "legal weight," has no other covering besides the one which forms the outside package, the actual weight of the merchandise will be considered to be its legal weight.

Kilogramme = 2·204lb. avoirdupois.
Square Metre = 1·196sq. yards. Dollar = 1s. 2d.

Tariff Proper.

No. in Old Tariff	Corresponding No. in New Tariff.	Articles, etc.	Rates of Duty now Levied.		Rates of Duty hitherto Levied.	
				Dollars.		Dollars.
265	209	Gypsum, gross weight	Kilog.	0·01	Kilog.	0·20
447	362	Powder other than that for mining purposes, gross weight	,,	1·00	,,	1·10
		Drugs and chemical products:—				
505	419	Fixed oils, not elsewhere specified, legal weight....	,,	0·50	,,	0·55
506	420	Essential oils of orange, geranium, nutmeg, mustard, patchouli, and rose, legal weight	,,	5·00	,,	4·10
	421	Volatile or essential oils, not otherwise distinguished, legal weight	,,	2·50		
509	424	Soccotrine aloes, legal weight	,,	0·30	,,	0·35
510	426	Acids of all substances, gaseous or liquid, not elsewhere specified, legal weight	,,	0·20	,,	0·25
511	427	Acids in crystals or powder, not elsewhere specified, legal weight	,,	1·00	,,	1·10
512	428	Waters, aromatic, manufactured, distilled, or spirituous, for medicinal or toilet purposes, legal weight	,,	0·50	,,	0·55
513	429	Mineral waters, natural or artificial, legal weight	,,	0·10	,,	0·20
516	431	Alkaloids and their salts, not otherwise distinguished, legal weight	,,	15·00	,,	13·50
517	432	Camphor, legal weight	,,	0·50	,,	0·55
522	436	Musk, legal weight	,,	10·00	,,	11·00
524	438	Ambergris, legal weight	,,	16·00	,,	16·50
525	440	Metallic antimony, net weight	,,	0·30	,,	0·35
529	443	Saffron, dry or in oil, net weight ..	,,	4·00	,,	4·20
541	452	Cantharides, net weight	,,	2·00	,,	3·00
542	453	Medicinal capsules, of all substances, legal weight	,,	1·25	,,	1·65
543	456	Castoreum, legal weight	,,	4·00	,,	4·70
546	459	Hydrochloral, legal weight	,,	1·50	,,	2·90
548	461	Chloroform, legal weight	,,	1·50	,,	1·65
549	462	Chloride of gold, legal weight	,,	25·00	,,	27·50
552	464	Collodion and its applications, legal weight	,,	1·00	,,	1·10
553	465	Paints in the rough, or prepared..........	,,	0·10 (gross)	,,	0·15 (legal)
555	468	Creosote, legal weight	,,	1·00	,,	1·25
561	470	Medicinal elixirs of all kinds, legal weight	,,	1·00	,,	1·10
562	471	Essence or extract of sarsaparilla, prepared in any form, legal weight	,,	0·30	,,	0·35
566	473	Extracts of all kinds for medicinal purposes, not otherwise mentioned, legal weight	,,	3·00	,,	3·30

No. in Old Tariff	Corresponding No. in New Tariff.	Articles, etc.	Rates of Duty now Levied.	Rates of Duty hitherto Levied.
			Dollars.	Dollars.
569	476	Phosphorus, clear or red, legal weight	Kilog. 0·75	Kilog. 1·50
576	480	Medicinal syrups of all kinds......	,, 0·50 (gross)	,, 0·55 (legal)
581	484	Metals and metalloids for medicinal purposes, not otherwise mentioned, net weight	,, 1·50	,, 3·00
584	486	Nitrate of silver, legal weight	,, 8·00	,, 11·00
589	491	Pepsine, legal weight	,, 3·00	,, 5·50
595	496	Salts and sulphates of all substances, not otherwise mentioned, legal weight	,, 0·15	,, 0·16
603	500	Valerianates of all substances, legal weight	,, 6·00	,, 11·00
608	502	Iodoform..........	,, 8·00 (gross)	,, 12·90 (legal)
609	503	Pure Iodine	,, 1·50	,, 2·20
610	505	Iodides of all substances..........	,, 2·00	,, 3·30

Free List.

No. in Old Tariff.	Articles, etc.	Rates of Duty hitherto Levied.		
				Dollars.
510 511	Sulphuric, phenic, and hydrochloric acid	Kilog. ,,	(legal) ,,	0·25 1·10*
527	White arsenic............	,,	(net)	0·30
—	Asbestos in powder		†	
537	Spanish white	,,	(gross)	0·02
252	Common lime and Roman cement	,,	,,	0·01
411	Machinery and apparatus of all kinds, not otherwise distinguished, for industrial, agricultural, mining, artistic and scientific purposes, and detached parts of the same, if not liable to be used otherwise than as machinery.............	,,	,,	0·005
—	Ore		†	
414 416 635	Powder fuses of any kind, and explosive compositions for mining........	,,	,,	0·01
550	Chloride, sulphide, bisulphide, and trisulphide of lime..................	,,	,,	0·02
361	Cork, in the rough or in sheets	,,	,,	0·07
253	Crucibles of all materials and sizes................	,,	,,	0·01
367	Emery, in powder or in grain....................	,,	,,	0·08
570	Glycerine, not perfumed..	,,	,,	0·10
573	Hyposulphate of soda....	,,	,,	0·01
597	Saltpetre, or nitrate of potash or of soda........	,,	,,	0·01
599	Soda, caustic.............	,,	,,	0·08
600	Sulphate of copper........	,,	,,	0·01
595	Sulphate of ammonia	,,	(legal)	0·16
691	Rag, paper scraps, and pastes of all kinds, for the manufacture of paper..................	,,	(gross)	0·01
615	Poison, for the preparation of furs.............	,,	,,	0·15

UNITED STATES.

Customs Decisions.

Certain so-called partially manufactured Portland cement, which upon investigation was found to consist of partially-manufactured Portland cement, and which upon being ground may be employed as such without any further admixture of chalk or lime, and which in its condition as imported, readily sets upon being mixed with water, is held to be a species of cement, and as such, dutiable at the rate of 20 per cent. *ad valorem*, under the special provision in Section 11, for "cement Roman, Portland, and all others."

Certain "water of Cedar," a medicinal preparation, which upon investigation is found to be composed in part of alcohol, is held to be dutiable at the rate of 50 cents per lb., under the provision in section 118, for "all medicinal preparations * * * and medicated wines, of which alcohol is a component part."

After a thorough investigation, it is held that platinum wire, which has assumed that form merely for convenience in transportation, and which is not adapted for any known use as wire, does not come within the scope of the provision in Section 216, for "manufactures, articles, or wares * * * composed wholly or in part of * * * platinum," but is exempt from duty under the provision in the free list for "platinum, unmanufactured."

The Treasury Department's decision of October 31, 1883, under which unground talc was held to be free of duty as a non-metallic mineral substance, under paragraph 638, and ground talc as a manufactured mineral substance, under paragraph 95, is affirmed.

SWITZERLAND.

Classification of Articles in Customs Tariff.

(*Note.*—Quintal = 220·4lb. avoirdupois. Franc = $9\frac{6}{10}$d.)

The following decisions affecting the classification of articles in the Swiss Customs Tariff have been given by the Swiss Customs authorities during the month of May last:—

Fungivore (mixture of vitriol and flour of sulphur for arresting vine diseases). Category 16, duty 30 centimes per quintal.

Sulphate of nickel. Category 18, duty 2 francs per quintal.

Celluloid and articles of celluloid, except collars, cuffs, etc. (*see* above). Categories 348—352, duties from 4 to 30 francs per quintal.

Asbestos, in sheets or frames, not interwoven with other materials. Category 272, duty 3 francs per quintal.

Asbestos felt for roofing with tissues loosely interwoven. Category 299, duty 1 franc 50 centimes per quintal.

Cords of asbestos are expunged from category 306*a*.

Twine and plaits of asbestos, not interwoven with other materials. Category 307, duty 16 francs per quintal.

Asbestos cloth is included in category 311, to replace asbestos mixed with cloth. Duty 4 francs per quintal.

Proposed Modifications in Customs Tariff.

A Bill has lately been presented to the Federal Assembly for the purpose of revising the present Swiss Customs Tariff. The following is a list of the alterations in the proposed tariff revision.

(*Note.*—Quintal = 220·4lb. avoirdupois. Franc = $9\frac{6}{10}$d.)

No. in Customs Tariff.	Classification of Articles.	Proposed New Duties. Per Quintal.	Conventional Rates of Duty. Per Quintal.
	I.—WASTE MATERIAL AND MANURES.	Fr. Ct.	Fr. Ct.
2	Stable manure; compost; chalk-lime; residue of animal black; ashes (of bone, coal, peat, wood); loam; sweepings; rags and other waste materials intended for the manufacture of manure .... (This category in the existing tariff includes sulphuric acid once used.)	Free.	Free.
	Guano; phosphorites; phosphates; bone powder, etc.:		
3	Not chemically prepared, such as ammoniacal salts (crude), sulphate of ammonia, chloride of potassium, potash manure; sulphuric acid once used................	Free.	Free.
4	Chemically prepared; such as artificial manures .... [The grouping of Categories 3 and 4 has been amended.]	0·20	‡

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* If imported in the form of crystals.

† Not specially classed in old Tariff.

‡ No conventional rates. These articles pay duty under General Tariff.

No. in Customs Tariff.	Classification of Articles	Prop's'd New Duties. Per Quintal.	Conventional Rates of Duty. Per Quintal.
	II.—CHEMICALS.	Fr. Ct.	Fr. Ct.
	a. Apothecaries' and Druggists' Articles.		
11	Pharmaceutical preparations, such as powder, pastilles, salves, ointments, tinctures, essential oils and essences in wholesale packages, that is to say, susceptible of division for retail sale; surgeons' bandages .... (Wording more explicit)	40·00	
	b. Chemicals for Industrial Use.		
16	Alum; white arsenic; sulphate of barytes; animal black; chloride of barium; chloride of calcium, crude; chloride of lime; chloride of magnesium; chloride of manganese; chrome-alum; iron-mordant; litharge; pyrolignite of lime; phenate of lime, crude; chlorhydrate of lime; extract of chestnut, liquid; sulphate of magnesia (Epsom salts); liquid arseniate of soda; bicarbonate of soda; sulphate of soda (Glauber's salts); hyposulphite, sulphite, and bisulphite of soda; muriatic soda; flour of sulphur; sulphuret of iron; sulphuret of sodium; sulphuric acid; soda; acetate and sulphate of alumina; sulphate (vitriol) of iron, copper, and zinc; soluble glass (Pyroligneous acid, crude, acetic acid of wood vinegar is expunged from this Category. *See* No. 17.)	0·30	*
17	Caustic potash, caustic soda; aniline; aniline compositions for manufacture of paints; anthracine; arsenious acid; benzoic acid; benzine; oil of bitter almonds, artificial; sugar of lead; nitrate of lead; bioxide of lead; borax; phenic acid, crude; cachou chloride of aluminium and of zinc; gallic and tannic acid; glycerine; verdigris; pyroligneous acid, crude; wood spirit, raw; yellow prussiate of potash; chlorate of potash; red chromate of potash; hypermanganate of potash; bisulphate of lime; chestnut extract, solid; oxalic acid; naphthaline; salts of soda, not otherwise mentioned; oleic acid; paraffin; potash; salicylic acid, crude; chloride of ammonia; spirits of ammonia; saltpetre, refined; nitric acid; oxalate of potassium; sulphuric ether; sulphide of arsenic; stearine; aluminous cake; aluminate of soda; oil of Turkey red; zinc powder; salts of tin .... (Pyroligneous acid, crude, is inserted, and the word "raw" is added after "wood spirit.")	1·00	*
	c. Colours.		
36	Chrome yellow and green; mountain blue; Prussian blue; smalt; ultramarine	7·00	7·00†
39	Varnish and lac of all kinds, with the exception of oil varnishes......	25·00	7·00
39*a*	Oil varnish	10·00	7·00

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

SALE OF POISONS IN SWEDEN.

A despatch, dated the 22nd June last, has been received from Mr. E. Corbett, Her Majesty's Minister at Stockholm, on the subject of the regulations relative to the sale of arsenic and poisonous substances now in force in Sweden. Mr. Corbett says:—

"The Royal Decree of the 7th of January, 1876, relative to the sale of poisons, and the Decree of the 26th January, 1883, are still in force; but the Decree of 14th November, 1879, has been replaced by a Decree, dated 10th April, 1885, of which the following is a translation."

Section 20 of the Ordinance dated the 7th January, 1876, shall be altered to the following effect:—

1. Paper-hangings, roller-blinds, Venetian blinds, artificial flowers, and other articles in water-colours (with glue, gum, starch, dextrine, glair, and the like), printed or painted with arsenical colours, shall not be kept or offered for sale if, at a chemical analysis, out of 200 square centimetres (= 22·7 square inches) of the article, or less, metallic arsenic, precipitated as a black or blackish brown, at least partly opaque mirror (arsenic mirror) in a glass tube of 1½ to 2 millimetres (= ½ to ⅔ Swedish line) inner diameter, can be educed, by reduction with cyanide of potash and carbonate of soda, from the sulphuret of arsenic then obtained.

2. The same prohibition shall also be observed with respect to stuffs, woven fabrics, yarn, lamp shades, sealing-wax, wafers, composite candles and other candles containing arsenical colours or other arsenical substances, if metallic arsenic, in the manner and quantity above stated, can be educed from 100 square centimetres (=11·3 Swedish square inches), or less, of stuffs, woven fabrics, and lamp-shades, or from 21grms. (= 5 Swedish orts), or less, of any of the other articles above enumerated.

3. A certificate as to the quality of the article in this respect, and indicating the weight and surface measure of the sample of the article used, containing samples of all the colours of the article, shall be issued by a chemist conversant with the subject. This certificate shall also be accompanied not only by the metallic arsenic educed by the test, enclosed in a glass tube closed up at both ends, but also by as large a sample of the article examined as may be required for its identification or for a new analysis, if needed, but the sample shall not measure less than 500 square centimetres (= 56·7 Swedish square inches); and the glass tube, as well as the sample of the article, shall be securely fastened by a seal either to the certificate or to a paper containing the signature of the analyst, together with the number referred to in the certificate, which, moreover, shall be drawn up in accordance with the form annexed.

Form of Certificate as to the arsenical contents of goods.

At the chemical analysis of square centimetres (square inches, grams, orts) of the wall-paper (cloth, carpet, yarn, etc.) annexed marked number , containing samples of all its colours, made by me at the request of X, I have educed, by reduction with cyanide of potash and carbonate of soda, from the sulphuret of arsenic then obtained, the metallic arsenic which is enclosed in the glass tube attached (I have not found any arsenic present), and I therefore (owing to the nature of this arsenic mirror) declare the said wall-paper (cloth, etc.) prohibited (permitted) for sale or barter, in pursuance of the Royal Decree of the 10th April, 1885. The re-agents employed by me at the analysis have been examined by me and been found free from arsenic, which I hereby certify.

(Place and time.)

(Name.)
(Qualification.)

MISCELLANEOUS TRADE NOTICES.

DEPOSITS OF MANGANESE ORE IN THE UNITED STATES.

According to *Bradstreet's* for May 28th last, the following facts are given in Mr. Joseph D. Week's report on manganese to the United States Geological Survey:

"Ores containing manganese, described in this report, are divided into two classes—viz., manganese ores and manganiferous iron ores. Difficulty has been experienced in fixing the dividing line between these two ores. The standard of shipments in English chemical works, however, has been adopted—that is, 70 per cent. of bi-oxide, equalling 44·252 parts of the metal per 100. Ores containing less than this percentage of manganese can, however, be used in the manufacture of high manganese spiegel and ferro-manganese, while some ores with an excess of manganese may be used for low spiegels. Manganese is found widely distributed in this country. It is almost as plentiful as the deposits of brown hematite ore. Manganese occurs as a constituent of most of the latter kind of ores. Sometimes so much manganese is found in the ore as to make it a manganiferous iron ore. At other times veins or pockets of manganese are found alongside of iron ore. This is especially true in the case of the ores in the Appalachian ranges, and is particularly so in Virginia. Notwithstanding its wide distribution, only four localities yielded any considerable amount of ore in 1885. The places mentioned were the Crimora and Leete's mines in Virginia; at Cartersville, Georgia, and Batesville, Arkansas. The Crimora mine contributed two-thirds of all the manganese produced in the United States. Two other mines in Virginia produced a small amount of ore in 1885—viz., the Houston mines and those of the Shenandoah Iron Company. The production in 1885 was 26,495 tons, of which 23,258 tons were manganese ores, and 3237 tons were manganiferous ores. The origin of manganese has never yet been authoritatively settled. It is thought to be similar to hematite ore in origin, and to have been deposited from solution. So far as known the most valuable deposits of manganese have been found in pockets, usually imbedded in a tenacious clay requiring washing to remove."

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* Duty payable under General Tariff, conventional rates being higher, except in the case of nitric acid, which will still pay 60 cents. per quintal.

GERMAN SUGAR BOUNTIES.

In the *Board of Trade Journal* for July will be found an analysis of the German Bill for reforming the sugar tax and bounties.

TRADE BETWEEN SPAIN AND THE UNITED KINGDOM.

Imports into the United Kingdom from Spain.

PRINCIPAL ARTICLES.	May, 1886.	May, 1887.
Chemical Products unenumerated .... Value	£4,340	£3,211
Copper Ore and Regulus .. Tons	2,208	4,519
Value	£52,505	£68,534
Manganese Ore .... Tons	375	275
Value	£1,313	£963
Pyrites of Iron and Copp'r. Tons	48,215	57,907
Value	£94,110	£103,025
Quicksilver .... lbs.	601,800	300,000
Value	£51,140	£26,500
Rags, Esparto .... Tons	3,564	5,250
Value	£21,432	£30,564
Total Value	May.	June.
1886	£759,616	£699,338
1887	£780,764	£718,561

Exports of British and Irish Produce from the United Kingdom to Spain.

PRINCIPAL ARTICLES.	May, 1886.	May, 1887.
Alkali .... Cwt.	16,005	22,157
Value	£5,813	£7,436
Manufactures of Caoutchouc Value	£1,253	£1,207
Cement .... Tons	570	710
Value	£1,061	£1,378
Chemical Products and Preparations, including Dyestuffs .... Value	£5,981	£5,091
Coal, Products of, including Naphtha, etc. .... Value	£1,907	£2,068
Glass Manufactures .... Value	£431	£792
Grease, Tallow, and Animal Fat .... Cwt.	591	1,865
Value	£601	£1,893
Manure .... Value	£2,517	£23,964
Painters' Colours and Materials .... Value	£1,136	£2,936
Paper of all sorts .... Cwt.	165	388
Value	£429	£1,075
Soap .... Cwt.	470	353
Value	£395	£321
Total Value	May.	June.
1886	£222,129	£262,576
1887	£265,780	£302,019

RECENT TRADE BLUE BOOKS.

The following memorandum has been prepared in the Department with reference to Parliamentary papers bearing upon trade matters which have recently been circulated:—

1. ***Alkali, etc., Works Regulation Act, 1881. Twenty-third Annual Report on Alkali, etc., Works by the Chief Inspector.***—(C. 5057). *Price, 2s.*

This is the annual report of Mr. Fletcher, the Chief Inspector under the Alkali, etc., Works Act for the year 1886. It contains his reports to the Local Government Board and to the Secretary for Scotland, and is presented to Parliament pursuant to Act 44 & 45 Vict. cap. 37.

The report states that the number of works under inspection during the year was 910, or if Scotland be included, 1,018. This shows an increase of 13 English and 3 Irish works during the year. Of the above total of 910, 118 were alkali works as defined by the Act, and 792 were other works which come within the scope of the Act. In the year 1885 the numbers were 132 and 762 respectively, showing a diminution of 14 in the number of alkali works, and an increase of 30 in that of the other works.

In some of the works several distinct processes are carried on, each of which requires a separate examination on the part of the inspector; these are set forth below as distributed among the districts:—

LIST OF SEPARATE PROCESSES UNDER INSPECTION.

—	District I.—Ireland.	District II.—North of England.	District III.—Cheshire, N. Wales, Part Lancashire.	Sub-Dist.—Widnes.	District IV.—East Lancashire and Yorkshire.	Dist. V.—South Midland.	Dist. VI.—South-West of England.	Dist. VII.—South-East of England.	Total.
Alkali	2	12	17	16	11	3	4	2	67
Hydrochloric acid (cylinder)	—	—	—	—	17	3	—	8	28
Copper (wet process) ..	—	5	2	5	3	2	3	—	20
Cotton carbonising (alkali)	—	—	—	—	9	—	—	—	9
Sulphuric acid	15	24	21	18	43	28	46	32	227
Chemical manure	20	31	15	1	28	45	42	60	215
Gas liquor	—	2	3	—	14	1	—	1	21
Nitric acid	—	2	3	1	40	19	2	15	82
Sulphate and muriate of ammonia	14	27	22	4	48	53	57	66	291
Chlorine and bleaching powder	2	8	9	17	7	2	1	2	48
Salt	10	7	55	1	—	4	—	—	77
Cement	2	14	2	—	6	7	4	58	93
Total	65	135	149	63	226	167	159	244	1,208

During the year 1886 the number of separate operations under inspection was 1208, while in Scotland there was a further number of 187; giving a total for the United Kingdom of 1395. During 1885 the total number was 1368.

TABLE OF AVERAGE AMOUNT OF ACID GASES ESCAPING FOR EACH DISTRICT.

The following tables have been compiled by the General Inspector from the reports of all the examinations sent in by the inspectors on their visits to the works. The total number of visits made in the year was 4090, and the number of separate tests or analyses of gas was 4786:—

	Dist. I.—Ireland.	Dist. II.—North of England.	District III.—Cheshire, N. Wales, Part Lancashire.	Sub-Dist.—Widnes.	District IV.—East Lancashire and Yorkshire.	Dist. V.—South Midland.	Dist. VI.—South-West of England.	Average. 1886	Average. 1885
Hydrochloric acid in chimney gases. Grs. per cubic foot	0·12	0·11	0·07	0·11	0·08	0·09	0·10	0·10	0·10
Hydrochloric acid. Amount escaping compared with that produced, per cent. ..	—	2·40	1·79	2·60	2·18	2·10	2·34	2·13	2·39
Acid gases escaping from sulphuric acid chambers given as SO_3. Grs. per cubic ft.	1·30	1·60	1·15	1·28	1·04	1·60	1·82	1·40	1·52
Acidity of chimneys given as SO_3. Grs. per cubic foot	0·91	0·71	0·76	0·56	0 66	0·72	1·04	0·77	0·67
Acidity of gases from manure works given as SO_3. Grs. per c. ft.	0·51	0·16	0·41	1·16	0·28	0·35	0·65	0·50	0·67

STATISTICAL TABLES.

PERIODICAL RETURNS OF IMPORTS AND EXPORTS.

Imports and Exports into and from the under-mentioned Countries in the latest Month for which Returns have been received, with Aggregates for the period of the Year, including such latest Month.

NOTE.—Rouble=2s. 0d.; Franc=9½d.; Milreis=4s. 6d.; Lire=9½d.; Dollar=4s. 2d.

I.—Imports.

Name of Country.	Latest Month.	Value for the Month.		Aggregate for Period of the Year, including latest Month.	
		1887.	1886.	1887.	1886.
Russia in Europe ..	May ..	Roubles 29,718,000	29,892,000	90,261,000	96,023,000
France	May ..	Francs 352,727,000	301,907,000	1,785,153,000	1,737,450,000
Portugal	April ..	Milreis —	—	12,326,000	11,508,000
Italy	May ..	Lire .. 115,853,000	111,953,000	621,621,000	571,629,000
United States	May ..	Dollars 58,662,000	52,872,000	296,290,000	271,378,000
Egypt	February	Piastres 55,771,000	59,829,000	120,559,000	128,511,000
	March ..	„ 81,776,000	67,192,000	202,335,000	196,033,000
British India*	April ..	Rupees 5,16,27,701	4,97,44,923	*	*

II.—Exports.

Name of Country.	Latest Month.	Value for the Month. 1887.	1886.	Aggregate 1887.	1886.
Russia in Europe ..	May ..	Roubles 58,979,000	25,078,000	111,108,000	98,561,000
France	May ..	Francs 285,850,000	258,955,000	1,335,361,000	1,295,952,000
Portugal	April ..	Milreis —	—	7,517,000	9,122,000
Italy	May ..	Lire .. 84,772,000	87,519,000	445,727,000	432,578,000
United States	May ..	Dollars 43,629,000	54,101,000	282,859,000	271,701,000
Egypt	February	Piastres 104,868,000	77,825,000	219,830,000	214,911,000
	March ..	„ 76,910,000	86,153,000	326,740,000	301,093,000
British India*	April ..	Rupees 8,74,03,997	8,11,33,318	*	*

The above figures are subject to revision in the Annual Returns.

NOTE.—The figures are those of the "special" imports and exports, except in the case of the United States and British India, where the figures are "general." "Special" means, in the case of imports, imports for home consumption, in the case of exports, exports of domestic produce and manufacture only.

* The aggregate figures are for the financial year commencing 1st April.

CHEMICAL IMPORTS AND EXPORTS FOR PAST HALF-YEAR.

During the past half-year we imported under the head of chemicals, dyestuffs and tanning substances, goods to the value of £1,579,250 as against £1,895,064 during the corresponding period of 1886, a decrease of £315,814. Our imports of Peruvian bark amounted to £116,188 as against £141,056 in the first six months of last year, a diminution of £24,868. Under the head of drugs unenumerated a diminution is also noticeable in comparison with the first half-year of 1886. The figures were £305,193 in 1887 and £357,182 in 1886, thus showing a decrease of £51,989. On the export side the figures came out rather better, although a slight diminution is still shown. The total value of chemicals and chemical and medicinal preparations exported during the half-year was £3,360,124 as against £3,368,265 in the six months ending June 30th, 1886. This is only a diminution of £8141.—*B. and C. D.*, 16th July, 1887.

THE KALI INDUSTRY.

According to the report of the sale convention of Strassfurt chloride of potash manufacturers, the despatchings for the second half of last year amounted to 1,005,028ctr. (879,032ctr. first half), giving an average price, after deduction of all petty charges, of 6501mks. (6552mks. first half) for 80 per cent. chloride of potash. The total despatchings for 1886 amounted to 1,881,060ctr., distributed as follows: Germany 886,960ctr., England 161,500ctr., Scotland 73,700ctr., France 136,700ctr., Belgium and Holland 137,900ctr., Italy 77,000ctr., North America 373,500ctr., Austria, Russia, Switzerland, etc., 79,300ctr. The report regrets that the German agriculturalists are yet very poor consumers.

THE OIL TRADE IN GERMANY.

The oil trade in Germany seems to be in quite as bad a way as is the Scotch trade, to judge by the following paragraph, which we take from *Kuhlow's Review*:—The report of the united Saxon and Thuringian paraffin and solar oil manufacturers for the business year 1886—87 shows that the fall in the prices of products is gradually increasing. The prices of paraffins are dependent upon those of fat goods, among which palm oil is the principal price regulator. Notwithstanding the increasing commerce with tropical countries from which palm oil is obtained, it is improbable that any lasting increase in the price of this oil will take place, and consequently the prospect of any definite improvement in paraffin, the most valuable product of the above company, cannot, at present, be entertained. The state of the market for paraffin oils is more favourable in consequence of the syndicate established last year, by which a decline in prices for the greater portion of the inland business is rendered impossible. Though a considerable percentage of last year's production of these oils remains unsold, and a small percentage at minimum prices has been exported, these facts need not occasion any anxiety, for while on the one hand the home consumption shows indications of increasing, on the other hand, the production was exceptionally high. Solar oil is being hard pressed by American and Russian petroleums. A portion of the year's production remains unsold. The following figures show the average prices per 100kilos. for the more important productions in the last two years:—

	1885—86. mks.	1886—87. mks.
Solar Oil	11·73	11·60
Dark Paraffin Oil	10·91	10·24
Hard Paraffin Oil	107·21	71·03
Soft Paraffin Oil	52·33	43·17
Paraffin Scales	42·77	29·53

The profits did not admit of any dividend being divided among the shareholders. A report which is identical with the above in all important details has been published by the Zeitz paraffin and solar oil manufacturers. In this instance, also, no dividend could be declared. An extraordinary general meeting of the united Saxon and Thuringian paraffin and solar oil manufacturers has decided on an amalgamation with the Zeitz paraffin and solar oil manufactory.

TRADE STATISTICS FOR JUNE.

The Board of Trade Returns for June show the following figures :—

Imports.

	June, 1886.		June, 1887.
Total value....................	£29,101,911	....	£27,555,217

Exports.

	June, 1886.		June, 1887.
British and Irish Produce	£18,536,076	....	£17,320,111
Foreign and Colonial Produce (partly estimated)	1,216,590	....	1,868,505

Below are the details affecting drugs and chemicals :—

Imports.

		June 1885.	June 1886.	June 1887.
Drugs, unenumerated..	value £			
Chemical manufactures and Products, unenumerated—				
Alkali	cwt.	8,116	8,211	6,953
,, ...	value £	6,570	6,342	6,581
Brimstone	cwt.	78,275	68,292	40,900
,, ...	value £	20,519	16,234	10,182
Nitre (nitrate of soda)	cwt.	181,965	115,891	172,218
,, ,,	value £	90,007	67,287	80,391
,, (nitrate of potash)	cwt.	21,695	24,712	17,879
,, ,,	value £	18,074	21,671	16,005
Quicksilver	lb.	1,599,600	684,741	877,500
,, ...	value £	117,569	62,160	76,828
Bark (Cinchona)........	cwt.	8,481	16,281	12,836
,, ...	value £	52,967	91,590	60,983
Gum Arabic	cwt.	6,058	2,743	2,983
,, ...	value £	19,795	9,796	12,499
Lac, seed, shell, stick, and dye	cwt.	7,401	8,153	10,873
Lac, seed, shell, stick, and dye	value £	23,778	22,871	27,732
Dyes and tanning materials—				
Bark (for tanners' or dyers' use)	cwt.	30,387	72,037	55,118
Bark (for tanners' or dyers' use)	value £	12,989	44,130	28,017
Aniline dyes	value £	18,340	15,393	24,299
Alizarin	value £	15,692	19,557	14,195
Other coal-tar dyes....	value £	366	—	464
Cochineal	cwt.	762	989	585
,, ...	value £	4,188	6,395	3,542
Cutch and gambier..	tons	1,461	1,273	1,931
,,	value £	30,065	28,151	42,212
Indigo	cwt.	1,352	2,270	3,357
,, ...	value £	23,276	37,025	57,662
Madder, madder root, garancine, and munjeet................	cwt.	2,024	1,557	1,327
Madder, madder root, garancine, and munjeet................	value £	3,012	1,898	1,695
Valonia	tons	2,109	3,878	3,155
,, ...	value £	31,295	52,410	44,721
Oils—				
Cocoa-nut	cwt.	21,785	4,012	17,878
,, ...	value £	33,518	5,736	26,058
Olive..................	tuns	1,788	1,867	1,641
,, ...	value £	69,688	70,211	62,897
Palm	cwt.	72,372	70,048	67,336
,, ...	value £	100,861	70,078	64,443
Petroleum	gals.	5,637,387	5,388,918	4,823,942
,, ...	value £	193,287	148,717	139,499
Seed, of all kinds	tuns	602	949	1,032
,, ...	value £	17,861	21,120	21,994
Train, blubber, and sperm	tuns	1,202	1,506	1,671
Train, blubber, and sperm	value £	34,009	40,152	32,456
Turpentine	cwt.	14,914	866	5,659
,, ...	value £	18,498	1,055	7,495
Rosin	cwt.	182,805	141,276	65,520
,, ...	value £	40,363	33,456	17,431
Tallow and Stearine....	cwt.	90,526	101,771	82,851
,, ...	value £	143,907	133,017	95,489

Exports.

		June, 1885.	June, 1886.	June, 1887.
British and Irish produce :—				
Alkali	cwt.	511,377	494,355	458,181
,, ...	value £	160,185	142,607	130,517
Bleaching materials	cwt.	125,002	130,143	104,111
,, ,,	value £	43,174	40,273	39,174
Drugs and medicinal preparations (unenumerated)......	value £	65,726	75,571	73,380
Other chemicals and medicinal preparations	value £	155,400	170,741	180,246
Chemical manure ..	value £	126,262	112,596	103,826
Oil (seed)............	tons	5,763	6,491	6,302
,, ...	value £	132,084	138,931	113,956
Soap	cwt.	40,426	31,238	43,788
,, ...	value £	46,769	32,030	42,631
Painters' colours and materials (unenumerated)	value £	121,988	117,891	112,895
Foreign and Colonial merchandise :—				
Bark, Cinchona	cwt.	9,397	8,692	9,921
,, ,, ...	value £	50,194	42,123	37,342
Chemicals (unenumerated)	,,	22,637	13,763	35,100
Cochineal	cwt.	1,314	991	730
,, ...	value £	9,248	6,527	4,779
Cutch and gambier	tons	557	767	1,042
,, ,,	value £	12,697	19,714	26,108
Gum Arabic	cwt.	2,796	3,578	2,966
,, ...	value £	9,246	15,172	10,393
Indigo	cwt.	3,310	1,962	2,323
,, ...	value £	62,457	44,518	52,361
Lac, various kinds..	cwt.	9,539	6,213	4,713
,, ,, ,, ..	value £	32,251	18,205	11,776
Oils, cocoa-nut......	cwt.	11,225	14,182	11,928
,, ,, ...	value £	17,440	19,096	15,890
,, olive	tuns	230	147	336
,, ,, ...	value £	11,273	7,064	13,624
,, palm	cwt.	38,317	11,548	46,758
,, ,, ...	value £	52,860	10,809	44,355
,, petroleum	gals.	40,922	73,938	18,539
,, ,, ...	value £	1,767	3,591	964
Quicksilver	lb.	368,590	499,250	560,289
,, ...	value £	27,848	42,474	49,199
Nitre (nitrate of potash)	cwt.	491	7,671	2,254
Nitre (nitrate of potash)	value £	423	6,287	2,107
Tallow and stearine	cwt.	15,988	14,642	20,338
,, ,, ,,	value £	23,740	16,417	22,416

DRUG IMPORTS INTO BOMBAY.

The import of drugs into Bombay during 1886 were largely in excess of those of the preceding year, as the following figures show :—

Imports.	1885.	1886.
	Rs.	Rs.
Chemicals	943,709	1,131,965
Drugs and medicines	1,534,778	1,576,550
Dye stuffs	1,490,974	1,585,172
Gums and resins	555,667	565,247
Quicksilver	66,058	118,866
Oils	2,391,196	2,969,288
Colours	608,112	815,274
Perfumery..................	389,066	331,714
Total..............	7,979,560	9,097,106

—*C. and D*, 25th June, 1887.

MISCELLANEOUS.

THE ANILINE TRADE OF GERMANY.

Kuhlow's Review says that the prospect of a slow improvement in the aniline industry has been fulfilled, and, but for the uncertain political situation of Europe which has lately had so damaging effect on all trades and industries, the improvement in question would doubtless have increased. The prices for the most important raw materials which are employed in the above industry reached in 1886 a normally low point. Certain reductions in the price of some of the products are also to be recorded. These, however, were on the whole moderate. The manufacture of fuchsin has just undergone a complete revolution in consequence of the employment of nitro-benzolin and the abandonment of the arsenic acid process. The manufacturers are now prepared to deliver a fuchsin and a blue absolutely free of arsenic compounds. Several modifications have had to be introduced into the machinery.

PROPOSED NEW DUTIES ON DRUGS IMPORTED INTO ITALY.

The duties are to be increased thus:—Acetic acid to pay 50 lire the 100kilos. instead of 10 lire; impure caustic soda raised from 50 centimes to 3·50; salts of quinine from 5 lire to 10 lire per kilo.; oxide of zinc from 2 lire to 5 lire; carbonates of soda and potash from 0·50 to 3·50; calcined magnesia from 20 lire to 50 lire; ordinary soap 8 lire instead of 6 lire; glycerin augmented from 30 to 60 lire; perfumery, alcoholic or otherwise, from 6·00 to 100 lire. On the other hand, mineral oil duties to be reduced from 27 lire to 10 lire; chicory from 20 to 15 lire; common sponges, now paying 20 lire, to enter free, but the duty on trimmed and prepared goods to increase from 20 to 25 lire.—*C. and D.*, 9th July, 1887.

ANTIMONY IN PORTUGAL.

It is not generally known, says the ***Financial News***, that some of the richest antimony mines in the world exist within a few miles of Oporto, in Portugal. For many years these mines have been worked by the natives, and traces of the old Roman workings have been found in nearly all of them. Lately a Portuguese company was formed, with a capital of £100,000, to work one of the mines, and under such management a dividend of 10 per cent was declared last year, and a very substantial sum added to the reserve fund. Immediately adjoining this mine there is a property which has, for some years, been worked by some of the English residents in Oporto, who have succeeded in opening up the mines to a point where the introduction of further capital becomes necessary. They therefore brought the Corgo Mines to the notice of English capitalists, with the result that they have since been purchased, and will shortly be offered to the public. Several hundred tons of the ores have been shipped, and sold to smelters here, the account sales showing an average of 60 per cent. of antimony to the ton. During the process of development a lode has been struck varying from 7in. to 3ft. 3in. in thickness, with a metallisation of pure antimonial lead. Visible gold appears in the quartz and antimonial lead, and assays have been made by several well-known experts, from samples as well as from bulk, and the average shows a mean return of over 22oz. to the ton. There are six distinct lodes in the Corgo Mine, and they have been opened up to a considerable extent. Two shafts have been sunk, one to a depth of 450ft., at which distance they have stopped for the present, and are now running new levels both east and west, where the lode shows itself from 3 yards to 5 yards thick, with abundant metallisation, having veins and pockets of pure antimonial lead from 2in. to 3ft. wide, besides auriferous quartz.

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS AND MACHINERY.

APPLICATIONS.

8768 W. Oliphant, London. Apparatus for promoting combustion. Complete specification. June 17

8796 N. C. Cookson, Newcastle-on-Tyne. Construction of pipes for the conveyance of fluids, fumes, and gases. June 18

8801 R. G. Brooke and T. White, London. Improvements in and pertaining to condensers. June 18

8870 Mill, Comte, and Mabut, London. Freezing machines. June 20

8938 G. Donkin, B. G. Nichol, and H. Macarthy, Newcastle-on-Tyne. Apparatus for the effective circulation of water in steam boilers, and heating of feed water. June 23

8945 S. Smillie, Glasgow. Distilling apparatus for producing fresh water from salt water. Complete specification. June 23

9015 H. H. Lake, London—From A. P. Lighthill, United States. Improvements in atomisers. Complete specification. June 24

9017 O. Bruner and C. G. Rommenhöller, London. Pressure reducing valves for highly compressed gases, especially for carbonic acid. Complete specification. June 25.

9064 J. Orchard, London. Construction of valves for gases under high pressure. June 25

9102 F. W. Dick and J. M. McMurtrie, Glasgow. Apparatus for pumping and compressing fluids and for regulating fluid pressures. June 27

9118 J. H. Cormack, Glasgow. Improvements in and relating to doors for flues, soot boxes, and the like. June 28

9199 A. J. Boult—From J. Fischer, Austria. Apparatus for cooling or heating liquids, gases, vapours, and the like. June 28

9206 J. Howes, Liverpool. Rotary filtering apparatus. June 28

9250 A. M. Clark—From T. D. Williams, South Africa. Amalgamating apparatus. June 29

9410 P. A. Newton—From R. A. Chesebrough, United States. Improvements in hot-air furnaces. Complete specification. July 2

9422 P. Everitt, London. Filters. July 2

9424 A. Tolhurst, Gravesend. Hollow fire-bars for furnaces of boilers, kilns, retort benches, stills, etc.; and smoke consuming apparatus for the same. July 2

9441 L McIntyre, London. Heating feed-water by steam for steam boilers, and extracting impurities from same. July 4

9456 J. Willoughby and A. Gledhill, London. Method and apparatus for consuming smoke in the furnaces of steam and other boilers. July 4

9460 C. E. Hudson, London. Improvements in furnaces and in the method of supplying fuel thereto. July 4

9463 H. Schellhaas, Liverpool. Revolving furnaces for drying, heating, combining, or decomposing substances. July 4

9501 W. P. Thompson—From the Aerated Fuel Company, United States. Furnaces for burning hydro-carbon fuels, and steam generators therefor. July 5

9521 S. H. Johnson and C. C. Hutchinson, London. Construction of filter presses. July 5

9537 R. Hamilton and T. McKillop, Glasgow. Apparatus for promoting combustion, and other furnaces. July 6

9539 W. Davidson, Glasgow. Apparatus for feeding fuel into furnaces. July 6

9606 P. Everitt, London. Filters. July 7

9691 J. Batson, H. Sedgley Batson, and W. G. Causer, Birmingham. Apparatus for charging steam boilers with anti-corrosive liquids, semi-liquid, or other substances. July 11

9746 M. Vinning, London. Apparatus for regulating or controlling the flow of fluids from reservoirs in which such fluids are contained under pressure. July 12

9797 T. Kirkwood, London. Grates for furnaces. Complete specification. July 12

9820 T. T. Edwards, Birmingham. Filtering apparatus for drawing off liquids. July 13

9870 H. Wilson, Stockton-on-Tees. Apparatus for heating, cooling, and condensing fluids, gases, and like elements. July 14

9952 F. Weldon, London. Compressing apparatus. July 15

10023 W. Tapp, Bristol. A water softening apparatus. July 16

*COMPLETE SPECIFICATIONS ACCEPTED.**

1886.

9098 E. Fischer and M. W. Weber. Improvements in amalgamators. July 16

9785 S. Smithson. Method and apparatus for heating furnaces by means of ground coal or coal dust, and for consuming smoke. June 29

10641 D. Rylands, B. Stoner, and R. Potter. Arrangements for feeding melting furnaces. June 29

10978 J. J. Roylo and J. Brown. Apparatus for rapidly heating or cooling liquids. July 13

10983 H. Montgomerie. Collecting and using the waste heat from steam boilers. July 13

11169 J. Williamson. Filter-presses. July 2

11178 J. R. Fothergill. Furnaces or apparatus for effecting combustion of fuel with air under pressure. June 29

11304 C. Hird. Filters for filtering water for manufacturing purposes. July 6

11477 W. P. Singleton. Improvements in valves or cocks. July 6

11589 D. K. Clarke. Filter-presses. July 16

12498 J. Brookbanks. Composition for removing scale or other incrustations from steam boilers. July 13

1887.

2915 J. Critchlow, T. Forester, W. Forester, H. Forester, and L. Forester. Filter-presses. July 9

6807 J. W. Hyatt. Water purifier and filter for steam boilers. July 6

7011 J. Fleischer and C. Muhlich. Valve for liquid carbonic acid. July 6

7515 C. A. Koellver. Filtering and lixiviating press. July 16

7525 H. H. Lake—From U. Cummings. Air compressing apparatus. June 29

7817 J. Kroog. Apparatus for automatically discharging water of condensation from steam pipes, etc. July 9

7830 W. Macnab, sen., W. Macnab, jun., and J. Donald. Apparatus for separating, by subsidence, solid matters from the liquids in which they are suspended. June 29

7901 J. M. Chase. Steam boilers or generators. July 13

8044 H. H. Lake—From H. Ogden. Cocks or faucets. July 6

8180 W. H. Farris. Steam generators. July 9

II.—FUEL, GAS AND LIGHT.

APPLICATIONS.

8890 E. Renshaw, Manchester. Improvements in apparatus for moistening and cooling or heating air in rooms or buildings. June 22

8903 W. P. Thompson—From C. Drevs, Germany. Improvements in machines for crushing colza. June 22

8919 E. J. Palmer, London. A regenerated lamp for illumination and heating. June 23

8953 R. B. Avery, New York. New and useful improvements in method and apparatus for generating gas or gases for illumination, heating, and metallurgical purposes from liquid hydrocarbons and steam, and liquid hydrocarbons and air. Complete specification. June 23

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* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

9077 S. Pitt—From J. R. Knapp, United States. Improved apparatus for producing intense heat and artificial light. Complete specification. June 25

9162 E. O. Eaton—Partly communicated by J. Lancaster, United States. Improvements in fuel cartridges. June 28

9332 F. R. Baker, Birmingham. A new or improved lamp, or system of illumination. July 1

9391 C. S. Ellery and J. Challin, London. Improved means for preventing the choking of pipes between the retort and hydraulic main in gasworks. Complete specification. July 2

9403 C. Rave, Liverpool. Improvements in or relating to the treatment of the acid residuums resulting from the refining of mineral oils by concentrated acids. July 2

9128 W. Patterson. See Class X.

9936 C. H. McEwen—From J. C. Alexander and W. F. Maddox, New South Wales. Improved apparatus for regulating the pressure flow of gas. July 15

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

11287 A. Paget. Manufacture of "mantles" for use in incandescent gas lighting. July 6

11300 A. C. Thomson. Apparatus for treating mineral oils with acids or alkalis. July 6

1887.

1072 A. J. Boult—From E. Hamélius. Gas generators. July 13

3118 J. A. Marsh. Apparatus for producing gas or vapour from hydrocarbons, and for utilising gas or vapour for lighting or heating, and for igniting gas. July 6

7182 R. de Soidenhoff. Means or apparatus employed in the manufacture of coke for the desiccation and incineration of precipitants or solids, resulting from sludge or other substances liable to putrify. June 25

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

10957 T. Nikiforoff. Production of benzol, anthracene, napththaline, and other products from naphtha and naphtha residues. June 29

11581 T. Rouet. Construction and arrangement of mechanical retorts for the destructive distillation or revivification of animal, vegetable, and mineral matters. July 13

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

8734 and 8735 R. Hunt. See Class XI.

8932 A. Ewer, P. Pick, and M. Lange, London. Process for the preparation of sulphuretted derivatives from the aromatic oxy compounds. June 22

9191 J. Imray—From La Societé Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Poirrier, Z. Roussin, and D. A. Rosenstiehl, France. Manufacture of azoic colouring matters, shading from yellow to orange, and from red to violet. June 28

9257 J. Imray—From the same. Manufacture of new azoic colouring matters. June 29

9299 G. Tall and W. P. Thompson, Liverpool. Improvements in, or relating to, the separation or the manufacture of colouring matter or mordant for dyeing purposes from cotton seed or cotton-seed oil. June 30

9315 J. Imray—From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Poirrier, and D. A. Rosenstiehl, France. Manufacture of yellow, orange and red azoic colouring matters. June 30

9381 J. Imray—From the same. Manufacture of azoic colouring matters. July 1

9414 J. Imray—From the same. Manufacture of yellow, orange, red and violet azo colouring matters. July 2

9458 T. D. Lichtenstein, London. Improvements in the production or application of matters or media suitable for use for writing, printing, dyeing and colouring, and analogous purposes. July 4

9468 T. R. Shillito—From J. R. Geigy, Switzerland. Production of a new red azo colour. July 4

9624 R. J. Waters, Manchester. Powdered aniline writing inks. July 8

10046 C. A. Bennert, London. The manufacture or production of colouring matters. Complete specification. July 18

COMPLETE SPECIFICATION ACCEPTED.

1886.

8431 J. Imray—From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Poirrier and D. A. Rosenstiehl. A process for the manufacture of anthraquinone. July 13

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

8721 W. Ambler and W. O. Blackburn, London. Improvements in machinery for washing wool or other fibres. June 17

8815 H. J. Simpson, G. de M. MacKirdy, and A. Taylor, Liverpool. An article of manufacture from the bark of a certain tree, being a textile material applicable for use in textile manufactures, including lint and wood-wool; and process employed in obtaining such article. June 18

8865 E. Edwards—From F. J. Maizier and F. J. W. Reitz, Belgium. Improvements in machinery or apparatus for separating textile fibres from the stalks or stems of plants. June 20

9270 H. M. Girdwood, Manchester. Improvements in retting, ungumming, washing, etc., rhea, ramie, or China grass, hemp, flax, jute and certain other fibres. June 30

9274 E. W. Serrell, jun., Paris. Process and machinery for reeling silk from the cocoon. Complete specification. June 30

9692 J. Hebblewaite, Manchester. Improvements in the treatment of textile fabrics. July 11

VI.—DYEING, CALICO PRINTING, PAPER STAINING AND BLEACHING.

APPLICATIONS.

8803 C. L. Klauder, London. Improvements in dyeing and scouring yarns. Complete specification. June 18

9027 W. Crowther and J. Crowther, Dewsbury. Mordanting or fixing mordants upon worsted or woollen fibres, and upon mixed fibres of wool, cotton, silk, jute, etc. June 25

9184 E. D. J. Neupert, London. Improvements relating to the production of coloured designs upon plates, sheets, or other articles of celluloid. June 28

9211 R. Crompton, London. Improvements in colouring and drying tissue and other paper, and apparatus therefor. June 28

9361 T. M. Denne, London. A novel method of producing defined patterns in celluloid. July 1

9720 C. Meadowcroft and P. Denanhouer, London. Improved apparatus for dyeing skeins. Complete specification. July 12

9722 W. P. Thompson—From J. Meikle, United States. Improvements in apparatus for cleaning and bleaching cotton and other fibrous and textile fabrics. Complete specification. July 12

9710 B. J. B. Mills—From E. Smith. See Class XVIII.

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

10933 E. Sutcliffe and G. E. Sutcliffe. Method and apparatus for bleaching, damping and dyeing loose fibre, yarns, threads, etc. June 29

10998 B. J. B. Mills—From F. Vladimirovitch Serikoff and W. E. Smith. Process and apparatus for bleaching cotton, linen and other textures and materials. June 29

11164 W. E. Heys—From H. Danzer, A. Simian, and D. Marcien. Method of dyeing and finishing textile fabrics simultaneously without immersion. September 29

11730 H. J. Haddan—From A. Henry. Improvements in dyeing. June 29

1887.

6737 C. Collin and L. Benoist. Process for fixation of the colouring matter, by oxidation at high temperature of the textile fibres. July 13

VII.—ACIDS, ALKALIS AND SALTS.

APPLICATIONS.

8820 C. T. G. Vautin, London. Improvements in the production of liquid or compressed chlorine. Complete specification. June 18

8922 W. N. Hartley and W. E. B. Blenkinsop, London. Improvements in the manufacture or preparation of cobalt sulphate, and its separation from other sulphates. June 22

9188 E. Hanisch and M. Schröder, London. An improved process and apparatus for the production of sulphuric anhydride. Complete specification. June 28

9227 C. Wigg, Liverpool. Improvements in the manufacture of bicarbonate of soda, and in apparatus therefor. June 29

9543 H. C. Bull and Co., Limited, and W. E. Sendey, London. An improved process for the manufacture of sulphate of ammonia, the recovery and purification of the by-products arising therefrom, and apparatus therefor. July 6

9760 A. Walker, Glasgow. Improvements in the manufacture of sulphates of soda and potash, and in the apparatus employed therefor. July 12

9873 E. W. Parnell and J. Simpson, Liverpool. Improvements in the production of sulphuretted hydrogen in combination with the manufacture of alkali by the ammonia process. July 14

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

7011 J. Fleischer and C. Mühlich. Valve for liquid carbonic acid. July 6

9158 P. Higgs. Process and apparatus for obtaining spelter and caustic soda, chloride of lime, chloride of calcium, etc. July 13

10191 J. Barrow. Improvements in the manufacture of alkali. June 25

10955 J. I. Watts and W. A. Richards. Manufacture, purification, and separation of sodium bicarbonate. June 29

11518 J. M. Collett. Manufacture of sodium sulphates. July 9

11311 J. W. Kynaston. Improvements in the manufacture of chloride of potash. July 20

1887.

6209 R. L. Hickes. Combining disinfectants with soda crystals. July 2

8820 C. T. J. Vautin. Production of liquid or compressed chlorine. July 20

VIII.—GLASS, POTTERY AND EARTHENWARE.

APPLICATIONS.

8752 E. Edwards, Brierley Hill. Improving and simplifying the tinting, staining and colouring of manufactured glass. June 17

8835 L. A. Fry, London. Improvements in the art of decorating clay ware. June 20

8886 J. Bentley and W. S. Simpson, Hanley. Improvements in producing on porcelain or other ceramic products, etc., designs in colours, gold, silver and other metals. June 22

8888 J. P. Guy, Longport. Improvements in potters' saggars. June 22

9074 W. H. L. Cooper, London. Making, finishing and drying plain or socketed stoneware, sanitary pipes or tubes. June 25

9080 S. Bunting, Dublin. Improved moulds, with apparatus attached for blowing glass. June 27

9195 M. R. von Spaun, London. Improvements in the manufacture of coloured glass-ware. June 28

9291 M. F. L. Ehrlich and C. T. Storck, Berlin. Improvements in a method of producing a bright printing gold, silver or platina Complete specification. June 30. (See 9292)

9292 M. F. L. Ehrlich, Berlin. Improvements in the method of producing dead gold (silver or platine) decorations on china, crockery-ware, glass, enamelled metals, etc. Complete specification. June 30

9529 C. G. Picking and E. Bussy, London. Producing art and other ornamentations on and in glass, or on enamel or ceramic-ware in relief. July 5

9711 W. Starley, London. Improvements in toilet ewers or jugs, chamber utensils and other vessels made of china, earthenware or glass. July 11

9957 J. Trassl and H. Lindner, London. Improvements in and relating to the manufacture of thin plates and other articles of glass. July 15

10001 E. Smith and F. Smith, London. Improved method or means of producing sparkling, brilliant effect in or from glass alone, or from a combination of glass and metal or metallised material. July 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

11233 H. Doulton. Improvements in making Bristol stoneware. July 9

12118 E. H. Pearce and H. Besson. Machinery for working glass. July 13

1887.

797 M. Hussy and W. Clark. Manufacture of roofing and other tiles and slates. July 5

1495 E. H. Pearce and J. Hills. Apparatus for bevelling small pieces of glass. July 9

3258 R. E. Donovan, F. Hazlett, and J. Johnston. Apparatus for blowing glass by mechanical means. July 13

3907 T. E. Halford and R. Morant. Method of making glass-lined metal articles. July 2

6177 W. P. Thompson—From M. C. Stone. Ornamentation of glazed earthenware articles. July 6

IX.—BUILDING MATERIALS, CLAYS, MORTARS AND CEMENTS.

APPLICATIONS.

8939 J. Crombie and J. Crombie, Middlesbrough-on-Tees. Improvements in laying down or constructing concrete pavements, floors, or the like. June 23

9039 F. Naumann, London. Process and apparatus for producing improved faced bricks. June 25

9160 J. Ashworth, London. An improved refractory material, and appliances for use in the manufacture of the same. June 28

9605 G H. Innes, London. Improvements in manufacturing Portland and other cement, and apparatus therefor. July 7

9627 F. Pilkington, London. A method of fireproofing columns, stanchions, girders (iron and steel), ceilings, walls, flooring or buildings in any position. July 8

9691 F. W. S. Stokes, London. Improvements in the continuous manufacture and burning of cement. July 11

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

7492 W. Brierley—From F. Wallbrecht and H. Russe. Manufacture of artificial elaterite or elastic bitumen to be employed in road-making, roof-surfacing, etc. July 6

14312 T. Arnold. Process and apparatus for moulding briquettes of cement or the like material to be employed for testing its quality. June 29

1887.

7539 A. Smith, J. Roberton, and J. R. Andrew. Improvements in making Portland cement. June 29

7611 F. Wicks. Paving for flooring and building purposes. July 9

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

8717 O. Schulz, London. Improvements relating to the elimination or removal from metal of acid or other liquids with which the same has been treated. June 17

8840 J. J. Arnold, Southampton. Improvements in armour plating. June 20

8866 W. Cross, London. Improvements in the manufacture of aluminium alloys. June 20

8930 F. C. Bellinger, London. Improvements relating to the joining or uniting of metal plates. June 22

8957 H. Defty, London. An improved process of extracting and refining metals from ores. June 23

8968 J. Toussaint, London. Improvements in the manufacture of iron and steel. June 23

9001 H. Johnson, London. Improvements in rammers used in tamping blast holes in the blasting or getting of coal and other minerals, and for other like purposes. June 24

9017 W. Cross. See Class XVIII.

9026 J. A. B. Bennett and W. Sunderland, Birmingham. Improvements in the mode of manufacturing aluminium chloride. June 25

9093 J. A. B. Bennett and W. Sunderland, Birmingham. Improvements in the methods of mixing metals of lower boiling points with other metals or alloys or compounds boiling or volatilising at higher temperatures. June 27

9103 J. Y. Johnson—From A. de Méritens, France. An improved process for electro-plating with tin, zinc and lead. June 27

9169 E. Patterson, London. Improvements in miners' safety lamps. June 28

9174 G. H. Jones, London. Improvements in the manufacture of mining implements. June 28

9200 A. G. Greenway, Liverpool. Improvements in the manufacture of iron or steel. June 28

9231 J. Toussaint, Birmingham. Improvement of converter, which has the advantage of operating without employing any machinery or blower. June 29

9235 J. Treherne, Llanelly. Improvements in miners' safety lamps. June 29

9286 A. Crighton and R. Crighton, Handsworth. An improved segmental metallic core bar for the casting of different kinds of metal thereon. June 30

9313 A. Mann, London. Improvements in alloys of aluminium with other metals. June 30

9316 R. A. Hadfield, London. Improvements in the manufacture of steel. June 30

9322 J. J. C. Smith, London. Improvements in means or apparatus employed in casting metals under pressure, June 30

9331 J. J. Hardy, Stockton-on-Tees. Improvements in miners' safety lamps. July 1

9365 C. E. Miles, London. Improvements in blast furnaces for smelting ores. July 1

9389 C. A. Burghardt and W. J. Twining, Manchester. Improvements in the production of aluminium. July 2

9428 W. Patterson, Low Fell. Improvements in electric safety lamps for use in coal mines and all other places where explosive gases are present. July 4

9471 J. B. d'Arcy Boulton, London. Process and apparatus for casting metallic ingots in a sectional mould. July 5

9474 J. Parkinson, London. Improvements in the treatment of ores. July 5

9499 A. J. Boult—From W. H. Larimer, United States. Improvements in drills for mining purposes. Complete Specification. July 5

9533 R. Thompson, Wigan. An expander for breaking down coal and other minerals. July 6

9568 N. C. F. Jochumsen, Barrow-in-Furness—From J. Hansen, Denmark. Improvements in the construction of furnaces for melting iron, steel and other metal. July 7

9572 A. E. Tucker, Smethwick. Improvements in the utilisation of flux skimmings or galvanisers' waste. July 7

9586 A. Mann, London. Obtaining aluminium and alloys of aluminium with other metals. July 7

9681 A. N. Contarini, D. Forbes and R. Matthews, London. A novel means and apparatus for the extraction of platinum from any ore containing same, and also gold from auriferous ferruginous sand. July 9

9706 J. B. Clark and The Panther Lead Co., Limited, London. Improvements in condensing and separating lead fume, and apparatus therefor. July 11.

9782 R. K. Boyle, London. Improvements in treating metals for modifying, hardening or alloying the same, applicable more especially to the case-hardening of iron or steel. July 12

9795 H. J. Smith, Glasgow. Improvements in and connected with the making of moulds for casting metal articles. July 12

9867 L. A. Brode, Glasgow. Improvements in treating pulverulent iron or iron compounds for smelting furnaces. July 14.

9868 A. G. Greenway, Liverpool. Improvements in the method of and apparatus for the manufacture of galvanised and tinned iron. July 11

10013 W. P. Thompson—From Mons. Faurie, France. Improvements in the manufacture of aluminium, magnesium, calcium, and similar metals and their alloys. July 18.

10057 E. de Pass—From M. Bernard and E. Bernard, France. A process for the extraction of aluminium from its fluorides by electrolysis. July 18

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

8989 E. Cottam. Manufacture of German silver. July 6

10062 W. P. Thompson—From W. H. Wright. Manufacture or working of metals in a cold state into certain forms, and apparatus therefor. July 6

10089 R. Heathfield. Apparatus for coating iron and steel with zinc or with alloys of zinc or other coating metal or alloy. July 6

10157 R. Evans. Apparatus for compressing scraps of metal into forms for re-melting or other use. July 9

11776 J. E. Baugh and C. Hinksman. Furnaces for chlorinating ores, and process in connection therewith. July 16

11816 A. Brin and L. Q. Brin. Manufacture of metallic oxides. July 20

11817 J. S. McArthur, R. W. Forrest, W. Forrest and G. Morton. Obtaining gold, silver, etc., from ores or other compounds July 16

12237 W. Fairclough and W. Warburton. Reflecting appliances for use in miners' safety lamps. July 13

12356 A. Brin and L. Q. Brin. Manufacture of iron and steel. July 20

12720 C. Heusler. Producing silicious copper and utilising the same for metallurgical purposes. July 20

15097 D. P. G. Matthews. Manufacture in sections of ingot moulds, and method of using and treating such moulds. July 9

1887.

1279 W. Patterson. Miners' safety lamps. July 9

5029 R. Hannan and M. Milburn. Obtaining zinc from its blende or sulphide. July 20

5501 A. L. Keeport. Separating metals from their ores or from crude minerals. July 20

7198 W. A. Baldwin. Obtaining aluminium from its ores or from aluminous earths, or earths containing alumina, and combining aluminium with other metals. July 20

XI.—FATS, OILS AND SOAP MANUFACTURE.

APPLICATIONS.

8734 R. Hunt, Liverpool. Improvements in the treatment of cotton-seed oil to refine and clarify the same, and to obtain colouring matter. June 17

8735 R. Hunt, Liverpool. Improvements in the treatment of cotton seed to obtain oil feeding cake and colouring matter. June 17

8825 R. Oxland, Plymouth. Improvements in the refining of oils and fats. June 18

8947 G. Tall, Liverpool. Improvements in the manufacture or purification of cotton-seed oil. June 23.

9376 J. Harris, London. Improvements in the manufacture of soap, specially applicable to scouring and other cleansing compounds. July 1

9943 W. A. Mitchell—From M. von Schmidt, Austria. Improvements in the purification of vegetable oils and fats, and the obtainment of useful products therefrom. July 15

9944 W. M. Riddell, Forest Hill. Improvements in the purification and oxidation of oils. July 15.

9953 T. H. Gray, London. Improvements in the mode of refining vegetable oils for illuminating or alimentary purposes. July 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

10833 H. H. Lake—From La Société Anonyme du Compresseur Jourdan. Apparatus for expressing oil from oleaginous substances. June 25

11192 H. W. Langbeck. Treatment of wool fat to produce unguent material therefrom. June 25

11560 J. E. Quayle. An improved washing powder. July 2

11741 W. Graff. Separation of fat and fatty acids from compounds containing the same. July 16

12216 J. Kirkpatrick. Manufacture of oil for Turkey-red dyeing, calico printing, etc. July 2

12799 C. Schill and C. Seilacher. Oxidising oils and fats and other organic substances. June 29

13765 J. Stott. Apparatus for treating waste lubricating oils. July 9

XII.—PAINTS, VARNISHES AND RESINS.

APPLICATIONS.

9122 J. F. F. F. Lowe, London. An improved process of manufacturing white lead. Complete specification. June 27

9618 S. Washington, Manchester. An improved compound for application to iron work as a paint or varnish. July 8

9887 J. Rust, London. A new and improved material for colouring paints, cements and other substances. July 14

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

11493 A. McLean and R. Smith. Preparation of colours for artistic purposes. July 13

1887.

7524 H. H. Lake—From J. P. Perkins. Manufacture of pigment or paint. June 29

XIII.—TANNING, LEATHER, GLUE AND SIZE.

APPLICATIONS.

9088 N. Proctor, Alfreton. The utilisation of curriers' shavings and waste leather by the use of chemical and mechanical appliances; to be used for insoles, etc. June 27

9353 W. P. Thompson—From J. P. N. Bidrow, France. Improvements in compounds for use in tanning, and in the manufacture of the same. July 1

9404 M. J. A. Darglos, Liverpool. A process of carotting skins. July 2.

9193 H. H. Lake—From A. M. Bowers, United States. Improvements in machines for softening and otherwise treating leather. Complete specification. July 5

9215 E. Worms and J. Babe, London. Improved process and apparatus for tanning by the aid of electricity. July 5

9545 R. Ward, London. The treatment of rhinoceros hide and its manufacture into articles of furniture and ornament. July 6

XIV.—AGRICULTURE, MANURES, ETC.

APPLICATIONS.

9543 H. C. Bull & Co., Limited, and W. E. Sendey. See Class VII.

10,060 T. Roxburgh, London. An improved process of making manure. Complete specification. July 18

XV.—SUGAR, GUMS, STARCHES, ETC.

APPLICATIONS.

8748 W. T. Crooke, London. Improvements in pockets or bags employed in the manufacture of sugar and like substances, together with an improved process for cleaning the same. June 17

9690 C. Leuchtenberger and B. Moiske, London. Improvements relating to the purification of molasses and other saccharine solutions. July 9

9751 E. J. P. Robet, Paris. Process for treating vegetable milky juices, and extracting therefrom indiarubber, guttapercha, mangabeira, and such like. Complete specification. July 12

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

11451 S. Vickers. Apparatus for making lump sugar. July 13

11861 T. C. A. Carré. Moulding sugar, and apparatus therefor. July 20

12012 H. H. Lake—From T. F. Krajewski. Treatment of sugar cane for the extraction of sugar therefrom, and apparatus therefor. July 9

12535 A. Brin and L. Q. Brin. Manufacture of sugar. July 16

1887.

7259 F. Harm. Converting the syrups from sugar-manufacture into mono-saccharates. July 2

XVI.—BREWING, WINES AND SPIRITS.

APPLICATIONS.

8986 W. W. Davenport, Birmingham. New or improved apparatus for automatically regulating the temperature of fermenting liquids, applicable for other similar uses. June 24

9045 O. Brunler and C. G. Rommenhöller, London. Means for impregnating beer and other liquids with carbonic acid in the cask. Complete specification. June 25

9046 O. Brünler and C. G. Rommenholler. Process and apparatus for automatically mixing liquids with carbonic acid. Complete specification. June 25

9048 O. Brunler and C. G. Rommerhöller. An improved apparatus for using carbonic acid in large quantities. Complete specification. June 25

9049 O. Brünler and C. G. Rommenhöller. Process and apparatus for the automatic mixing of liquids with carbonic acid. Complete specification. June 25

9219 A. G. Greenway, Liverpool. Preserving ale, beer, porter, and other fermented liquors in barrels. June 29

9363 G. C. Jacquemin, London. The manufacture of wine from barley and other grain. July 1

9425 E. J. Taylor, London. Improvements in the manufacture of spirits. July 2

9505 J. Wetter—From E. T. Gautier, Belgium. Process or processes for the manufacture of alcoholic liquors. July 5

COMPLETE SPECIFICATION ACCEPTED.

1887.

4138 O. Imray—From F. W. Weisebrock. Process and apparatus for drying and cooling malt, etc. June 29

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, ETC.

APPLICATIONS.

A.—CHEMISTRY OF FOODS.

9247 J. F. V. Steenberg, London. Improved process for preserving fish, meat, and other victuals. June 29

9319 W. H. Gilruth, London. Mechanically treating tea leaf in what is known as the fermentation process. June 30

9419 Prince J. Tarchan-Mouranoff (called Tarchanoff), London. Improvements in the treatment of eggs, or the albumenous portions thereof, for preservation, transport, and use as food. July 2

9950 L. Stollwerck and C. Stollwerck, London. An improved method of preserving fruit, vegetables and other articles of food. July 15

9956 A. C. Drenkham, London. Improvements in apparatus for evaporating or boiling milk and other matters. July 15

B.—Sanitary Chemistry.

8800 F. W. Lacey, Brentford. Improvements in apparatus connected with the treatment of sewage. June 18

8999 W. Horsfall, London. A new or improved construction of furnace for burning towns' or other refuse. Complete specification. June 24

9040 B. C. Badham, London. Certain improvements in and apparatus for purifying gases arising from sewers, surface water drains, closets, etc. June 25

9755 R. Weaver, London. An improved means of treating sewage and other matters. July 12

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1886.

10076 A. Dutour. A process for making the bones in fishes eatable. July 6

11995 W. G. Dunn. Improvements in baking powders. July 13

1887.

8008 T. A. Marshall. Preparation of farinaceous substances for use as food. July 6

8063 J. C. Mewburn—From J. J. Bate. Processes for preserving crustacea, and certain new and useful chemical solutions of special utility in such connection. July 6

XVIII.—ELECTRO-CHEMISTRY.

APPLICATIONS.

8855 E. Julien, Liverpool. Improvements in and appertaining to electric piles and plates therefor. June 20

8856 H. Aron, Liverpool. Improvements in apparatus for measuring electric currents. Complete specification. June 20

9011 E. Jones, London. Improvements in the construction of dynamo-electric generators and motors. June 24

9013 C. Coerper, London. Improvements relating to dynamo electric machines. Complete specification. June 24

9017 W. Cross, London. An improved method of heating ores and other substances by an electric current for effecting metallurgical, chemical and other operations, and furnaces or apparatus therefor. June 24

9104 A. P. Trotter, H. W. Ravenshaw and W. T. Goolden, Clapham. Improvements in dynamo-electric generators and motors. June 27

9196 A. J. Boult—From S. Doubrava, Austria. Improvements in apparatus for changing or regulating electric currents. Complete specification. June 28

9215 E. Worms and J. Babé. See Class XIII.

9654 J. J. Shedlock, London. Improvements in galvanic batteries. July 8

9725 W. P. Thompson—From G. Westinghouse, jun., United States. Improvements in dynamo-electric machines. July 12

9726 W. P. Thompson—From G. Westinghouse, jun. Improvements in armatures for electric generators. Complete specification. July 12

9727 W. P. Thompson—From G. Westinghouse, jun. Improvements in or relating to commutators for electric machines. Complete specification. July 12

9810 B. J. B. Mills—From W. E. Smith, Russia. Improvements in bleaching by electrolysis. July 12

9829 T. Stanley, London. Improvements in dynamo-electric machines. July 13

9853 H. Watt, London. Improvements relating to dynamo-electric machines. July 13

9871 J. Gibson, Glasgow. Improvements in or connected with electro-dynamic and dynamo-electric machines. July 14

9876 R. Dick and R. Kennedy, Glasgow. Improvements in and relating to dynamo-electric machines. Complete specification. July 14

9904 L. Grabau, London. Improvements relating to the production of insulated coatings or linings in electrolytic apparatus. July 14

9979 R. E. B. Crompton, Chelmsford, and J. C. Howell, Llanelly. Improvement in circulation of electrolyte in electric depositing vats, accumulators, etc. July 16

10057 E. de Pass—From M. and E. Bernard, France. See Class X.

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

8573 J. T. Armstrong. Portable electric batteries and appliances. June 25

9016 Sir W. Thomson. Apparatus for measuring the efficiency of an electric circuit. June 25

10765 W. Lowrie and C. J. Hall. Secondary generators for the conversion of electrical energy by induction. June 29

11487 S. Farbaky and S. Schenek. Manufacture of positive pole-plates for secondary batteries. July 16

11834 C. E. O'Keenan. Improved primary battery. July 16

1887.

7527 R. M. Hunter. Electric motors or dynamo-electric machines. July 2

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

8782 J. Wood and R. Wood, Glasgow. Improvements in apparatus for straining paper pulp and the like. June 18

8817 H. J. Simpson, G. de M. MacKirdy and A. Taylor, Liverpool. A manufacture of cellulose or wood pulp from a certain tree bark and wood, and treatment and process employed for obtaining such material. June 18

8861 G. H. Mallary, London. Improvements in the manner, method or mode of treating esparto grass and other fibrous materials for paper-making and other uses. June 20

8862 G. H. Mallary. An improved machine or apparatus whereby fibrous materials, such as esparto grass, may be reduced to pulp for paper making and other uses. June 20

8969 H. Gardner—From S. S. Stevens, United States. A novel process of manufacturing pulp for paper, and in apparatus for the purpose. Complete specification. June 23

9211 R. Crompton. See Class VI.

9294 G. Kirkman, London. An improvement in glazing paper and other materials by machinery. June 30

9632 T. B. Holmes and S. H. Holmes, Liverpool. A new or improved manufacture of pulp suitable for paper-making and for other purposes, and utilisation or treatment of a certain waste product or article of commerce therefor. July 8

9850 M. Strasser and P. Hosemann, London. An improved composition for coating pasteboard and other material to form writing tables. July 13

9919 E. A. Sengel and L. F. Dobler. An improved manufacture of gelatinised cloth or artificial parchment. July 15

10,006 G. R. Gill, London. The utilisation of paper, paper board, paper pulp or any of the preparations of which paper forms the base, for the manufacture of geometric models. Complete specification. July 16

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

5649 C. Barataud. Apparatus for reducing material for the manufacture of paper. July 2

7738 The British Xylonite Co., Limited, and L. P. Merriam. A novel xylonite celluloid or pyroxylin fabric suitable for making shirt fronts, collars, etc. June 29

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

8816 H. J. Simpson, G. de M. MacKirdy, and A. Taylor, Liverpool. A manufacture of tannins, gallates, kinos, and other vegetable extracts, from a certain tree, bark and wood, and treatment and process employed for obtaining such articles. June 18

9639 A. McDougall, London. New manufacture or preparation of compounds of sugar and tea extract or other extracts or essences. July 8

XXI.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

8929 H. Güttler, London. An improvement in the manufacture of charcoal for explosives and other purposes and apparatus therefor. June 22

8970 E. Grüne, London. Improvements in the manufacture of dynamite cartridges. June 23

9141 W. Hill, Longport. An improved safety blasting cartridge. June 28

9209 L. G. Heusschen, London. A new explosive. Complete specification. June 28

9502 H. C. Seddon, London. Improvements in percussion fuses for projectiles. July 5

9511 W. B. Fitch, London. An improvement in matches. July 5

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

11135 A. F. Hawksley. Means for lighting cigars, etc. June 29

11140 R. H. Punshon. Explosive compounds. July 2

11197 T. Nordenfelt. Fuses for projectiles. July 2

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Comment having been made on the delay in reprinting the numbers for January, 1882 and 1883, the Secretary begs to inform those whom it may concern, that the delay is due to the fact that up to the present not more than twenty orders for those numbers have been received. It is hoped that this notification may stimulate those who desire to complete their sets, to make early application with a view to expedite the consideration of the question of reprinting by the Council. Notice is also hereby given that the numbers for January and February, 1886, being exhausted, no orders for those copies, nor for complete sets of Vol. V., can be executed.

The Secretary is instructed to negotiate for the purchase of copies of the Society's Journal for January, 1882 and 1883, at the following prices:—January, 1882, 5s.; January, 1883, 2s. 6d. Members possessing odd copies of these numbers are particularly requested to communicate at once with Mr. Cresswell.

Authors of communications read before the Society or any of its Local Sections are requested to take notice that, under Bye-Law 43, they cannot receive the prescribed 50 copies of their communications unless they comply with the condition laid down in that Bye-Law—viz., that they give notice of their desire to receive such copies upon their manuscript before sending it to the Editor. Mention should also be made as to whether the Discussion is to be included in the reprint.

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W. B. Andrew, l/o Duntocher; Gavinburn, Old Kilpatrick, Dumbartonshire.

G. H. Beckett, l/o Horton Lane; 37, St. Andrew's Place, Listerhills, Bradford, Yorks.

Bertram Blount; Journals, etc., to Chemical Laboratory, Broadway, Westminster, S.W.

F. G. Claudet, l/o Runcorn; c/o F. Claudet, 10, Oakhill Park, Hampstead, N.W.

R. L. Dale, l/o Cornbrook; 1, Chester Terrace, Chester Road, Manchester.

Robt. Davidson, l/o Greenock; Fiji Sugar Co., Samanoa, Navua River, Fiji.

T. J. Flynn, l/o Mitcham; 2, Dorset Villas, Herbert Road, Wimbledon, S.W.

J. W. Freestone, l/o New Ferry Road; 33, Brownlow Road, New Ferry, Cheshire.

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Edwin B. Morgan, 318, Nechells Park Road, Birmingham, chemical manufacturer.

John M. C. Paton, Messrs. Manlove, Alliott, Fryer and Co., Nottingham, mechanical engineer.

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James Sutherland, Ballyclare, Co. Antrim, Ireland, chemist to paper mills.

G. W. A. Teanby, 22, Grosvenor Place, Blackman Lane, Leeds, student.

Frederick Percy Watson, 31, Carholme Road, Lincoln, analyst and pharmacist.

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The meetings of the London Section will be resumed on Monday, 7th November next.

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Notices of papers and communications for the meetings to be sent to the Local Secretary.

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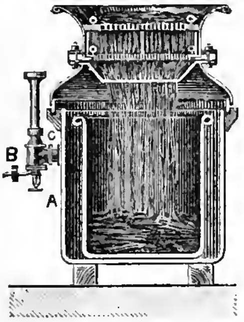
Notices of papers and communications for the meetings to be sent to the Local Secretary.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS AND MACHINERY.

Körting's Steamjet Aspirator for the Filtration of Viscid Liquids. Chem. Zeit. **11**, 510.

The action of the apparatus is based on the production of a vacuum below the filter. Fig. 1 shows the essential parts of an apparatus, A being the filtering vessel, B the steam-aspirator, and C the suction pipe.—S. H.



Apparatus for Drying Waste Animal Matter and for like Uses. J. S. Edwards and J. Edwards, Eastbourne. Eng. Pat. 6306, May 10, 1886. 11d.

The apparatus consists of a short cylinder provided with a hollow steam-heated bottom. The upper part is covered with a conical dome provided with a lip at the lower part which catches and drains away the condensed steam. The interior of the cylinder is provided with a revolving mechanical agitator and also fixed blades for the agitation of the material during the operation.
—C. C. H.

Improvements in Filter Presses and in Apparatus connected therewith. J. B. Alliott and J. M. C. Paton, Nottingham. Eng. Pat. 7045, May 26, 1886. 8d.

The central screw which is usually employed to press the plates of the filter press together, is replaced by a double acting hydraulic piston or ram. Low-pressure water is used to force into place or withdraw the loose head or follower of the press, and high-pressure water is used afterwards for holding the plates tight against the pressure in the press. The high pressure may be applied either by a pump, a screw plunger or a weighted accumulator. The second portion of the specification describes an improved "clip nut" for securing the cloths on the plate round the central orifice which forms the communication between chamber and chamber.
—C. C. H.

Improvements in Apparatus for Separating Impurities or Objectionable Matter from Solids. S. Vickess, Liverpool. Eng. Pat. 8905, July 8, 1886. 1s. 1d.

For the removal of the matter separated by filtration of a liquid from the filtering body, in order that it may be re-used, the patentee describes a form of apparatus, which consists essentially of a revolving cylindrical vessel, the internal periphery of which is provided with curved or screw shaped projections; passing through the centre of the cylinder is a rotating continuous archimedian screw of opposite pitch to the projections in the cylinder. This combination serves to ensure the passage of the material through the apparatus in a contrary direction to a current of water which is intended to carry away the impurities. The washed material is delivered into one of a series of vertical receivers where some of the excess washing water drains away.—C. C. H.

Improvements in Apparatus for Filtering Liquids. S. Vickess, Liverpool. Eng. Pat. 10,370, July 8, 1886. 1s. 1d.

The improved apparatus is applicable to the treatment of large quantities of liquid such as water in a water works. It consists of an arrangement of tanks so contrived that the liquid treated is filtered by upward filtration through a bed of filtering material arranged to lie on a sloping surface. Apparatus and appliances for the removal and washing of the filtering medium are also described. The various details are shown on five sheets of drawings.
—C. C. H.

Improvements in Filtering Machines. J. A. Crocker, New York, U.S.A. Eng. Pat. 2710, Feb. 22, 1887. 8d.

The improved filtering machine consists of a cylindrical wrought-iron vessel, capable of rotation on its axis, placed horizontally, provided with a hollow inlet trunnion and a similar outlet trunnion at the opposite end. The periphery of the cylinder is provided with corrugated, curved or cylindrical strainers, through which the water must pass before passing through the filtering material, which may be of charcoal or any similar material. The current can be reversed by the revolution of the whole apparatus, the water then entering the machine by the perforated pipe and corrugated sheet by which previously it had left the apparatus after filtration, and *vice versâ.*
—C. C. H.

Improvements in Filtering Machines. J. A. Crocker, New York, U.S.A. Eng. Pat. 2711, Feb. 22, 1887. 8d.

This specification describes improvements on former similar apparatus patented by the author, and refers to that description of filter described in Eng. Pat. 2710. The reversal of the current of water in the improved machine is effected by a gravity valve, which falls and so reverses the current of water passing through the apparatus, in place of the coincidence of parts and passages in the hollow journals upon which the machine is rotated.—C. C. H.

Improvements in Decantation Apparatus for Clarifying and Purifying Water and other Liquids. J. Y. Johnson, London. From La Société G. Boone et J. Nery, Paris. Eng. Pat. 2766, Feb. 22, 1887. 8d.

This apparatus is somewhat similar to those already known as "Subsidence" apparatus, and is intended to separate solid matter from the liquid in which it is suspended without filtration. The apparatus consists of a vessel, shown in adjoining figure, divided into three portions—A, B and C. Water or other liquid to be

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* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.........	½d.
Above 8d., and not exceeding 1s. 6d...	1d.
„ 1s. 6d., „ „ 2s. 4d...	1½d.
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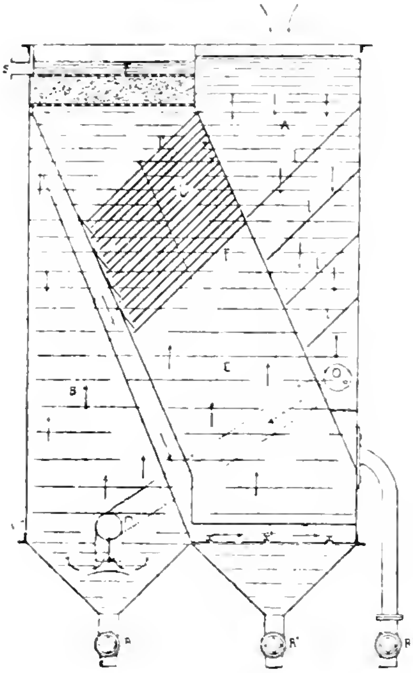
clarified enters at the upper part of A: some of the solid matter deposits on the sloping shelves *b*, down which it slides into the bottom of A, and is periodically removed through valve R. The pipe *o* conducts the liquid from A to B, where in its ascension further subsidence occurs. It finally enters at the bottom of C through the perforated pipe or pipes *x*; ascension through the sloping shelves *b''* causes more of the solid matter to be removed, as described in the case of A. R and R' serve for the periodic removal of the subsided matter. F is a filter formed of any porous material sufficiently fine to remove the last traces of the suspended matter still remaining in the liquid.—C. C. H.

FIG 1



II.—FUEL, GAS AND LIGHT.

Improvements in Means for Utilising Oils or Gases as Fuel and for Lighting Fires. W. Welch, Portsmouth. Eng. Pat. 9658, July 27, 1886. 4d.

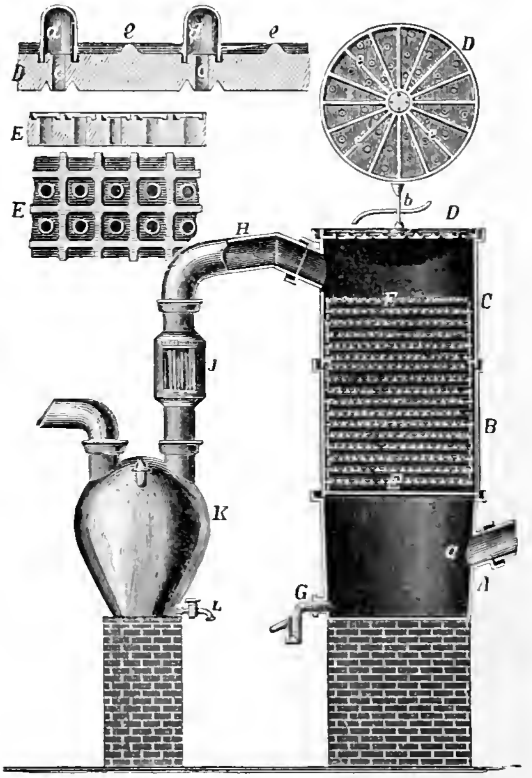
A METAL or fireproof porcelain box, small enough to pass between the bars of an ordinary grate, is employed with a pipe admitting oil or gas to its lower portion. This lower portion is packed with some porous or granular material, which is covered with a perforated fireproof lid. The oil or gas percolates through the porous medium and, burning upon the perforated surface, kindles the coal or other fuel in the grate. The supply of oil or gas is, of course, controlled by a tap.
—A. R. D.

Improvements relating to the Production of Light by the Incandescence of Refractory Materials. F. L. Rawson and W. S. Rawson, London. Eng. Pat. 11,161, Sept. 1, 1886. 8d.

THE patentees stretch the mantles upon a mandril of platinum foil and ignite them with a blow-pipe flame. By this means a great regularity of shape is secured and the mantles when brought into use may be raised to their full efficiency at once. Otherwise they require four or five hours' burning over the ordinary Bunsen flame to produce full incandescence. To diminish risk of breakage in transport the mantles are dipped in a hot liquid hydrocarbon, preferably a paraffin of high boiling point, such as ozokerit. The paraffin is soon burned away when the mantle is used. The improvements include various details concerning the suspension of the mantle and arrangement of burner and chimney.
—A. R. D.

Absorption Apparatus for the Condensation of Gases and Vapours by Liquids. Lunge and Rohrmann. Chem. Zeit. 11, 693.

THE apparatus consists of the dish A, which is the bottom of the absorbing column B, and the top D. The cooled gases enter at the bottom through *a* and thence rise into the cylinder, where they meet a descending stream of liquor, which is equally distributed over the top by the turbine *b*. Lutes *d* and holes *e* form a passage for the liquor into the interior, which consists of a large number of horizontal shelves. Raised divisions divide each shelf in a large number of squares, each of which is provided with a hole, through which the liquor flows to the lower shelf. The diagram shows the peculiar construction of the squares and holes, which has the effect of compelling a layer of liquor to stand on each square, thus exposing an immense surface to the ascending gases. The shelves are arranged in such a manner that each hole is above the junction point of four squares in the next lower shelf. The descending liquid drops on this point, is splashed about and collects on the adjoining squares, renewing its surface continually. G is the outlet pipe for the saturated liquor. The "shelf-tower," as the apparatus is termed, claims to be far more effective than the absorbing columns of the usual construction.—S. H.



An Improved Magnesium Light for Photographic Purposes. J. Gaedicke, Berlin, and A. Miethe, Potsdam, Germany. Eng. Pat. 7035, May 13, 1887. 6d.

IT is proposed that the magnesium be mixed in the state of fine powder with an oxidising agent, such as a chlorate or nitrate, and a substance such as amorphous phosphorus, which would accelerate combustion. The mixtures suggested as most suitable are—12 parts of chlorate of potash, six parts of magnesium powder and one part of prussiate of potash, or 24 parts of chlorate of potash, 12 parts of magnesium powder and one part of amorphous phosphorus. The light may be coloured by the addition of salts of suitable metals to the above mixtures. The powder burns with a flash, lasting only from $\frac{1}{30}$ to $\frac{1}{50}$ of a second, and yields a more intense light than when wire or ribbon is used; and the shortness of its duration removes the difficulty hitherto experienced of getting the proper "exposure" with the magnesium light.—A. R. D.

Regenerative Gas Lamps. F. Siemens, London. Eng. Pat. 7610, May 25, 1887. 6d.

A HORIZONTAL gas flame burns in a transparent or translucent globe. Above the flame is a perforated reflector which forms the bottom of a kind of flattened chamber connected with a casing round the base of the chimney. By suitable apertures air enters this casing and travels through the flattened chamber, whence part of it passes through the perforated reflector to the upper surface of the flame, and part finds its way by another channel into the globe space and supplies the under side. The products of combustion pass upward into a cavity above the flattened chamber, and thence through a perforated top to the chimney. It will be seen that the flattened chamber is kept hot by the flame below it, and the passage of the products of combustion above. Moreover, the air before entering here has been already heated by contact with the chimney base. The lamp is started by a small gas jet, which is lighted from the outside through one of the air apertures. This renders it unnecessary to remove the globe when lighting up, as the main jet ignites from the smaller one, which may then be extinguished.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Notes from Baku. Chem. Zeit. **11**, 476.

It has been decided to lay pipes from Baku to the Caspian Sea, for the purpose of conveying both kerosene and naphtha. There can be no doubt that as a result of this, a considerable quantity of naphtha residues, which hitherto were wasted, will be utilised.

A patent has been recently taken by G. Tergmanowski for the production of naphtha gas, which is made in a generator, identical with those used for gas-firing in metallurgical and glass works. Gas is produced from wood, turf or coal, and is employed for igniting lime in the so-called "lime furnace," and on this ignited lime, crude naphtha is poured and steam passed over it at the same time. The evolved gas is chiefly composed of hydrogen, mixed with small proportions of other combustible gases and carbonic acid. It is passed through a condenser and thence into the gasometer. After being purified by the lime process it enters if necessary the carburetter. Another portion of the gas from the generator is used for decomposing some naphtha, but without the aid of steam. The product consists chiefly of olefines, which in conjunction with that from the lime furnace gives a constant illuminating gas.—A. R.

The Baku Petroleum Industry. Chem. Zeit. **11**, 605.

A CONSIDERABLE rise in prices has been caused by the combined action of some of the more important companies interested in this industry. The Caspian and Black Sea Association (*i.e.*, the Rothschilds') has made an arrangement with most of the smaller firms according to which they are for the next five or six years to sell their distillates exclusively to this Association, and at a fixed price. At present the yield of naphtha is small, and the oil is only obtained at considerable depths (210 to 255 metres). Some firms, seeing that the Baku supply must be exhausted sooner or later, have been looking out for new naphtha districts and have already purchased land near Elisabethpol and Tiflis. The richest oil fields in the Trans-Caucasus lie between Tiflis, the province of Kakhetien, and the valley of the river Kura. Naphtha is found close to Tiflis, on the banks of the Kura, and also near Elisabethpol, about 15 kilometres from the railway. Geological investigations of the Trans-Caucasian provinces have only been carried out in a few places, and there very superficially. The country contains an abundance of valuable minerals and offers an inviting field for energetic capitalists, of whom, unfortunately, there appear to be few in Russia.—D. E. J.

Notes on the Analysis of Commercial Benzene. C. Häussermann. Chem. Zeit. **11**, 803.

It is the custom at some works to ascertain the quantity of olefines in commercial benzol by the titration of the latter with bromine. This process may easily cause mistakes, since the power of rapidly absorbing bromine depends principally upon the presence of pyridine, pyrrol and members of the thiophen group and also upon occasional olefines. So that a benzene from which these impurities have been removed by treatment with sulphuric acid may have completely lost the property of decolorising bromine water, and still contain valueless hydrocarbons. The author frequently detected as a companion of commercial toluene a hydrocarbon, or a mixture of several hydrocarbons, which was not acted upon by bromine and resisted nitrification. It was separated during the process of nitrifying toluene on the large scale, and forms a colourless liquid of sp. gr. 0·728, boiling between 119° C. and 124° C. It is not dissolved by sulphuric acid, and consists probably of a member of the paraffin group (octane?). The test with bromine is therefore only a test for the more or less complete treatment with sulphuric acid.—S. H.

Presence of Fatty Acids in Light Resin Oil. J. Lwoff. Ber. **20**, 1017—1023.

It has already been shown by Kelbe (*Ber.* **13**, 1157; and **15**, 308) that from the lower boiling fractions of resin oil, a number of acids of the general formula $C_nH_{2n}O_2$ can be extracted by means of caustic soda, amongst which are isobutyric and caproic acids. Kelbe and Warth subsequently showed that the caproic acid of resin oil was methyl-propylacetic acid. In addition to these acids the author has succeeded in extracting valeric and œnanthylic acids from the acid mixture obtained by treating light resin oil with soda.—D. B.

Pyrogenic Reactions. P. Ferko. Ber. **20**, 660—664.

The experiments were made in an iron tube 60cm. long, and 4cm. in diameter, which was heated in a Mermet's gas furnace. Washed and well-dried ethylene gas was passed through gently-boiling benzene and then through the tube until 1·5 litres of benzene were used, a process which occupied seven hours. A brownish black distillate was obtained, commencing to boil at 80°, from which the following compounds were separated by fractional distillation:—Unchanged benzene 80grms., cinnamene (styrol) 17grms., diphenyl 300grms., phenanthrene 10grms., and anthracene 15grms. The absence of naphthalene and acenaphthene is explained by the fact that in these experiments a lower temperature was used than in the case of the trials made by Berthelot.

From toluene *per se* (1·5 litres), the following products were obtained:—Benzene 150grms., toluene 180grms., cinnamene 7grms., naphthalene 40grms., diphenyl 27grms., a yellow oil, boiling at 270—280°, 10grms., phenanthrene 1·5grms., and anthracene 12grms. When toluene and ethylene are passed through the tube, the following hydrocarbons are obtained, 1·25 litres of toluene being used:—Benzene 200grms., toluene 160grms., cinnamene 10grms., naphthalene 35grms., an oil boiling between 270—280° 13grms., and anthracene 20grms.

Naphthalene alone (850grms.) yielded 470grms. of unchanged naphthalene and 130grms. of dinaphthyl. Naphthalene (900grms.) and ethylene gave 400grms. of unchanged naphthalene, 0·5grm. of acenaphthene, 1grm. of phenanthrene and 125grms. of dinaphthyl; no anthracene was formed.

Ethyl-benzene (500grms.) yielded 75grms. of benzene, 5grms. of toluene, 20grms. of unchanged ethylbenzene, 10grms. of cinnamene, 11grms. of naphthalene, 3grms. of diphenyl, 13grms. of phenanthrene and 2grms. of anthracene.

Azobenzene yielded only small quantities of benzene and diphenyl, no anthracene or chrysene being formed, although in the trials made by Claus (*Ber.* 8, 37) these hydrocarbons are said to have been isolated.—D. B.

Pentamethylbenzene. O. Jacobsen. Ber. **20**, 896—902.

THE author has prepared this compound by treating trimethylbenzene with methylchloride at 100—110° in the presence of aluminium chloride, cooling the product, pressing it and subjecting it to fractional distillation. The portion boiling between 220° and 235° was then dissolved in hot alcohol; hexamethylbenzene crystallised out on cooling, whilst the mother-liquor contained the penta-compound. The latter was purified by conversion into its sulphone and sulphamide derivatives and subsequent treatment with hydrochloric acid. *Pentamethylbenzene* $C_6H(CH_3)_5$ forms large flat prisms melting at 51·5° and boiling at 231°. It is readily soluble in alcohol. The picrate crystallises from alcohol in golden yellow prisms melting at 131°. The bromo-derivative $C_6Br(CH_3)_5$ forms nacreous rhombic leaflets melting at 163° and boiling at 292°. It dissolves readily in ether, but is only sparingly soluble in alcohol. The sodium and potassium salts of the sulphonic acid are insoluble in cold and sparingly soluble in hot water. The barium salt forms small plates sparingly soluble in hot water. The calcium salt crystallises in large nacreous scales; the silver salt in small lustrous plates. The copper salt forms thin hexagonal greenish white tablets, which are almost insoluble in water. The sulphonic chloride dissolves readily in alcohol and ether. It crystallises from the latter in large, well-defined flat prisms melting at 82°. The sulphamide forms large, flat prisms, having a vitreous lustre and melting at 186°. Pentamethylbenzenesulphone $C_6(CH_3)_5.SO_2.C_6(CH_3)_5$ crystallises from warm petroleum spirit or dilute alcohol in long, fine, colourless needles melting at 98·5°. It is readily soluble in alcohol. By the action of cold concentrated sulphuric acid on pentamethylbenzene, hexamethylbenzene and prehnitene and the sulphonic acids of the latter are obtained.—D. B.

Preparation of Primary and Secondary Xylylamines from Xylenols. P. Müller. Ber. **20** 1039—1042.

ON heating β-orthoxylenol with zinc-ammonium bromide and ammonium bromide in the proportion of 1:3:1, the following compounds are obtained:—

EXPERIMENTS—	I.	II.	III.	
Xylidine	27·5	25·5	26·0	per cent.
Dixylylamine	50·0	48·0	20·0	,,
Carbonaceous matter	4·0	4·0	17·0	,,
Unchanged Xylenol	—	16·5	30·5	,,

In experiments I. and II. the temperature was kept for 40 hours at 310—320°, whilst in experiment III. the mass was heated for 20 hours at 330—340°.

On heating α-metaxylenol under similar conditions the following results were obtained:—

	I.	II.	
α-Metaxylidine	39·0	40·0	per cent.
Di-α-metaxylylamine	19·5	12·5	,,
Carbonaceous matter	3·5	4·5	,,
Unchanged Xylenol	34·0	32·5	,,

In No. I. the temperature was kept for 40 hours at 310—320°, and in No. II. the temperature ranged from 330—340°.
—D. B.

Improvements in the Manufacture of Benzene, Anthracene, Naphthalene and other Products from Naphtha and Naphtha Residues. A. Nikiforoff, Chimka, Russia. Eng. Pat. 10,957, August 27, 1886. 6d.

THE inventor claims the production of benzene and other aromatic hydrocarbons from naphtha and naphtha residues (presumably petroleum residues) by first slowly decomposing the naphtha in cylindrical retorts at a low temperature, the object being to obtain as large a quantity as possible of hydrocarbons boiling below 200° and having a sp. gr. of about 0·800 to 0·810, and then submitting the hydrocarbons to a second distillation, by which they are transformed into hydrocarbons of the aromatic series, C_nH_{2n-6}, anthracene and naphthalene being obtained from the residue. The second distillation can be effected in cylindrical or in other shaped retorts, and it has been found that the best result is obtained by dividing the hydrocarbons for redistillation in two parts—viz., those boiling at from 0° to 140° and higher, and then to redistil them again separately. The following results are usually obtained:—About 12 per cent. of benzene and its homologues, sp. gr. 0·870, boiling at 80—135°, 0·5 per cent. of anthracene, 2 per cent. of naphthalene, 5 per cent. of coke, and a residue consisting of a mixture of different hydrocarbons, some of which can be used for the manufacture of lubricating oils.

The invention "is based on the theory of producing, firstly, easily transformable hydrocarbons with a grouping of elements capable of being transformed into a more solid group—viz., into the aromatic group. These hydrocarbons, at the pressure and temperature obtained by a second distillation of the tar boiling at from 0° to 200°, produce benzene, from which aniline oil can be prepared." Hitherto it has not been possible to produce benzene commercially from naphtha, though it has been proposed to produce it in retorts charged with coke, copper filings or platinised coke; but as each charging of the retorts, besides increasing the cost of the production, is quite impracticable, owing to the stopping-up of the retorts, such method of producing benzene has not been successful. In the second distilling process, as above described, the coke detaches itself in the retorts, which, up to the present, has not occurred in the distillation of naphtha for gas.—D. B.

Improvements in Retorts for the Destructive Distillation of Shale, Coal and other Bituminous Substances. J. Jones, Dalmeny, N.B. Eng. Pat. 11,134, Sept. 1, 1886. 8d.

IN constructing vertical retorts for the destructive distillation of coal the common practice is to set them in two rows, with their backs disposed towards each other, and the discharge mouths projecting outwards at the bottom of each retort. In retorts thus constructed hindrance to their efficient working is caused by the clinker collecting as a hard mass at the back of the retort. In the present invention the parts to which the clinker usually adheres, forming the backs of a pair of retorts, are removed, and the lower part of each pair thereof is thus constituted into a chamber common to the upper parts of the two retorts. It is stated that this mode of construction is applicable both to the setting of new retorts as well as to the alteration of existing retorts.—D. B.

IV.—COLOURING MATTERS AND DYES.

Contributions to the Knowledge of Hydroxyanthraquinone Colouring Matters. C. Liebermann and W. Wense. Ber. **20**, 862—866.

IT has been shown by Liebermann and Kostanecki that only those hydroxyanthraquinones possess tinctorial properties which contain the hydroxyl groups in the alizarin position. In order to obtain evidence in confirmation of this view a compound which is an alizarin and a quinazarin simultaneously has been prepared from hemipinic acid by condensation with quinol in the presence of concentrated sulphuric acid. The mass thus obtained crystallises in microscopic leaflets of brown-red colour melting at 225—230°, and having the constitution $C_6H_2(OCH_3)_2 < \genfrac{}{}{0pt}{}{CO}{CO} > C_6H_2(OH)_2$. It is, therefore, a *dimethyl ether of quinalizarin.* It dissolves readily in hot glacial acetic acid, less readily in hot alcohol or benzene. Alkalis dissolve it with a violet colour, whilst concentrated sulphuric acid gives a blue solution. With mordants it gives but a faint colour reaction. The acetyl compound crystallises in small needles melting at 210–211°. It is almost insoluble in cold alcohol, acetone, or petroleum spirit, but more readily soluble in hot solvent. *Quinalizarin* $C_6H_2(OH)_2 < \substack{CO \\ CO} > C_6H_2(OH)_2$ is obtained by heating its dimethyl ether with hydrochloric acid at 200° for 3—4 hours. It crystallises in long deep red needles which are more insoluble than the dimethyl ether, hot glacial acetic acid being the best solvent. Its reactions with alkalis and concentrated sulphuric acid are similar to those of the dimethyl ether; its barium and calcium salts are insoluble in water. It sublimes in dark-red needles, but exhibits no sign of fusion at 275°. On distillation with zinc dust anthracene is obtained. It possesses strong tinctorial properties resembling those of cochineal. The *tetracetyl* compound $C_{14}H_4(OC_2H_3O)_4O_2$ crystallises in needles melting at 201°.—D. B.

Trimethylanthragallol. H. Wende. Ber. **20**, 867—870.

ψ-CUMIDINE, when converted by Sandmeyer's method into duryl-cyanide (duronitrile) yielded only 15 per cent. of the theoretical quantity. The nitrile was converted by heating with HCl into durylic acid. Three parts of durylic acid, 2 parts of gallic acid and 30 parts of strong sulphuric acid were gradually heated from 70—115° during 8 hours, and then kept at 120° until a sample showed the absence of durylic acid. The sulphuric acid was removed from the melt by precipitating and washing with water, and the trimethylanthragallol was extracted first with alcohol and then finally with benzene, leaving a residue of rufigallic acid. *Trimethylanthragallol* $C_{14}H_2(CH_3)_3.O_2.(OH)_3[(CH_3)_3:(OH)_3=1:3:4:1':2':3']$ crystallises from dilute alcohol in brilliant brown needles, melting at 244°, readily soluble in alcohol and glacial acetic acid, less soluble in benzene; it dissolves in strong sulphuric acid with a red-violet, in potash with a green, and in ammonia with a violet colouration. Its absorption spectrum and dyeing properties are similar to those of anthragallol. Its triacetyl-derivative $C_{14}H_2(CH_3)_3.O_2.(OC_2H_3O)_3$ forms pale yellow rhombic tables, melting at 174°. When distilled over zinc-dust trimethylanthragallol yields a solid hydrocarbon, melting at 236° —probably the trimethylanthracene of Gresly—and an oily substance which the author considers to be a hydride of trimethylanthracene.—T. L. B.

Dimethylanthragallol. W. Birukoff. Ber. **20**, 870—873.

WHEN gallic acid (3 parts) is condensed with metaxylic acid (5 parts) by means of sulphuric acid (40 parts) *dimethylanthragallol* $C_{14}H_3(CH_3)_2O_2(OH)_3[(CH_3)_2:(OH)_3=1:2:1':2':3']$ is obtained. After heating the above mixture for 20 hours at 70—120°, the melt is poured into water and the sulphuric acid washed away. The precipitate is extracted with absolute alcohol, which leaves undissolved the rufigallic acid formed. The alcohol is evaporated, and the dimethylanthragallol is extracted by benzene from the residue. The yield is only about 2 per cent. on the xylic acid used. This body crystallises in yellowish-red needles, and is similar in its absorption-spectrum and behaviour with alkalis to anthragallol. On distilling over zinc-dust, it yields a solid hydrocarbon, probably a dimethylanthracene, melting at 220—226°, the quinone obtained from this melting at about 112°. The isomeric compounds obtained by Gresly melted at 202° and 180° respectively. The author recommends the following methods for obtaining the metaxylic acid. Pure metaxylidine is prepared from commercial xylidine by Limbach's method:—4 parts of xylidine are mixed with 1 part of glacial acetic acid, and allowed to stand for 24 hours; the crystals of the acetate of metaxylidine are then pressed free from the paraxylidine, which remains in solution, basified, dried and distilled. The meta-compound is converted by Sandmeyer's method into the nitrile. 12grms. of this product are dissolved in 8grms. of water and 20grms. of HCl, and 7grms. of sodium nitrite dissolved in 20grms. of water slowly added. This diazo-solution is poured in a thin stream into the copper cyanide solution warmed to 90°. The yield of cyanide of metaxylene (metaxylonitrile) is 50—60 per cent. of the theoretical. By gently warming the nitrile with about 85 per cent. sulphuric acid, it is converted into the amido-acid, and this, by heating for two hours at 170° with HCl, yields about 60 per cent. of metaxylic acid.—T. L. B.

Opiaurin. C. Liebermann and P. Seidler. Ber. **20**, 873—874.

OPIANIC ACID and phenol, when heated together with strong sulphuric acid, give rise to an intense yellow-red dye. The reaction takes place between the aldehyde-group of the acid and the phenol:—$C_6H_2(OCH_3)_2(CO_2H)(COH) + 2C_6H_5.OH = H_2O + C_6H_2(OCH_3)_2.(CO_2H).CH:(C_6H_4OH)_2$. This compound *leucopiaurin* is oxidised during the process to opiaurin $C_{22}H_{18}O_6$. The best results were obtained by stirring an intimate mixture of opianic acid and phenol into sulphuric acid (60° Bé.) and keeping the mixture well cooled. After 24 hours' rest the melt was thrown into a large quantity of cold water, and the precipitate when washed and dried, freed from tarry matters by extraction with hot benzene. Opiaurin is soluble in alcohol, ether and glacial acetic acid, insoluble in benzene and petroleum ether. It could only be obtained in amorphous condition. It dissolves in alkalis with a purple colour; the solution in alcoholic ammonia becomes on heating brownish-yellow, but the purple colour returns on cooling.

Sulphurous acid does not reduce it. Opianic acid reacts in a similar way with other phenols, and the reaction can be used to detect the presence of opianic acid, as also of an aldehyde-group in aromatic compounds; the reagents being each dissolved in an excess of cold sulphuric acid, on mixing the solutions the coloration takes place at once.—T. L. B.

Preparation of β-Nitronaphthalene. E. Lellmann. Ber. **20**, 891—893.

THE following is a modification of the method originally employed for the preparation of this compound. The mixture of *o*- and *p*-nitroacetonaphthalide is obtained as in the old process, the product is then boiled with a 14 per cent. solution of caustic potash in the presence of alcohol and the resultant mass consisting of the *o*-aceto-compound and *p*-nitronaphthalene is treated with ethyl-nitrite. A brown precipitate is obtained which was found to contain the diazoamido-derivative of *p*-nitronaphthylamine. This is filtered off as quickly as possible so that the *o*-nitroacetonaphthalide crystallises out in the filtrate. It is purified by recrystallisation and filtration through animal charcoal and is decomposed by the addition of an alcoholic solution of hydrochloric acid. The *o*-nitronaphthylamine thus obtained forms small red needles melting at 143° and is suitable for the preparation of β-nitronaphthalene.—D. B.

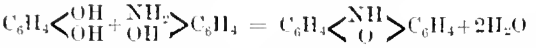
An Universal Reaction of Diazo-amido Bodies. K. Heumann and L. Oeconomides. Ber. **20**, 904—909.

THIS reaction takes place when diazo-amido bodies are brought in contact with phenols, one of their basic constituents being regenerated, the phenol taking its place and forming oxyazo compounds. Thus on heating gently diazoamidobenzene with resorcinol, aniline is regenerated and benzeneazoresorcinol, melting at 161°, formed: $C_6H_5N=N.NH.C_6H_5 + C_6H_4(OH)_2 = C_6H_5.NH_2 + C_6H_5.N=N.C_6H_3(OH)_2$. Diazo-amidoparatoluene treated with phenol yields paratoluidine and paratolueneazophenol $C_7H_7N=N.C_6H_4OH$; with resorcinol, the same base and paratolueneazoresorcinol $C_7H_7N=NC_6H_3(OH)_2$, which forms yellowish-red needles melting at 184°. A monochloro-oxyazobenzene was obtained by acting on diazoamidoparachlorobenzene with phenol; it forms red-yellow needles melting at 151—152°. In a similar manner, diazoamidometabenzoic acid is converted into benzoic-acid-azophenol melting at 220°. The author found that the diazo-amido bodies obtained by diazotising aniline and combining with paratoluidine, or *vice versâ*, and considered to be identical, give rise with phenol, to mixed oxyazo bodies, a mixture of about equal parts of aniline and paratoluidine being regenerated. Diazoamidoparachlorobenzene-benzene, obtained by diazotising parachloraniline and combining with aniline, yielded parachloraniline and oxyazobenzene. This reaction can be readily illustrated in a lecture experiment, by warming some diazoamidobenzene with a little phenol in a test tube for a few moments, when on the addition of caustic soda solution the oxyazo body formed will dissolve, and can be thrown down on the addition of an acid.

—T. L. B.

A New Chromogenic Body—Phenazoxin. A. Bernthsen. Ber. 20, 942—944.

RIS has shown that phenazine may be obtained by the action of *o*-phenylenediamine upon catechol. By the action of *o*-amidophenol upon catechol, phenazoxin may be prepared, thus:—



$$C_6H_4\left\langle{}^{OH}_{OH}\right. + {}^{NH_2}_{OH}\!\left.\right\rangle C_6H_4 = C_6H_4\left\langle{}^{NH}_{O}\right\rangle C_6H_4 + 2H_2O$$

Equal weights of *o*-amidophenol and catechol are heated in closed tubes for 40 hours to 260—280°. The product is extracted repeatedly with water and caustic soda solution, and the residue with ether. The ethereal solution on distillation leaves a solid brownish residue which, on recrystallisation from alcohol, yields a colourless crystalline product. The analysis corresponds to the formula $C_{12}H_9NO$. Phenazoxin may be readily nitrated, and the nitro product on reduction with Sn and HCl, and subsequent oxidation with Fe_2Cl_6 gives a red-violet colouring matter. This reaction corresponds to the formation of Lauth's violet from thio-diphenylamine, and confirms the chromogenic character of phenazoxin.

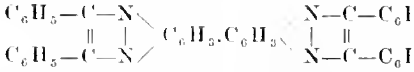
—J. B. C.

m-(αβ¹)-Naphthylene Diamine. C. Urban. Ber. 20, 973—974.

LIEBERMANN and Hammerschlag prepared a dinitronaphthylamine with the amido and nitro-groups in one nucleus, the former and one of the nitro-groups in the α, the other being in the β position. Worms showed that the latter group occupies an adjacent position to the amido-group, and the compound has, therefore, the formula—$C_{10}H_5.NH_2(NO_2)_2.[NH_2 : NO_2 : NO_2 — 1 : 2 : 4.]$ By eliminating the amido-group a dinitronaphthalene should be obtained with the nitro-group in the meta-position. On reducing the dinitro-compound, a meta-diamido compound is obtained, which yields with nitrous acid the deep yellow colour characteristic of meta-diamines, and further a precipitate of the corresponding chrysoidine with diazo-benzene sulphonic acid.—J. B. C.

Some Derivatives of Benzidene. P. Brunner and Otto N. Witt. Ber. 20, 1023—1030.

THE authors recommend the following method for obtaining the orthodinitrobenzidine of Strakosch: 10grms. of diacetylbenzidine are stirred into 100grms. of nitric acid (sp. gr. 1·48) kept cool with ice, and then ice and water added until the dinitrodiacetylbenzidine is precipitated. From this body the acetyl groups are readily removed by warming with 1½ parts of caustic potash and a little alcohol, the dinitrobenzidine precipitating in the form of fine red needles. It is insoluble in water, soluble with difficulty in alcohol, more readily soluble in phenol. When it is ground up with the proper quantity of stannous chloride, HCl added, and the mixture warmed on the water-bath until all dissolves in water, it is reduced to a *tetramidodiphenyl*: $C_{12}H_6(NH_2)_4$. The hydrochloride of this base forms needles containing $2H_2O$, readily soluble in water, less soluble in HCl. The basic sulphate $C_{12}H_6(NH_2)_4H_2SO_4$ is very slightly soluble in cold water, alcohol and ether, soluble in hot water. The base precipitates on the addition of ammonia to a solution of the hydrochloride, forming small silvery plates soluble in hot water, but which decomposed so readily that they could not be analysed. The dry hydrochloride gives Ladenburg's reaction with benzaldehyde; with sodium nitrite, a crystallised azimido compound is formed. The platinum double salt forms needles which quickly decompose. Ferrous chloride gives a brown colour reaction. Tetramidodiphenyl condenses with phenanthrenequinone, forming a brownish-yellow azine, subliming in yellow needles, which dissolve in H_2SO_4 with a violet colour. With isatine a yellow-orange, and with β-naphthoquinone a brown gelatinous compound is formed. On mixing glacial acetic acid solutions of this base and benzil together, a pale yellow azine $C_{10}H_{26}N_4$ precipitates. It does not melt at 270° and decomposes when heated higher. It is very soluble in phenol. Its sulphate forms lemon yellow needles, dissolving in strong H_2SO_4 with a fine magenta colour. Its constitution is probably as follows:



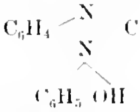
From the properties of the above tetramidodiphenyl it is evident that the four amido groups are arranged in two pairs, in each of which the groups are in ortho-position to each other. It follows that in Strakosch's dinitrobenzidine the NO_2 and NH_2 groups are similarly placed. The authors succeeded in removing the two benzidine NH_2 groups by diazotising, and subsequent removal of the diazo-groups by boiling alcohol, obtaining thus a new body, the symmetrical *metadinitrodiphenyl* $C_{12}H_8(NO_2)_2$. This is a yellow-orange substance forming fine dichroic needles from alcohol or acetic acid; it is soluble in benzene or cumene. It melts at 197—198°. It is reduced by tin and HCl to the symmetrical *metadiamidodiphenyl* $C_{12}H_8(NH_2)_2$. The hydrochloride of this base is readily soluble. The sulphate $C_{12}H_{12}N_2.H_2SO_4$ is slightly soluble in cold water, forming long needles from hot water; the platinum double salt $C_{12}H_{12}N_2(HCl)_2PtCl_4$ forms straw-yellow grains. Alkalis precipitate the free base from solutions of its salts as an oil which solidifies after a few days' rest. An isomer of Congo-red is obtained by combining the diazo compound with sodium naphthionate; it forms small yellow-orange plates. This substance dyes cotton in a soap-bath a fast orange without a mordant, but the affinity for the cellulose is much less intense than in the case of the benzidine azo-compounds; the cause of this affinity is therefore apparently connected not only with the diphenyl nucleus, but also with the position which the two azo groups bear to each other.—T. L. B.

β-Naphthoicaldehyde. E. Bamberger and O. Boekmann. Ber. 20, 1115—1119.

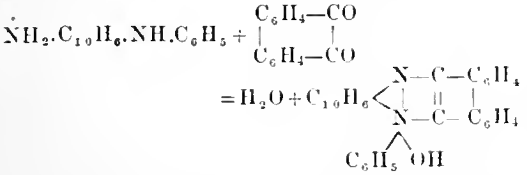
IN preparing this aldehyde, the authors obtained a series of new derivatives of naphthalene. For the production of *β-naphthoicthiamide* $C_{10}H_7.CSNH_2$, β-naphthylnitrile $C_{10}H_7.CN$, obtained from β-diazonaphthalene chloride by means of potassium cuprosocyanide, was digested with ammonium sulphide in a closed vessel at 35—40° for several days. It forms golden-yellow silky needles melting at 149°, and readily soluble in alcohol, ether and benzene. *β-naphthylmethylamine* $C_{10}H_7CH_2.NH_2$ is obtained by reducing an alcoholic solution of the thiamide with zinc dust and alcoholic solution of hydrochloric acid. It crystallises in colourless lustrous prisms melting at 59—60°, and absorbs carbonic anhydride freely on exposure to the air. It is sparingly soluble in cold water, more readily soluble in hot water and easily soluble in alcohol and ether. It is a powerful base. The hydrochloride crystallises in flat, satin like prisms melting at 260—270°. The picrate forms gold-coloured lustrous needles soluble in hot water, and the platinochloride crystallises from hot water in fine dendritic needles. *β-naphthylmethylalcohol* $C_{10}H_7.CH_2.OH$ is obtained by treating naphthylmethylamine hydrochloride with sodium nitrite. It crystallises in small lustrous plates, melting at 80—80·5°, and is readily soluble in alcohol and ether. On oxidation, it yields *β-naphthoicaldehyde* $C_{10}H_7CHO$, which forms small silver-white plates melting at 60·5—61°. This compound reduces an ammoniacal solution of silver and forms a leuco-base with dimethylaniline and zinc chloride, which yields a dye resembling benzaldehyde green in properties.—D. B.

On Azonium Bases. Otto N. Witt. Ber. **20**, 1183—1186.

THE formula recently proposed by the author for safranine is based upon the hypothetical base, which he terms *hydroxyphenylphenazonium*—



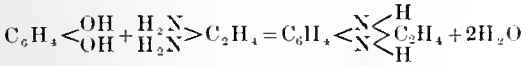
(This Journal, 1887, 285). All attempts to obtain this substance by removal of the amido-groups of phenosafranine, however, failed. The ease with which most orthodiketones react with orthodiamines, rendered it probable that phenyl-derivatives of the latter bases would behave in a similar way, in which case the desired azonium bases would be obtained. Experiment has proved the correctness of this idea, phenylorthonaphthylenediamine reacting with phenanthrenequinone as follows :—



The phenylnaphthylenediamine was obtained by reducing 10 parts of the perfectly pure azo-compound of sulphanilic acid and β-naphthylphenylamine, dissolved in 10 parts of glacial acetic acid and 100 parts of alcohol, with 12 parts of stannous chloride dissolved in 20 parts of acetic acid, and gradual addition of HCl till the solution is colourless. Its hydrochloride forms white needles insoluble in water, soluble in alcohol. The free base crystallises in glass-clear, flat prisms, melting at 136—137°. When equal quantities of this base and phenanthrenequinone dissolved in acetic acid, are mixed together, intermediate yellow fluorescent bodies are at first formed, an addition of a mineral acid causing the formation of the azonium base. The solution is diluted with alcohol and a good excess of nitric acid (sp. gr. 1·3) added, when the nitrate of the new base $C_{30}H_{19}N_3O_3$ slowly crystallises out in the form of long needles or thick prisms, with strong red and green dichroism. This salt is scarcely soluble in water, more so in alcohol, dyeing wool and silk a salmon red and behaving like a true dye. The other salts are much more soluble than the nitrate, and dissolve with a splendid blue colouration in strong sulphuric acid. The basic qualities are more strongly marked than in the case of the azines, the above salts only being basified by boiling with an excess of alkali.—T. L. B.

Action of Ethylenediamine on Catechol. V. Merz and C. Ris. Ber. **20**, 1190—1197.

WHEN ethylenediamine is allowed to act on catechol at 200—210°, the following reaction takes place :—



$$C_6H_4<\begin{matrix}OH\\OH\end{matrix}+\begin{matrix}H_2N\\H_2N\end{matrix}>C_2H_4=C_6H_4<\begin{matrix}N\\N\end{matrix}\begin{matrix}H\\C_2H_4\\H\end{matrix}+2H_2O$$

Ethylenеorthophenylenediamine crystallises from hot water or ether in small colourless lustrous plates, melting at 96·5—97° and boiling at 288·5—289·5°. It is sparingly soluble in cold, more readily soluble in hot water, and forms crystallisable salts with acids. Dilute aqueous solutions of the base give a blue coloration with ferric chloride and oxidising agents. It is converted into quinoxaline on treatment with an alkaline solution of potassium ferricyanide.—D. B.

A New Method for the Production of Picrocarmine. L. Gedölst. Le Monit du Practic. 1887, 91.

A PICROCARMINE of good colour, which filters well and may be boiled without decomposition, is made by substituting caustic soda for ammonia in its preparation. 95cc. of distilled water are added to 5cc. of a 1 per cent. NaOH solution, and in this mixture is dissolved 0·45grm. of the best carmine in the state of fine powder; the solution is stirred with a glass rod and boiled for 10 to 15 minutes, cooled, filtered and made up to 100cc. with water. It is next diluted in a 300cc. graduated glass cylinder with 100cc. of water, and is ready for the addition of a 1 per cent. acid solution, of which 20 to 25cc. should suffice. 15cc. of the picric solution is added first, producing a cloudiness which disappears on stirring; a further 5cc. still produces a transient turbidity, but with a final addition of 5 or at most 7cc. the precipitate becomes permanent and indicates the end of the reaction. After an hour's subsidence, the solution is passed twice or thrice through the same filter until clear, and concentrated by evaporation with, if necessary, a final filtration. The sodium picrocarminate is said to possess distinct advantages over the ammonium compound, and is recommended for microscopical work.—W. G. M.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Method of Preparing Fibres capable of being spun from Wood. Alex. Mitscherlich, Freiburg, Germany. Eng. Pat. 10,545, Aug. 17, 1886.

BOARDS, as free from knots as possible, of any desired width, and about $\frac{3}{8}$ of an inch thick, are cut in a direction parallel with the fibre, preferably from pine or fir-wood or from the softer part of larch, and are boiled in a solution of sulphurous acid or a bisulphite whereby the disintegration of the wood is effected. No chopping is required, and before boiling the wood is steamed at 212° F. for a long time. After boiling, the mass is partly dried on a wooden frame and then passed through rollers having "deep ribs" in the direction of their length, the projections on one roller fitting in the corrugations of the other, whereby the fibres will be separated from each other and may be combed in an apparatus similar to that for combing flax, etc.—H. A. R.

VI.—DYEING, CALICO PRINTING, PAPER STAINING AND BLEACHING.

On Turkey-red Oils. R. Benedikt and F. Ulzer. Monatsh. Chem. **8**, 208.

THE product obtained by the action of concentrated sulphuric acid on triolein consists of two portions, one of which is soluble, whereas the other is insoluble in water. The latter is chiefly oxystearic acid and its anhydride, sometimes accompanied by oleic acid and unchanged triolein, while the soluble portion splits up under suitable conditions in oxystearic and sulphuric acids. The opinions on the nature of this soluble portion are divided. Liechti and Suida believe it to be a mixture of oxystearic acid and oxyoleic acid-glycerol sulphonic ether, which opinion is not shared by Müller-Jacobs and the authors. Müller-Jacobs and Tsabenejew take the soluble oil to be sulphonic acids, either sulpho-oleic or sulpho-oxystearic acid. The authors produced the sulphonic acid of a higher homologue by heating oleic acid with sulphur at 200—220° C. and oxidising the sulpho-oleic acid, $C_{18}H_{32}SO_2$, thus obtained with potassium permanganate. The object of this proceeding was to see whether compounds similar to the soluble Turkey-red oils, but belonging to a higher series, had similar properties. This is, indeed, the case. They are attacked by boiling concentrated caustic solutions, but differ from the acids derived from the Turkey-red oils by not being decomposed by hydrochloric acid. This behaviour seems to point to the fact that the acid from Turkey-red oil is no real sulphonic acid, but rather a sulphonic acid ether. The authors compared the Turkey-red oils from olive oil, which chiefly consists of triolein, cotton-seed oil and castor oil, and explain the difference in the behaviour of the olive and castor oil by the different constitution of oleic and ricinoleic acid. The latter, being an oxyacid, combines with sulphuric acid to an ether sulphonic acid, $C_{18}H_{33}O_2.O.SO_3H$, which, on decomposition, must yield ricinoleic acid and sulphuric acid, whereas the oleic acid combines with sulphuric acid to oxystearinsulphonic acid. The Turkey red oil from castor oil, therefore contains the acid sulphonic acid ether of an unsaturated acid, while the Turkey-red oil from olive oil contains the corresponding derivative of a saturated acid. The Turkey-red oil from castor oil therefore possesses a high oxidising power, which is not the case with the derivative of olive oil. The former is consequently the far better mordant for Turkey-red dyeing.—S. H.

Process for the Production of Alumina compounds applicable for Bleaching. R. Weiss, Oranienburg, Russia. Eng. Pat. 6573, May 15, 1886. 6d.

HYPOCHLORITE of alumina has long since been employed in bleaching, under the name of "Wilson's bleaching liquid," and has been preferred on the grounds that "it accelerates the bleaching process and deteriorates the fibres of the tissue much less than the chloride of lime." Up to the present, the usual method of manufacture has been by double decomposition of alumina sulphate and chloride of lime. "Experiments have proved that similar, but still more energetic bleaching compounds of alumina, are produced by the direct action of chlorine on aluminates, and especially on aluminates of sodium or calcium and of magnesium, whereby the use of chloride of lime is entirely obviated. These bleaching alumina compounds may be prepared either in the form of a solution, or in a solid form." Chlorine is passed through a solution of the aluminate or over the solid substance, till no more is absorbed. The inventor claims that the alumina compounds prepared in the manner he describes, act as very rapid bleachers "in consequence of the delivery of ozonised oxygen." "The use of acid baths is also dispensed with ; also these alumina compounds deteriorate the fibres much less than chloride of lime."—H. A. R.

Improvements in Dyeing Wool or other Animal Fibres, in either the raw or manufactured state. F. A. Gatty, Accrington. Eng. Pat. 9286, July 17, 1886. 6d.

IN carrying out the process of mordanting according to this method, the patentee instead of boiling the wool, alkaline chromate and acid together, as is usual, steeps the goods in the bichromate or chromate (of potash or soda) and the acid, preferably sulphuric, at the ordinary temperature of the air, and then after working for some time in this bath, washes and subjects to the action of boiling water or steam. Chromium oxide is thus fixed on the fibre, which is then ready for the usual dyeing operations. Before mordanting, the wool is well prepared and freed from all oily and similar impurity.—H. A. R.

Improvements in Dyeing Textile Fibres. T. Holliday, Huddersfield. Eng. Pat. 10,542, Aug. 17, 1886. 6d.

THE inventor dyes wool and other textile fibres various shades of colour by alternately treating the fibre with "chrome iron," copper or lead salts, and the nitroso-compounds of α and β-naphthol. "The quantities of wool or other fibre and the nature of the metallic salt, acid and nitroso-compound are varied according to the result required and the shades of colour varied by using logwood or alizarin along with or alternately with the nitroso-compounds. The fibres can be dyed either in a raw, spun, woven, felted or otherwise partly manufactured state."—H. A. R.

A New or Improved Method of Dyeing and Finishing Textile Fabrics without Immersion. W. E. Heys, Manchester. From H. Danzer, A. Simian and De Marcien, Paris, France. Eng. Pat. 11,161, Sept. 2, 1886. 8d.

THE solution of the dye is applied to the surface of the fabric in the form of a fine spray and the colour fixed by a jet or jets of steam playing upon the opposite side of the piece ; the finishing, dressing, etc., being also carried out in the same apparatus.—H. A. R.

Improvements in Dyeing. H. J. Haddan, London. From A. Henry, Bar-le-Duc. Eng. Pat. 11,730, Sept. 15, 1886.

THE claim is for the dyeing of cotton and other textiles a fast black by passing the goods rapidly and in small quantities through a bath of two solutions as follows :—The first solution consists of chlorate of potash, sulphate of copper, "chlorhydrate of ammonia," nitrate of iron and water ; the second solution consists of aniline, toluidine, etc., hydrochloric and tartaric acids ; the solutions are mixed just before use. The goods are then dried in a current of air for a short time at 35° C., and for about 12 hours at 30° C. without exposure to light. Afterwards the goods are passed through a bath of potassium bichromate, sulphuric acid and water, stretched and frequently turned in a dark place for about two hours, finally washed and dried.—H. A. R.

Improvements in the Manufacture of Oil for Turkey-red Dyeing, Calico Printing, and such like purposes. J. Kirkpatrick, Glasgow. Eng. Pat. 12,216, Sept. 25, 1886. 4d.

TEN gallons of olive oil are treated with 15 gals. of sulphuric acid at 168° B., washed with hot water and neutralised with 3 gals. of caustic soda at 68° B. and 1 gal. of ammonium hydrate 0·9 sp. gr.—W. L. C.

An Improved Process and Apparatus for Dyeing Unspun Textile Fibres. G. Jagenburg, Rydboholm, Sweden. Eng. Pat. 443, Jan. 11, 1887. 8d.

THE dye in the form of a concentrated solution is injected into the water contained in the vat and in which the goods are continually agitated. It is claimed that by this means the dyeing is even and without prejudice to the strength of the fibre, also that cotton dyed in this way remains soft and as fit for spinning as ordinary raw cotton, whereby it will be possible for spinners to spin dyed yarn up to the finest counts according to the quality of the cotton employed.—H. A. R.

An Improved Process of Preparing Indigo Solutions for Dyeing Purposes. F. E. Schmückert, Pritzwalk, Prussia. Eng. Pat. 7333, May 19, 1887. 4d.

THE inventor produces indigo solutions for dyeing purposes, especially for wool dyeing, by dissolving the indigo in water by means of Peruvian guano and the like ; also by adding bodies which absorb oxygen, such as zinc powder (at 65° to 75° C.), proposes to regulate automatically the process so that any supervision may become superfluous. It is claimed that such additions will obviate the defective treatment and consequent loss of indigo which frequently occurs in the preparation of the bath.—H. A. R.

VII.—ACIDS, ALKALIS AND SALTS.

Ammonio-zinc Chlorides. H. Thoms. Ber. **20**, 743—744.

IN addition to the compound of the formula $ZnCl_2.NH_3$, described by Berzelius, a compound of the formula $ZnCl_2.5NH_3 + H_2O$ has been recently observed. The author finds that if ammonia be passed into a hot concentrated solution of zinc chloride until the precipitate first formed is redissolved, nacreous scales separate on cooling, which have the composition $ZnCl_2.4NH_3 + H_2O$. On concentrating the mother-liquor, colourless rhombic crystals of the formula $ZnCl_2.2NH_3$ are obtained, which do not change on exposure to air, and are insoluble in water. When, however, boiled with water, decomposition takes place with evolution of ammonia and formation of zinc oxychloride. This compound is easily soluble in solutions of ammonium chloride or ammonia.

Well-formed crystals of the same compound have also been found in Leclanché cells (this Journal, 1887, 515), the following equations illustrating the formation:—

$$\begin{cases} ZnO + 2NH_4Cl = ZnCl_2 + 2NH_3 + H_2O \\ ZnCl_2 + 2NH_3 = ZnCl_2.2NH_3 \end{cases}$$

The author considers the constitution of this compound to be expressed by the formula $NH_3Cl\ Zn.NH_3Cl$.
—D. B.

The Borate Industry in Chili. Dr. L. Darapsky. Chem. Zeit. **11**, 605—607.

In a lengthy paper the author gives an account of this industry, and discusses the probabilities of its future development. Boric acid occurs on the west coast of South America, principally in the form of boronatrocalcite and is found throughout the province of Atacama and the newly-acquired portions of Chili. Ascotan—which is now on the borders of the republic, but formerly belonged to Bolivia—and Maricunga, which is to the north of Copeapó, are the places which have proved most successful commercially. The crude material occurs in both places in lagoons or troughs; these, instead of being entirely filled with common salt—as is usually the case in the desert—contain zones or layers of boronatrocalcite imbedded in it. The lagoons of Maricunga lie about 64km. from the nearest railway station, and are estimated to cover 3,000,000 sq. metres. The boronatrocalcite occurs in beds alternating with layers of salt and salty earth. The author gives a large number of analyses of the raw material, from which it would appear that the average amount of boric acid contained in it is about 25 per cent., but the percentage varies very much in different samples, and can be considerably increased by proper treatment; in one case quoted it was raised to 60·52 per cent. by washing and calcination (Kröhnke).

The raw material contains, in the form of gypsum and glauberite, a large amount of calcium sulphate, which apparently cannot be removed either by washing or mechanical treatment. Instead of investigating some method of working up the crude material into a better state for the market, the promoters of the industry appear to have turned their attention to the manufacture of crystallised borax. This was a fundamental mistake, for about half the weight of borax consists of water, and in the purest state it only contains 36·64 per cent. of boric acid; transport is therefore as costly as that of the raw material, the percentage of which can be raised to 30 simply by careful selection, and to 50 or 60 by dehydration. As there are no large chemical works in the country, the soda and acids required in making the borax had to be imported or specially made; and experience has shown that the conversion of boronatrocalcite into crystallised borax offers difficulties even when the requisite materials are easily obtained. The works at the Copeapó harbour, belonging to the Maricunga Co., were erected without sufficient knowledge and foresight, and never yielded satisfactory results. After a while the boronatrocalcite (roughly purified) was shipped direct to England and Germany, and finally all operations were suspended.—D. E. J.

The Borate Industry in Chili. L. Darapsky, Santiago, Chili. Chem. Zeit. **11**, 675.

The following analysis may be taken as representing the general average percentage composition of the mineral:—$H_2O = 29·0$; Al_2O_3 and $Fe_2O_3 = 0·7$; $Cl = 12·6$; $SO_4H_2 = 0·7$; $MgO = 0·5$; $CaO = 12·5$; $Na_2O = 14·8$; $B_2O_3 = 26·4$; insoluble matter $= 5·7$. The mineral is purified to some extent before it is shipped for export. This purification consists of a preliminary washing and drying operation, after which it may be considered to test as follows:—$H_2O = 11·76$; Al_2O_3 and $Fe_2O_3 = 3·08$; $Cl = 0·70$; $SO_4H_2 = 0·49$; $CaO = 12·48$; $Na_2O = 9·12$; $B_2O_3 = 55·20$; insoluble matter $= 7·31$ per cent. If the amount of the foreign impurities is not large, the percentage of boracic acid in the crude mineral may be estimated in a very simple manner. The sample is dissolved in hydrochloric acid and filtered, the sulphuric acid being estimated in one portion and the lime in another portion of the filtrate. The amount of lime which is equivalent to the sulphuric acid is subtracted from the total amount of lime, and the rest, multiplied by 3·1, gives the percentage of boracic acid.
—S. H.

On a New Class of Ferro- and Ferricyanides. J. A. Müller. Compt. Rend. **104**, 992—995.

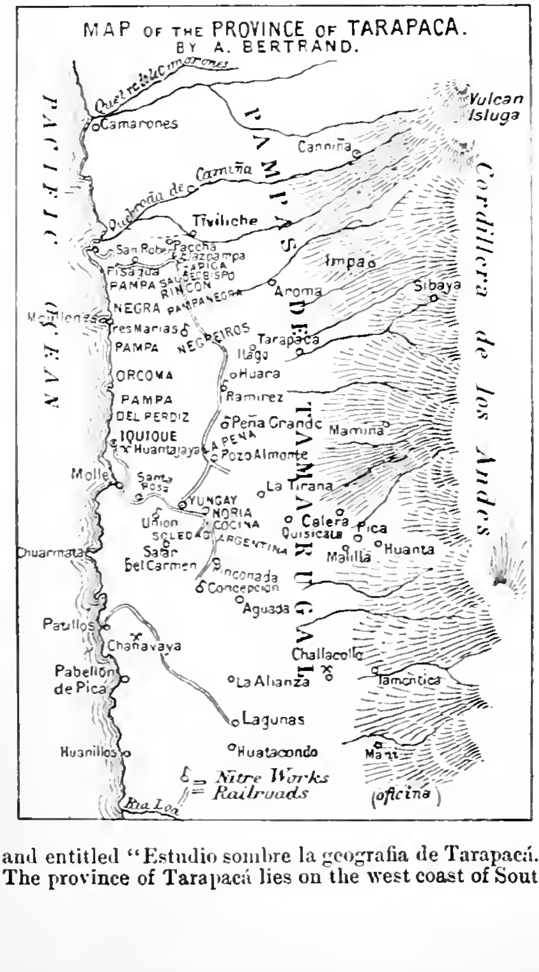
In the chemical works at Croix, where Ortlieb and Müller's process for obtaining cyanides is carried on, Ortlieb obtained a solution giving a violet precipitate, by fractional precipitation of the mother-liquor of the ferrocyanide with ferric chloride. By treatment of this precipitate with potassium carbonate and a subsequent process of purification, the potassium salt of the new substance was obtained in thin scales or plates very soluble in water. The solution is coloured violet by ferric chloride, and a precipitate settles out after one or two days.

The analysis of the new ferrocyanide corresponds to the formula $K_3FeC_6N_5O + 3\frac{1}{2}H_2O$. The water volatilises at 110°. Heated in a closed vessel to 300—400°, the substance loses 9·05% of its weight and yields 8·33% of CO. The formula $K_3FeCO(CN)_5$ requires 8·47%. In this decomposition ordinary ferrocyanide and cyanide of iron are formed amongst other compounds. The formula $K_3FeCO(CN)_5$ becomes explainable by the assumption of a trivalent radicle, carbonylferrocyanogen $[FeCO(CN)_5]'''$.

To the above is appended a note by C. Friedel, who finds in the existence of the substance $K_3FeCO(CN)_5$ a support to his proposed formula for the ferrocyanides.
—G. H. B.

The Nitre Deposit in Tarapacá. L. Darapsky, Santiago, Chili. Chem. Zeit. **11**, 752.

The report is an abstract of a book lately published by Mr. W. E. Billinghurst, himself a nitre manufacturer, and entitled "Estudio sombre la geografia de Tarapacá." The province of Tarapacá lies on the west coast of South



MAP OF THE PROVINCE OF TARAPACA.
BY A. BERTRAND.

America, between 68° 15' and 70° 18' long. and 19° 12' and 21° 28' 30" lat. The nitre deposits do not only occur in the province of Tarapacá, but also further south, especially near Antofagasta and Taltal. From east to west the province may be divided in five zones. The first reaches from the sea coast for a width of 74 miles, and yields guano. It also contains many silver mines, among which is the famous mine of Huantajaya. The second zone is the nitre zone. It occurs at an altitude of 3600ft., and goes down to the Pampa de Tamarugal. The third zone is the pampa, devoid of water and vegetation. The fourth, between the Pampa de Tamarugal and the Cordillera de los Andes, contains silver and copper mines, whereas the fifth, the Cordillera, is scarcely explored yet. The natives are said to collect sulphur here. The author then proceeds to the valuation of the total quantity of nitre which may be expected from the second zone, and states his conclusions in the following table :—

Group.	Number of Estacas.	Exhausted Estacas.	Untouched Estacas.	Average Yield of Nitre per Estaca in Spanish cwts.	Total Quantity of Nitre in Spanish cwts.
North	5,611·50	1,208·62	1,402·87	145,958·71	204,750,878·38
Pampa de Huara	1,000·00	—	1,000·00		145,958,710·00
Midland	5,150·50	3,433·66	1,716·83		250,611,105·07
South	9,450·00	—	9,450·00		1,379,309,809·50
	21,212·00	7,642·28	13,569·70		1,980,630,502·95

* 1 Estaca = 40,000 Square Varas = 27,949·55 Square Metres.

The State receives an export duty of 27968d. per Spanish cwt., which is equivalent to the sum £230,809,474 for the total 1980 millions spanish cwts.—S. H.

Two New Hydrates of Caustic Potash. C. Göttig. Ber. **20**, 1094—1096.

ONE hydrate of potash $KHO+2H_2O$ is already known. The author has prepared two new hydrates :—

1. From a concentrated solution of caustic potash in strong alcohol, prismatic crystals of the formula $2KOH+9H_2O$ separate out. These crystals lose 3 molecules of water over sulphuric acid.

2. If a moderately concentrated solution of potash in strong alcohol be evaporated down until the temperature of the boiling liquid rises to 110°, and then allowed to cool, the new hydrate crystallises out in a mass of fine needles of the formula $2KHO+5H_2O$.—J. B. C.

On Antimony Pentachloride. R. Anschütz and N. P. Evans. Annalen, 1887, 285.

IF a solution of antimony pentachloride in chloroform be treated with the equivalent quantity of water, crystals, of antimony pentachloride monohydrate $SbCl_5.H_2O$ are formed, which melt between 87° and 92° C., and are very deliquescent. A larger quantity of water converts the monohydrate into the tetrahydrate, which is insoluble in chloroform. Daubrawa's statement that antimony pentachloride is decomposed by one molecule of water into the oxychloride and hydrochloric acid could not be confirmed. The authors attempted to produce the oxychloride by the action of the pentachloride on anhydrous oxalic acid, but they obtained a new compound, $C_2O_4Sb_2Cl_8$, which is decomposed by warm water. On the basis of these results the different behaviour of phosphorus and antimony pentachloride to carbon compounds, which contain both hydrogen and oxygen, can be explained. Whereas antimony pentachloride combines with water, phosphorus pentachloride decomposes it. The former, therefore, does not exchange chlorine for oxygen, whereas the latter displaces oxygen in hydroxyl and ketone groups by chlorine, being itself converted into phosphorus oxychloride. On the other hand, the antimony pentachloride acts similarly to phosphorus pentachloride on carbon compounds, which contain no oxygen. The same will be the case if the compound contain no hydrogen atoms which are not combined to carbon. The oxalic acid is a case in point, and the production of a compound like $C_2O_4Sb_2Cl_8$ or $SbCl_4.COO—COO.SbCl_4$ makes the existence of $PCl_4.COO—COO—PCl_4$ probable. The investigations of Anschütz and some of his pupils show that phenols and oxyacids, which contain an oxygen atom which is very difficult to displace, are likely to yield directly or indirectly compounds of the general formula $R.O.PCl_4$.—S. H.

Process for the Production of Alumina Compounds applicable for Bleaching. R. Weiss, Oranienburg, Russia. Eng. Pat. 6573, May 15, 1886. 6d.

SEE page 544.

Improvements in Means or Apparatus employed in the Manufacture of Sulphites. A. W. Gillman and S. Spencer, London. Eng. Pat. 10,000, August 4, 1886. 8d.

THE following arrangement of apparatus is employed by the inventors in the manufacture of sulphites:—Sulphurous acid is generated in a sulphur kiln, and the gas is cooled by suitable means before it passes into the limestone tower. The latter is constructed of headless casks placed one above the other, the ends of the casks are bevelled to fit each other, and are connected by leaden bands. The limestone is supported on a wooden frame in the lower part of each tower, so as to leave a free space below for drainage and the entry of the gas. The gas in rising through the limestone is to a great extent absorbed by the descending water, which is admitted at the top of the tower, and the saturated water dissolves out lime from the limestone, forming a solution of calcium bisulphite which runs from the bottom of the limestone tower into suitable store tanks. For the manufacture of calcium monosulphite the sulphurous acid gas is conveyed to the bottom of a chamber provided with trays, on which sifted slaked lime is spread, the trays being so arranged as to make the gas pass to and fro over the lime. The top of the chamber is removable to enable the trays to be charged and emptied. Sulphite of soda or potash is made in similar chambers, the trays being filled with a solution of sodium or potassium carbonate, which is admitted at the top of the chamber through a bent pipe and flows over the trays, descending from one tray to another until it arrives at the bottom, meeting in its course the current of gas which traverses the chamber in the opposite direction.—S. H.

Improvements in Separating the Ammonium Chloride from Liquors obtained in the Manufacture of Soda by the Ammonia-Soda Process. G. Jarmay, Winnington. Eng. Pat. 10,419, August 14, 1886. 6d.

THESE improvements relate to the separation of ammonium chloride from the spent liquors of the ammonia-soda process. It is proposed to lower the temperature of these liquors by artificial means, until a sufficient quantity of ammonium chloride has crystallised out. After the crystals are separated, sodium chloride is added to the mother-liquor and the liquor afterwards again cooled, when an additional crop of ammonium chloride crystals is secured. The addition of salt and subsequent cooling is several times repeated. The mother liquor is ultimately used again in the place of brine for the initial stage of the ammonia-soda process, thereby saving the expense of distillation and effecting a great economy of sodium chloride.—S. H.

Improvements in the Manufacture of Alkali. J. Barrow, Manchester. Eng. Pat. 10,491, August 16, 1886. 6d.

Sodium sulphate is decomposed by barium sulphide, or a mixture of barium sulphide and oxide, whereby a solution of sodium sulphide and oxide and a precipitate of barium sulphate is obtained. The latter is separated by filtration, and the filtrate is treated with carbonic acid, thus converting the solution into sodium carbonate and bicarbonate, both of which may be obtained at will according to the amount of carbonic acid added. At the same time sulphuretted hydrogen is given off, which is worked up for sulphuric acid to be used in the conversion of sodium chloride into sulphate. The precipitate of barium sulphate is reduced to sulphide or a mixture of sulphide and oxide by means of carbonaceous matter.
—S. H.

Improvements in Machinery for Charging Liquids with Carbonic Acid Gas. F. Foster, Hoxton. Eng. Pat. 10,722, August 21, 1886. 8d.

This invention relates to a modification of an apparatus described in a previous specification (Eng. Pat. 2426, 1882). The machine there described was fitted with an arrangement for generating, storing and delivering carbonic acid gas in a compressed form to the condenser containing the liquid to be aërated. The present invention dispenses with all those parts, as it is now intended to use portable vessels containing compressed carbonic acid gas.—S. H.

Improvements in the Manufacture, Purification, or Separation of Sodium Bicarbonate. J. J. Watts and W. A. Richards, Sandbach. Eng. Pat. 10,955, August 27, 1886. 4d.

The sodium bicarbonate, as obtained in the ammonia-soda process, contains ammonium compounds and tarry matters. Mond and Jarmay (this Journal, 1885, 282) purify the crude bicarbonate by dissolving it in water and recrystallising it from the solution by refrigeration. The yield of crystals being small, the present inventors increase the yield by adding to the warm saturated solution of sodium bicarbonate a quantity of common salt, which, on dissolving, separates sodium bicarbonate. The yield of the latter is in proportion with the quantity of sodium chloride added and dissolved. The mother liquor may be used for dissolving fresh quantities of crude bicarbonate, or for the initial stage of the ammonia-soda process in lieu of brine.
—S. H.

VIII.—GLASS, POTTERY AND EARTHENWARE.

A New and Improved Process for Producing Ornaments and Lettering on Glass, or other Round or Flat Substances, for Decorating and Advertising Purposes. F. Winterhoff, London. Eng. Pat. 5978, May 3, 1886. 6d.

Glass and other surfaces are sometimes coated with a solution of a substance such as "asphalte," which is rendered insoluble by the action of light. A photographic negative is placed over the coated surface and exposed to light, part of the coating is thus rendered insoluble, the remainder is dissolved away, and the portions of the glass, etc., so left exposed are etched with hydrofluoric or other acid. According to this invention, the surface to be treated is coated with a solution of asphalte in spirit of turpentine. The matter to be etched is drawn or engraved on a lithographic stone or steel plate, from which as many impressions as are required are printed with printing ink on to lithographic transfer paper. The pattern or design is then transferred from the paper to the coating on the glass or other article to be etched. The transferred matter is now dusted or covered with bronze powder, gold or other metal leaf, or any fine powder which obstructs the passage of light. The powder adheres to the printed matter only, and forms above it an opaque surface. After exposure to light the surface is treated with paraffin oil, the asphalte coating being removed from those parts which have been protected from the action of the light. The surface is now ready for "aciding" in the usual manner.
—E. G. C.

Improvements in or relating to the Manufacture of Glass. E. Picard, Brussels, Belgium. Eng. Pat. 7338, June 1, 1886. 11d.

This invention relates to the production of a layer or sheet of glass of uniform thickness and of indefinite length, which, without break of continuity, can be cast, rolled, tempered or annealed, straightened or flattened, polished and cut into suitable pieces; also to a method of manufacturing glass consisting in the formation of a continuous layer or sheet, by means of a rolling apparatus combined with a continuously fed reservoir or tank and with an annealing or tempering gallery, provided with a movable table, in which the sheet is tempered or annealed without further heating.
—E. G. C.

Improvements in the Production of Fireproof Materials and Articles of Enamel. A. Feldman, Linden, Prussia. Eng. Pat. 8064, June 17, 1886. 6d.

Fireproof and enamelled articles are produced from a mixture of one or more of the fluorides of sodium, calcium, magnesium, strontium, barium and aluminium with one or more of the following basic oxides: lime, magnesia, baryta, strontia, alumina, and oxide of zinc. The substances to be employed are powdered and mixed with water to form a dough, which is dried and burnt at such a temperature that its ingredients will sinter together.—E. G. C.

Improvements in the Manufacture of Porous Earthenware. H. J. Allison, London. From C. G. Gilman, Iowa, U.S.A. Eng. Pat. 15,579, Nov. 30, 1886. 6d.

Clay is mixed with vegetable matter, cut in short lengths, pressed, dried, burnt in a kiln and shaped with edged tools to the desired form.—E. G. C.

The Manufacture of Opaque Glass of a New Colour. E. Moore, South Shields. Eng. Pat. 4822, March 31, 1887. 4d.

A light brown or fawn colour is imparted to opaque glass, by adding to the ordinary batch used in making the glass any of the following substances:—Flowers of sulphur, calcined oats, or other calcined cereal, vine stalks, etc.—E. G. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS AND CEMENTS.

Improvements in the Processes and Manufacture of Cement in a Powdered State, and the Apparatus relating thereto. F. W. S. Stokes, London. Eng. Pat. 7888, June 12, 1886. 1s. 1d.

This is an improved process which consists in introducing finely powdered slurry or other cement material, while held in suspension in air or gas, into a chamber, subjecting it therein, while still held in suspension, to the action of heat, and then separating the particles of cement from the gases or products of combustion. Various improvements in apparatus, etc., are described in detail in the specification.—E. G. C.

X.—METALLURGY, Etc.

Which Form of Blast Furnace least hinders the regular descent of the Charge? F. W. Larmann. Stahl u. Eisen, 1887, 163.

THE author considers that the charge rests more lightly in a furnace without, than in one with boshes. A wide furnace with but slightly contracted area gives free space for the descent of the charge and is indeed practically without boshes; but a furnace in which the retarding action of the boshes on the downcoming materials makes itself felt even in the centre, is objectionable. A charcoal furnace built on the author's principle was run regularly on grey, mottled or white irons of extremely high quality, working steadily and without derangement for fifteen months. It was 9·651 metres high, 1·25 metres in diameter beneath, and 1·10 metres at the mouth; from below, to a height of 1·255 metres, it rose cylindrically, and was thence evenly reduced in diameter, making an inclination of 1° with the vertical. The furnace was of 10cbm. capacity, and produced on an average 6000kilos. per 24 hours, equivalent to 1 ton of metal per diem per 1·67cbm. capacity—thus comparing favourably with the larger coke furnaces in Germany and in the Cleveland district, of which the outputs are 1 ton per 3cbm. and per 10cbm. respectively. On blowing out the furnace it was found that the greatest diameter was at the tuyeres, from which the writer concludes that the shoulder of the boshes is quite unnecessary.—W. G. M.

Notes on the Recovery of Copper, Lead and Silver from Rio Tinto Burnt Ore. Chem. Zeit. **11**, 753 and 785.

THE burnt ore coming from the pyrites kilns tests as follows:—

Fe_2O_3	77·00 — 78·00 %
FeS	3·75 — 4·00
CuO..........	2·75 — 2·90
S	3·00 — 3·70
CuS..........	1·50 — 1·75
Pb	0·30 — 0·50
Ag	0·0025— 0·0050

The result of a year's working (1886) at a well-managed works was as follows:—

Burnt Ore worked up.	Metallic Copper.	Sulphate of Lead.	Silver Precipitate.	Flue-dust.
10,000,000 Kilos.	158,000 Kilos.	71,000 Kilos.	3,109 Kilos.	30,000 Kilos.
		(28 % Pb)	(48 % Pb)	(20 % Cu)
		(1—1·5 % Ag)	(26 % Ag)	(5 % Pb)
		(0·0018 % Au)	(0·031 % Au)	

—S. H.

On the Influence of a Heated Blast on the Composition of the resulting Pig Iron. A. Ledebur. Stahl u. Eisen, 1887, 168.

THE author has experimented with two samples of foundry pig produced from precisely the same materials, but one with a heavy charge of fuel and with cold blast, the other with a blast heated to 350° C. The fractures were alike that of a good grey charcoal pig; the only noteworthy differences in composition being observed in the percentages of carbon and silicon, the carbon in the cold blast metal being 4·363, and in the hot blast iron 4·063—an increase in the former, due probably to the longer period of exposure to the carburising influences, owing to the greater proportion of fuel in the charge. The silicon was lower in the cold blast pig, the proportion being 0·635 : 1·168. Hence it is probable that the cold blast metal was slightly the stronger of the two. The question whether foreign earths existing in the charge are more largely reduced at the higher temperature of the hot blast furnace is negatived by the fact that aluminium, titanium, calcium and magnesium are rarely found in the pig and never in sufficient quantity to influence appreciably its mechanical properties. The correctness of the theory that the heating of the blast facilitates the reduction of deleterious bodies, is therefore reasonably open to doubt. W. G. M.

Chemical Notes for Foundrymen. Otto Gmelin. Oestern. Ztschr. f. Berg. u. Hüttenw. 1887, 155.

On the Introduction of the Blast and the Formation of Carbonic Oxide in the Cupola and matters connected therewith.—The lowest zone of the charge should, as far as practicable, be evenly penetrated by the blast, to ensure complete combustion and a uniformly high temperature. The blast pressure for large cupolas should not exceed 55cm. of water, and should be even less for those of which the shaft diameter is under 800mm.; a stronger blast produces a cold blown metal. Two tuyères will generally be sufficient, but the actual number is of little consequence, provided that the relation of the aggregate areas of the tuyères to that of the shaft be not less than 1 : 2·5; the arrangement of tuyères in two superposed bands has no advantages over the usual disposition. The diameter of the shaft should not exceed 900mm.; works requiring to run down more than 6000kilos. per hour would find two cupolas preferable to one of larger size. Finding that a cupola gives so much the more favourable results the lower the zone of high temperature is maintained, the author has constructed a water-cooled furnace with double sheet metal casing, and has found it to give most satisfactory results.

—W. G. M.

Improvements in the Process of obtaining Alloys of Aluminium with Copper and with other Metals. J. Clark, Birmingham. Eng. Pat. 10,594, August 18, 1886. 6d.

HYDRATED aluminium chloride, obtained by treating clay or other aluminous matter with *aqua regia* or commercial hydrochloric acid, is heated with a reducing agent; a mixture of 3½ parts of granulated zinc with 1 part of iron borings is preferred, but ammonia or its bicarbonate may be employed instead. The residue is then mixed with a suitable proportion of shot copper and with fluxes, and fused in crucibles to melt the alloy, and to volatilise the chlorides of the reducing metals.—W. G. M.

Improvements in the Production and Treatment of Steel. R. Hadfield, Sheffield. Eng. Pat. 566, Jan. 13, 1886. 6d. Amended Specification.

THE emendation consists in a slight variation of the amounts of silicon and manganese originally employed.

—W. G. M.

XI.—FATS, OILS AND SOAP MANUFACTURE.

Improvements in the Treatment of Fish and other Matters to Extract Oil or Fat therefrom and in Apparatus to be employed therein. J. S. Edwards, Eastbourne. Eng. Pat. 6736, May 19, 1886. 8d.

THE fish or other material is placed in a closed vessel, connected with a steam boiler by pipes which run both from its top and bottom. A constant circulation of hot water is thereby maintained, so that the fat is washed out. From the mixture thus obtained, the fat is separated by simple subsidence. In some cases, pumps may be used to draw or suck the hot water through, or any other liquid heavier than the fat, as *e.g.* petroleum, may be employed. Drawings are given.—W. L. C.

On the Non-acid Constituents of Bees-wax. F. R. Schwalb. Arch. Pharm. **13**, 979.

THE author has carefully re-investigated the matter with the following results:—(1) Besides higher fatty acids and alcohols, bees-wax contains hydrocarbons, two of which boiling at 60·5° and 68° were isolated. (2) The highest melting alcohol has the formula $C_{31}H_{64}O$ (not $C_{30}H_{62}O$, as stated by Brodie). (3) Besides myricyl alcohol, bees-wax contains ceryl alcohol ($C_{27}H_{56}O$), and a third alcohol ($C_{25}H_{52}O$).—F. W. T. K.

Improvements in Apparatus for Expressing Oil from Oleaginous Substances, and for similar purposes. H. H. Lake, London. From La Société Anonyme du Compresseur Jourdan, Paris, France. Eng. Pat. 10,833, August 24, 1886. 11d.

THE apparatus consists of a hydraulic press with two rams and two receptacles so arranged that while the compressed cakes are being prepared in or removed from one, fresh material for compression can be introduced into the other. The apparatus therefore performs double the work of an ordinary press. In some cases the receptacles are mounted on rollers and transported from the compressing ram to the emptying rams. Filter plates of peculiar and special construction are employed. Elaborate drawings are given.—W. L. C.

A Process for the Treatment of Wool Fat to Produce Unguent Material therefrom. H. W. Langbeck, London. Eng. Pat. 11,192, Sept. 12, 1886. 6d.

THE raw fat is treated with solvents, such as a mixture of alcohol and carbon disulphide, to remove the fatty acids, cholesterin, etc., and the remaining fat is treated with animal charcoal (preferably "Prussia waste"), and from this mixture the pure wool fat is dissolved out by benzine, naphtha, etc., the solvent being in its turn removed by the injection of steam.—W. L. C.

An Improved Washing Powder. J. E. Quayle, Liverpool. Eng. Pat. 11,560, Sept. 11, 1886. 4d.

CARBOLIC ACID hard soap and the ordinary dry soap of commerce are dried and ground together in equal weights.—W. L. C.

A New or Improved Process for Oxidising Oils and Fats and other Organic Substances. C. Schill and C. Seilacher, Stuttgart, Germany. Eng. Pat. 12,799, Oct. 6, 1886. 6d.

TRAIN OIL or other fat, heated to 120° C., is supplied to an injector apparatus, which is worked by heated air at 4 or 5 atmospheres' pressure. The "grease-mist" thus produced is condensed in suitable chambers. Ozonised air, or a mixture of air and ammonia, may be employed with advantage in some cases.—W. L. C.

A Process for Extracting Oil or other Lubricants from Greasy Waste or Cleaning Cloths, and for Making the Extracted Grease into Soap. S. Schofield. Eng. Pat. 5960, April 23, 1887. 4d.

THE cloths, etc., to be extracted are put into a washing machine with an alkaline solution. The soapy water thus produced is decomposed with acid, the resulting rough grease pressed and, if desired, re-saponified.
—W. L. C.

Method and Apparatus for Distilling Fatty Acids by Means of Superheated Steam. W. Sanzenbacher and S. Tanatar, Odessa, Russia. Eng. Pat. 6986, May 12, 1887. 8d.

IN the ordinary plant for distilling fats, the steam is superheated in a furnace separate from the still. In the arrangement here patented, the superheating coils are inside the still, and are so arranged that, until the steam reaches 200° C., it escapes into the air, after which it is turned into the fatty matters. The steam is, therefore, always very slightly cooler than the fatty matters, instead of being much hotter, as is often the case, much to the detriment of the distilled product. Another feature of the apparatus is that the latent heat of the fatty acid vapours is utilised to heat the fatty acids that are to be distilled, when the apparatus is worked continuously. Great economy in fuel, and great improvement in the products, are claimed for the arrangement.
—W. L. C.

XII.—PAINTS, VARNISHES AND RESINS.

On the Changes which Vulcanised Caoutchouc undergoes. Balland. Pharm. Chim. **15**, 417.

VERY elastic caoutchouc tubing becomes gradually covered with white spots, which penetrate into the interior, in consequence of which the caoutchouc loses some of its elasticity. Later, the tubes break on stretching, even if previously laid in warm water, and finally they crack if pressed between the fingers. This change the author puts down to a very slow formation of sulphuric acid by the action of moist air on the sulphur contained in the caoutchouc. By frequent washing with slightly alkaline water the action of the acid is prevented. Tubes which were washed five or six times a-year remained perfectly elastic.—A. R.

Obtaining certain Products or Substances from Essence of Birch Bark, and utilising the same in the Manufacture or Production of certain Compounds or Substances. W. L. Wise, London. From E. Mourlot, Paris, France. Eng. Pat. 7903, June 12, 1886. 6d.

THE inventor obtains from essence of birch bark, by rectification, an essential oil, which possesses among other properties that of being fatal to "insect life," and an electrically insulating tarry substance. These two products are so treated and combined with other substances as to produce an anti-oxidising material and an insulating substance capable of the same applications as ebonite. Among the other ingredients employed, in additon to the products from the essence of birch bark, are caoutchouc, sulphur, chalk, talc, litharge, antimony sulphide, kaolin, zinc white and red ochre.—E. G. C.

A New or Improved Manufacture and Process of Production of Material that can be used as or in the Making of Substitutes for Indiarubber, Varnish, Ivory, Whalebone and other Substances. F. Greening, Uxbridge. Eng. Pat. 8442, June 26, 1886. 6d.

FIBROUS SUBSTANCE of any suitable kind, such as paper, old rag, grass, cotton, etc., is saturated with a mixture of sulphuric acid and potassium nitrate, and maintained for about 20—24 hours at a temperature of from 75° to 90° F. The converted fibre is then freed from excess of the mixture by pressure or otherwise, washed with water and dried sufficiently to be submitted to a suitable bath for neutralising the excess of acid. "Such a bath may be of liquid carbonic acid, or carbonic acid gas may be used. The fibrous mass is to be thoroughly impregnated with the carbonic acid, and afterwards allowed to dry; when dry it will be ready to be treated with a suitable solvent or solvents." A suitable solvent is produced as follows:—To 100galls. of methylated alcohol are added from 25—30lb. of refined colophony, from 10—12lb. gum benzoin and from 80—100lb. of castor oil. The mixture is distilled until the temperature reaches 300—320° F., and the distillate is dried by quicklime or calcium chloride. The residue in the retort is suitable for waterproofing or for mixing with the prepared base before described.—E. G. C.

Improvements in the Manufacture of Indiarubber Waterproof Textile Fabrics. P. M. Matthew, jun., Edinburgh. Eng. Pat. 9337, July 19, 1886. 6d.

FOR several years waterproof textures have been made by coating various fabrics with a thin film of indiarubber, and coating the surface so obtained with a layer of farina or other substance capable of producing a lustrous or ornamental effect. This inventor covers the indiarubber surface with some light fabric of an open nature, such as lace or similar material, in such a manner that the greater part of the rubber surface remains exposed. The network or open fabric is attached under considerable pressure to the rubber surface while the latter is still tacky or adhesive. The farina or other ornamental material is then spread over the whole surface, and adheres to those portions of the indiarubber which are still exposed. The fabric may be vulcanised either before or after the application of the farina or ornamental powder.—E. G. C.

Improvements in Making White Paint. J. B. Hannay, Dumbarton, and E. J. Pape, Oxton. Eng. Pat. 9581, July 24, 1886. 4d.

Oxide of zinc is combined with a white pigment, consisting principally of sulphite or chlorosulphite of lead, the mixture being subsequently ground up with a suitable oil or medium to form the paint.—E. G. C.

The Manufacture of a Transparent Flexible Material Suitable for all Purposes where a Transparent, Flexible and Light Material is required, such as a Base for Photographic Pictures, Transparent Show Cards, Artistic Work, Similar and other Purposes. F. H. Froedman, Dublin. Eng. Pat. 10,659, August 20, 1886. 6d.

This invention consists in rendering gelatin or other colloid insoluble with chromium salts and converting these bodies into colourless transparent and pliable films by means of sulphurous acid or its compounds. Gelatin is softened in water, then dissolved in a certain quantity of water on the water-bath and bichromate of potash added. Alcohol, and if necessary a small proportion of glycerine, is also added. Clean glass plates which have been dusted with French chalk are coated with enamel collodion, and when set, immersed in water till the coated surface is free from greasiness. The plates are then coated with the hot gelatin solution and dried at 65—70° F. When dry they are exposed to light and then washed in water, after which they are immersed in a solution of sulphurous acid or its compounds, and when sufficiently acted on are thoroughly washed and then dried. The following is a mixture which may be used advantageously:—Best hard gelatin 3 parts, water 24 parts, 4 parts of a 6 per cent. solution of bichromate of potash, alcohol 4 parts, glycerin $\frac{1}{4}$ part. —B. H.

Improvements relating to means for rendering Textile Fabrics and other Substances Impermeable, or for Protecting them from Injury by Moisture. W. R. Lake, London. From C. Orlay, Milan, Italy. Eng. Pat. 10,828, August 24, 1886. 6d.

The inventor claims to be able to retain acetate of alumina in the fibre, "by means of a pitchy varnish, insoluble and not powdery, without however obstructing the pores of the fabric." This substance, according to the nature of the fabric and its colour, is applied in either a dry or a hot state, after they have been subjected to baths of acetate of alumina, soap and alum, and after they have been dried in a drying stove at about 30° C.

The soap bath is made up with either a solution of soap of 1, 2 or 3 per cent. or an emulsion of soap, paraffin and resin. The alum bath contains 4 per cent. of alum. For cloth, a gall-nut bath comes before the alumina process and then stoving with hot plates not exceeding 36—40° C. The next process consists in treating with the following substances:—Paraffin wax, wax and vaselin, the proportions of each varying according to the nature and thickness of the fabric. A metallic soap, such as of iron, copper, zinc or the like may be added according to the colour desired. Besides for paper, pasteboard, etc., this preparation also serves for treating leather, hides, ropes, etc., also for the manufacture of awnings.—H. A. R.

Manufacture of Material for Removal of Old Paint. M. Benedictus, Brussels, Belgium. Eng. Pat. 10,960, August 27, 1886. 6d.

This invention relates to the manufacture of a material which, when laid by a brush or spatula on old paint, has, in the course of an hour or less, such action on the paint that the whole can be readily sponged off with water without any scraping. The material in question consists of a mixture of water, flour or meal, alum, black soap, with caustic soda and caustic potash.—E. G. C.

Improvements in Apparatus for the Manufacture of Varnish. W. L. Wise, London. From R. Lehmann, Dresden, Germany. Eng. Pat. 6323, April 30, 1887. 6d.

This inventor claims—(1) an apparatus heated by superheated steam for melting resins, such as amber and copal, consisting mainly of a melting vessel provided with a rising body and cover, and surrounded by a steam jacket; and (2) the use in conjunction with this apparatus of a vessel, surrounded by a steam jacket, into which the waste steam from the melting apparatus is introduced, to heat the oil varnish before and during its mixture with the melted resin.—E. G. C.

Improvements in Compositions for the Manufacture of Articles by Moulding, Carving or Turning, or of Varnish and Lacquer, and for similar Purposes. H. H. Lake, London. From E. N. Todd, Newark, New Jersey, U.S.A. Eng. Pat. 6870, May 10, 1887. 4d.

The object of this invention is to effect the solution or conversion of soluble nitrocellulose by means of a "latent solvent" other than camphor, and also to enable solutions of pyroxylin dissolved in any of the known solvents and mixed with any of the known menstrua, to be used as lacquers or varnishes, which shall be free from iridescence or irregularities. These desiderata are attained by the use of balsam of tolu, which the inventor has found to be a "latent solvent" of pyroxylin, in place of camphor.—E. G. C.

Improvements in the Manufacture of Pigment or Paint. H. H. Lake, London. From J. P. Perkins, Pullman, U.S.A. Eng. Pat. 7524, May 25, 1887. 6d.

The inventor reduces silicate iron slag to a granular or pulverulent form, calcines it and mixes it with oil or some other suitable vehicle. Colouring matters may be added, with the view of producing other than the natural shades of the calcined material.—E. G. C.

Improvements in the Preparation of Fireproofing Fluids or Paints, to be applied to Textile and other Inflammable Materials. G. Harrison and O. Trimming, London. Eng. Pat. 7809, May 28, 1887. 4d.

The articles to be fireproofed are dipped in a solution prepared by adding to one gallon of water sixteen ounces each of ammonium sulphate, powdered borax, and potash alum, and one ounce of boracic acid. After immersion, the materials are wrung out, dried and ironed in the ordinary way. The paint is prepared by first mixing with the above preparation enough whitening to form a thin paste and then adding boiling size until the mixture is thinned to the gauge of ordinary paint. Any colour may be imparted to the paint in the usual way.—E. G. C.

XIII.—TANNING, LEATHER, GLUE AND SIZE.

Tannin from Oak Wood. C. Böttinger. Ber. **20**, 761—766.

The author has investigated the tannin of oak wood, which has of late occurred largely in commerce in the form of an extract. In order to separate the tannin he used the method previously described by him (this Journal, 1884, 526), which consists in converting it into the acetyl compound. *Acet-tannin* from oak wood is a greyish-white heavy powder, soluble in water and cold alcohol, but insoluble in boiling absolute alcohol; it slowly loses acetic acid on exposure to the air. On analysis it gives numbers corresponding to the formula $C_{15}H_7(C_2H_3O)_5O_9$. Fused with potash it is decomposed, yielding acetic acid, protocatechuic acid and an undetermined phenol. It is also decomposed, yielding the corresponding tannin by heating for two hours with water in a sealed tube at 135° with frequent shaking and subsequent treatment with water and absolute alcohol. The *tannin* from oak wood thus purified forms a light yellow hygroscopic powder readily soluble in water; the aqueous solution gives no precipitate with bromine, but a brown precipitate with excess of caustic soda, a yellowish-white precipitate with lead acetate and a flocculent precipitate with gelatine solution: with solutions of the alkaline earths it only gives a precipitate after addition of ammonia. When dried in a desiccator the substance gives numbers corresponding to the formula $C_{15}H_{12}O_9 + 2H_2O$, and on heating it loses 1 molecule of water at 100° and the second at 125° without alteration of properties. Tannin from oak wood is not soluble in a mixture of bromine and water, differing in this respect from the sumach-tannin and its acetyl compound. When heated at 130° with bromine water, it appears to yield the same substance as the bromine derivatives of oak-bark tannin, hemlock tannin and the tannin of Terra japonica.

The acet-tannin from oak wood when treated with bromine in chloroform solution yields a substance which appears to be a monobromo-derivative containing one acetyl group. This substance can be easily converted into a higher bromine derivative by adding excess of bromine to the chloroform solution and warming the precipitated oil at 40—50°; the product has the composition $C_{15}H_7Br_4(C_2H_3O)O_9$.

The author concludes from the foregoing experiments that oak-wood tannin is the methyl salt of digallic acid, and that it has quite a different constitution to tannin, as shown by its action towards bromine, alkalis and moulds (*Penicillium glauc.*, etc.). With the two latter it forms gallic acid.—G. H. M.

Improvements in Treating Hide or Skins. J. Townsend, Glasgow. Eng. Pat. 10,987, Aug. 28, 1886. 6d.

THE hides or skins are first steeped in a solution of aluminate of soda or potash, containing 1lb. aluminate per gallon. After a few days of this treatment the hair can be removed. The hides or skins, having, by preference, been washed with water, are next placed in a solution containing 2—4 per cent. of boracic acid, and are again washed with water. The hides or skins may be then tanned in the ordinary way or otherwise treated. The treatment with boracic acid may also be used for hides or skins which have been "limed," the boracic acid removing the lime. Sulphate or other soluble salt of alumina may be used along with the boracic acid, and instead of first treating the hides or skins with aluminate of soda or potash, or after so treating them, silicate of soda or potash of a strength of about 18° Tw. may be used.—B. H.

Improvements in Apparatus for Drying Hides, Skins and other Articles or Materials. J. H. Lorimer, Philadelphia, U.S.A. Eng. Pat. 16,411, Dec. 14, 1886. 8d.

THIS invention has reference to improved drying apparatus, whereby the materials to be dried may be passed through the apparatus in a limited time and exposed to mechanical air draughts. For this purpose are provided one or more tubular passage ways or chambers, through which trucks containing the material to be dried are passed. The movement of the vehicle through the chamber is made intermittent, being arrested at certain distances by a suitable stop, and this movement may be made either automatic or controlled by hand. Through the chamber, in an opposite direction to the movement of the vehicle, air currents are caused to pass by a fan or other mechanical means, and this air may be either cold or heated, pure or impregnated with disinfecting or bleaching substances. When desirable, two or more passage ways may be connected together, so that a truck can be run successively through each of them. Drawings are given.—B. H.

XIV.—AGRICULTURE, MANURES, Etc.

On the Assumed Loss of Nitrogen in Mixtures of Superphosphates with Nitre. O. Güssefeld. Chem. Zeit. **11**, 591.

THE author describes experiments to prove that mixtures of superphosphate with nitre suffer no loss of nitrogen, and attributes the reason of the loss in such cases where it has been known to occur to the adventitious presence of free sulphuric acid. He shares the opinion of Peterman in opposition to that of Andouard on this question.—G. H. B.

On the Action of Superphosphates on Nitrates. A. Andouard. Compt. Rend. **104**, 583—585.

THE author's experiments show that mixtures of Chili saltpetre and superphosphates experience a great loss of nitrogen, due to the formation of nitric acid and its subsequent reduction. A marked diminution in organic nitrogen is also found to occur. Mixtures to which ammonium sulphate had been added showed a loss of ammoniacal nitrogen as well. The decomposition starts at temperatures between 25—30° C., but once started it goes on even at 15—12° C. An intimate mixing of superphosphate with Chili saltpetre should, therefore, be avoided.
—F. W. T. K.

On the Relations between Plants and Inorganic Nitrogen Compounds. Dr. H. Molisch (Akademie der Wissenschaften, Wien). Chem. Zeit. **11**, 607.

THE following are the most important results arrived at by the author:—1. Nitrates occur throughout the vegetable kingdom, but are found in much larger quantities in herbaceous plants than in trees. 2. Nitrites, although occurring frequently in the soil, were not found in any of the plants (100) investigated. Nitrites, when absorbed by the plants, are rapidly reduced; and this is clearly the reason why they can never be detected. On the other hand, nitrates may remain without change within the plant-cells for weeks or even months. 3. Even in dilute solutions (0·1 to 0·01 per cent.), nitrites—unlike nitrates—act prejudicially upon some plants. 4. When plants are supplied with nitrogen in the form of nitrites or ammonia, they are never found to contain nitrates; it follows from this that their nitric acid is not produced by the oxidation either of nitrous acid or ammonia. Contrary to the views of Berthelot and André, plants (with perhaps the exception of bacteria) have not the power of converting nitrogen compounds into nitrates. Plants obtain their nitrates simply by absorption; and when they contain more than the soil, the apparent production is only due to a process of accumulation. 5. Diphenylamine dissolved in sulphuric acid is a convenient reagent for detecting nitrates under the microscope; but the reaction is sometimes masked by the action of the acid upon the tissues. 6. The communication contains some further observations upon the localised occurrence of substances which produce a blue colour, both with guaiacum emulsion and potassium iodide starch paste.—D. E. J.

On the Composition of Thomas Slag. Bücking and Linck. Stahl u. Eisen, **7**, 245.

IT has been incorrectly supposed that the crystalline concretions formed in the cellular spaces in Thomas slag and the coarsely crystalline phosphatic slags consist almost entirely of tetrabasic calcium phosphate. If the not too finely-powdered slag be sifted from the fine dust, and the particles of iron be removed by magnets, a further separation can be effected by means of solutions of high specific gravity, and the three most important bodies contained in the slag may be separately obtained in a homogeneous condition suitable for crystallographic observation. The authors found: 1. Slender six sided needles, the ends showing usually a cleavage on which smooth pyramidal faces were not observed. The chemical composition corresponded nearly to the formula $4Ca_3P_2O_8 + Ca_3SiO_5$, so that the phosphoric acid is tribasic in this compound, as is further proved by the yellow precipitate of silver phosphate produced with a solution of silver nitrate. In many respects these crystals resemble apatite and may be considered as closely analogous thereto. 2. A body difficult to isolate from the two accompanying forms, crystallising in the monoclinic system and approximating in composition to the formula $4Ca_3P_2O_8 + 3Ca_3SiO_5$. The crystals are very small, possessing a brilliant lustre and showing a striking dichroism between light blue and intense blue. 3. The principal constituent of the coarsely crystalline phosphatic slags. It crystallises sometimes in thin plates $\frac{1}{5}$ to $\frac{1}{2}$mm. in thickness and 5 to 15mm. in length, sometimes quite clear and colourless, sometimes more or less coloured and cloudy and holding particles of slag. The crystals belong to the rhombic system and correspond nearly to the formula $Ca_4P_2O_9$. Other compounds found in Thomas slag are still under investigation.—G. H. B.

Is Nitric Acid formed in the Higher Plants? U. Kreusler. Ber. 20, 999—1001.

THE author has carried out a series of experiments with potatoes in order to ascertain whether the nitrates which are generally found in growing plants are formed from other nitrogenous constituents during the growth of the plant, or are directly obtained from the surrounding media. The results lead the author to the conclusion that nitrates are not formed during the growth, but that the conditions of their presence must be looked for outside the plant.—G. H. M.

Investigation on the Water Capacity of Soils. Part II. E. Wollny. Agriculturphysik, 1886, 361—378.

FOR the first communication (see *Bied. Centr.* 15, 225), the author arrives at the following conclusions, based on his experiments:—I. The water capacity (measured by volumes) of a soil diminishes with a rise in temperature. The opposite is the case with peat. This diminution is relatively greater the larger the pores in the soil. II. (*a*) The freezing of the water in soils usually causes a diminution in their water capacity. (*b*) This latter result is merely transient in the case of soils of only a slightly cohesive character—*i.e.*, coarsely granular, sandy, poor in vegetable matter. It is of a more permanent nature in the case of soils which show a tendency to form crums—*e.g.*, finely granular, argillaceous soils, or soils rich in vegetable matter. (*c*) The result mentioned in (*a*) is more marked, the greater the quantity of water in the soil, and the more frequently (within certain limits) the frosts alternate with thaws. (*d*) In the case of crummy soils the duration of the diminished water holding capacity may be materially altered, and even converted into an increased capacity if there are frequent alternations of frost and thaw or the crums are loosely aggregated, as this facilitates the breaking up of the crums into a finer state. An explanation of these facts is the increased or diminished aggregation of the soil, resulting from the freezing of the water in the soil. III. (*a*) The water holding capacity of a coarsely granular soil is increased by the presence of even a very thin (3—5cm.) difficultly permeable subsoil—*e.g.*, clay. The more so, the nearer the latter is to the surface. This effect is more marked the greater the difference in water capacity of the upper and lower soils. (*b*) An easily permeated subsoil only slightly increases the water capacity of the soil above it, if the latter is of a finely granular or argillaceous character, but diminishes its capacity if it is more coarsely granular.—F. W. T. K.

Experiments with Beets in Manured Sand. A. Pagnoul. Bull. de l'Assoc. des Chim., 1887, 12.

THE sand employed was free from chalk and organic matter and contained only traces of alumina, clay, iron, potash and phosphoric acid. The object of the experiments was to determine what effect the various fertilisers had on the growth of beets when supplied in various forms. The fertilisers, used either alone or in combination, were (*a*) Chili saltpetre (15·5 per cent. nitrogen), ammonium sulphate (20 per cent. nitrogen), ammonium nitrate and dried blood. (*b*) Potassium chloride (50 per cent.) (*c*) Superphosphate, Thomas slag (7 per cent. P_2O_5), and a natural finely powdered phosphate from the Pernes deposits (20 per cent. P_2O_5.) (*d*) Calcium carbonate. The unmanured sand and that to which no phosphates had been added gave practically no results. The addition of phosphates in all cases produced a marked increase in production, the improvement being least marked with the natural phosphate, and not much better with the Thomas slag. The use of carbonate of lime always caused an increased production. Manuring with coarsely crushed oil-cake gave good results, though the development of the plants was slightly retarded, and the diffusion of the fertilising juices does not seem to go on very uniformly in this case. Deficiency of potash appears to diminish the quantity of sugar in the beets; at the same time the soda salts and consequent impurities show a considerable increase. A deficiency of soda and potash considerably lowers the yield of beets, and consequently of sugar, though the amount of sugar in the beets themselves is apparently not lessened. Experiment shows, that though the beets take up soda, they absorb potash in preference, as the amount of soda in beets grown in the soil to which potash had been added was less than in the cases where the potash had been omitted. The conversion of ammonia into nitric acid was also observed, especially where a sufficient quantity of potash and soda was present.—F. W. T. K.

Employment of the Lye from the (Strontium Method) Sugar Factories as a Manuring Agent. L. Kuntze. Organ des Centr. Verein's f. Rubenzucker Ind. 1887, 125—131.

THE author has been continuing his experiments on the fertilising power of a manure prepared by mixing 25 parts of peat dust with 100 parts of the lye (concentrated to 40° B.). This lye contains 3—2·2 per cent. of nitrogenous matter, and between 13—14 per cent. and 7—8 per cent. of potash respectively. Manuring experiments were carried out with (*a*) the dilute lye as obtained directly from the presses; (*b*) the concentrated lye mixed with peat dust; (*c*) the lye mixed with the mud from the clarifying vats. The dilute lye was employed with good results as a manure for hay, and also for beet and clover fields (directly after gathering the crops) intended for winter wheat and oats. Potato fields should not be treated with the lye, as the potatoes are said to acquire the taste of the lye. Experiments with the second form of manure gave good results with wheat, barley and beets; 4—6 centners of the loose sandy mass were used per morgen. These manures seem particularly to affect the strength of the stalks. The mixture of the hot lye with the mud offers a convenient means of keeping the lye constituents for a long time without loss. Five to six cart loads of this manure per morgen ($\frac{1}{4}$ hectare) gave good results. Large quantities of straw, which only undergo slow decomposition when mixed with ordinary stable dung, are converted into good manure in four to six weeks by treatment with the hot lye.—F. W. T. K.

On the Direct Fixing of Gaseous Atmospheric Nitrogen by Soils. N. Berthelot. Compt. Rend. 94, 205—209.

PREVIOUS experiments of the author have shown that clay and clayey sand soils directly absorb the nitrogen of the atmosphere. The fixing of the nitrogen appears to be brought about by means of micro-organisms, which first take it up. This fixing of the nitrogen goes on, both in a soil free from vegetation, or with grass on it, in the open air and in closed vessels. The above soils were almost free from nitrogen and organic matter. Experiments which the author has now carried out with arable land containing more or less nitrogen, show a similar increase in nitrogen, both when kept under cover and exposed to rain; only in the latter case the increase of nitrogen was greater, no doubt, on account of the more thorough airing of the soil, which assists the development of the organisms. The necessary corrections were made for the small quantities of nitrogen compounds in the air and rain water.—F. W. T. K.

Chemical Investigations on the Feeding and Development of the Silkworm (Bombyx Mori). O. Kellner, T. Kakizaki, V. Matsuoka and P. Joss. Landw. Versuchstationen, **33**, 381—382.

Previous experiments had shown that 1000 caterpillars, fed on a quantity of leaves = 5162·6grms. of dry leaves, ate 2172grms. of dry substance, and digested 771·2 grms. The following experiments were carried out to determine approximately the minimum amount of food necessary to insure the complete development of the larvæ. A batch of caterpillars was divided into three lots. Lot I. received a quantity of leaves equivalent to the following quantities of dry substance:—

Period	I.	II.	III.	IV.	V.
Dry Substance	19·2grms.	72·5grms.	241·8grms.	948·5grms.	3813·5grms.

Lot II. received two-thirds of this, and Lot III. one-half of the quantity. The quantity of food given to Lot I. proved perfectly sufficient. Lot II. was insufficiently fed, and Lot III. still more so. The development of Lots II. and III. progressed very irregularly, and the mortality was greater in each successive lot. The periods of eating, too, were lengthened and the shedding retarded. The insufficient feeding produced a marked effect on the yield of the more valuable portion of the cocoon. The larvæ (5th period) cocoons and butterflies of Lot III. were found to contain a higher percentage of mineral and nitrogenous matter than those of Lot I., though Lot I. yielded a greater amount of fat and non-nitrogenous matter. As in previous experiments other non-nitrogenous matter besides fat was found in the larvæ which were ready to spin.

—F. W. T. K.

Investigations on the Solubility of Gypsum in Solutions of Ammonium Salts. S. Cohn. J. Prakt. Chem. **27**, 1887, 43—56.

Ammonium sulphate, chloride, nitrate and acetate all increase the solubility of gypsum. It is most soluble in solutions of the acetate, next of the nitrate, then the sulphate and finally the chloride. The sulphate probably forms a more soluble double salt; with the other ammonium salts, double decomposition probably takes place. The formation of double salts probably plays a less important part in these cases. For the same weight of salt, the power of reacting on the gypsum is greatest in the case of the acetate, then follows the chloride, the nitrate and lastly the sulphate. This power rapidly increases with dilution.—F. W. T. K.

Manure for Fruit-trees in Winter. Prof. P. Wagner. Bied. Cent. **16**, 357.

For this purpose a mixture of (*a*) potassium chloride (50%) and superphosphate (20%) in equal parts, is recommended. In November the mixture should be strewn over the whole area covered by the foliage and incorporated with the soil, together with ordinary stable dung. In February, Chili-saltpetre (*b*) should be spread over the surface. The latter should also be strewn on the paths if the trees flank or overshadow them. The Chili-saltpetre may be omitted if the trees show a good development both in wood and leaves but do not bear much fruit. If the trees, however, are defective in all three points, the saltpetre is indispensable. The treatment should do equally well for ornamental trees and bushes. A strong fruit tree requires 1kilo. of *a* and ½kilo. of *b*. Weaker trees require proportionately less and in moist ground only half as much of *b*. A large pyramidal tree or wall fruit tree requires about 250grms. of *a* and 150grms. of *b*. Small border trees require 60grms. of *a* and 40grms. of *b*.—F. W. T. K.

Improvements in the Treatment of Manure and other Organic Matters and in the Production therefrom of Ammonia and Residual Products free from Ammonia. W. F. Nast, St. Louis, U.S.A. Eng. Pat. 15,887, Dec. 4, 1886. 6d.

This invention relates to the extraction of the fixed nitrogen in the form of ammonia. It has been found that the presence of sodium chloride greatly facilitates the liberation of ammonia by lime at an elevated temperature.—S. H.

XV.—SUGAR, GUMS, STARCHES, Etc.

The Sugars from Hesperidin and Naringin. W. Will. Ber. **20**, 1186—1190.

The author has previously shown (this Journal, 1887, 449) that naringin and hesperidin are closely related chemically. It was, however, supposed that the former glucoside gave isodulcite on treatment with dilute acid, while the latter yielded dextrose by the same treatment. He has now shown that each substance yields a mixture of isodulcite and dextrose. The former he separated in a crystalline state and analysed, whilst the latter was obtained as phenylglucosazone by means of Fischer's reaction with phenylhydrazine. Isodulcite also gives a compound with this reagent, but it can be easily separated from the dextrose compound by its solubility in acetone.

—G. H. M.

On the Work of the Brushing Cylinders in the Manufacture of Starch. Ztschr. f. Spir. Ind. 1887, 810.

The use of the cylinders is solely to separate from the crushed matter such quantities of starch as have already been set free; they themselves have no freeing action, for Saaren has found as much as 63·5 and 63·6 of starch (calculated on the dry substance) in the residual matter separated by them.—W. G. M.

On Sugar Cane. Journ. Fabr. Sucre, 1887, 15.

According to Schickendantz, the cane contains sugar and invert sugar: colouring matters bleached by sulphur dioxide, precipitated by lime but again dissolved by excess of the precipitant: citric, oxalic, malic acid, and, after longer storing, acetic acid: silicic and phosphoric acids, of which the greater part passes away in the separated solids: alkalis, which are found in the molasses: organic substances: bases, pectin, albumenoids (not precipitated by tannic acid) and various carbohydrates.—W. G. M.

On Alcoholic Polarisation of Sugar-Beet. Ztschr. f. Zucker Ind. 1887, 255.

Degener has found that certain conditions in climate and manuring cause the juice of the sugar-beet to become optically active. This interferes considerably with the exact results otherwise to be obtained with alcoholic polarisation. As a remedy, the alcoholic solution should be boiled, and, before polarising and after cooling, precipitated with lead acetate. Occasionally, as in the case of molasses, reducing substances are present, but, contrary to what has been expressed by others, invert sugar is not one of these products.—A. R.

On Sugar Production without Bone-black. Ztschr. f. Zucker Ind. in Böhmen, 1887, 305.

The disuse of bone-black is considered to be gaining ground. The sugar made thus is equally good, and easily refinable with that in which this material has been employed; and at the Madgeburg Refinery, under the management of Lach, and at that under Miksch, it has

already been very greatly reduced in quantity. It is strongly recommended that the treatment with lime alone, and the removal of the resulting slimes, should be effected before saturation; the addition of the ½ per cent. of lime, mixed with a small quantity of ground and washed coke dust, the remainder of the lime being added to the filtered liquor, gives a firm but porous precipitate, which filters well and is easily freed from sugar. Since the carbon dioxide cannot now decompose the precipitated lime compounds, the juice shows a far higher degree of purity than does that produced in the usual way.
—W. G. M.

Oxidation of Dextrose by Red Oxide of Mercury and Baryta Water. Ztschr. Zucker Ind. 1887, 337.

THE oxidation was conducted by Herzfeld in the same way as with levulose, using red oxide of mercury; the yellow oxide acts too energetically. The oxidation was considered to be complete, when the product ceased to reduce Fehling's solution. The reaction yielded formic and glycollic acids and a mixture of acids, consisting principally of glyconic acid. The same products were obtained by Haberman and Honig in the oxidation of dextrose by hydrated cupric oxide.—G. H. B.

On Molasses Sugar-making according to Le Franc. Bull. Ass. Chim. 1887, 33.

POISSON has described the method employed in Tracy-le-Val for treating 3000ctrs. of beet and 80ctrs. of molasses daily. The cold diluted molasses (containing 8 to 9 per cent. of sugar) is stirred in 8 to 10 charges, with very finely ground quicklime, until 38 to 40 parts are dissolved for each 100 parts of sugar and a dibasic saccharate is produced. The excess of lime is filtered off, and the solution boiled; the tribasic saccharate thus precipitated is filtered, washed once or more by mashing in boiling water, pressed and finally conveyed to the beet-juice. The separated solution still retains one-third of the sugar; it is therefore cooled, saturated with lime as before, filtered, treated with calcium chloride and caustic soda, and again boiled to separate the tribasic saccharate, the liquid being now allowed to run to waste. The cost per 100kilos. molasses should be 19·2fr., which would be made up as follows:—Molasses, 10; chemicals, 2·5; coal, 0·9; wages, 1·65; press-cloths, 1·9; sundries, 2·25frs. The nett profit on the 95 per cent. of the sugar obtained would be 10fr. at present, or by improved methods, 15fr.—W. G. M.

Notes on Saccharates. W. Stromeyer. Arch. Pharm. 1887, **25**, 229.

Barium Saccharate.—Peligot has ascribed to this salt the formula $C_{12}H_{22}O_{11}.BaO$, whereas Stein believes its constitution to be expressed by $C_{12}H_{20}O_{10}.BaO$. The author corroborates the previous formula.

Calcium Saccharate.—According to E. O. v. Lippmann, cane sugar may form mono-, di- and tri-calcium saccharates, thus—$C_{12}H_{22}O_{11}.CaO + 2H_2O$; $C_{12}H_{22}O_{11}.2CaO + 2H_2O$; $C_{12}H_{22}O_{11}.3CaO + 3H_2O$. The author considers that Peligot's is the only method of preparing the pure monocalcium salt—viz., to add alcohol to a clear lime solution containing an excess of sugar.

Aluminium Saccharate.—Freshly precipitated and pure aluminium hydroxide was mixed with a 10 per cent. sugar solution, and the mixture allowed to stand several days. Very little aluminium hydroxide was dissolved.

Chromium Saccharate can be prepared in the same manner as the previous salt.—A. R.

Improvement in the Treatment of Jerusalem Artichoke, to prepare it for use in Distilling in the Manufacture of Glucose and similar Industries. H. J. Haddan, London. From A. Z. Champy, A. N. Champy and L. P. Champy, Brussels. Eng. Pat. 10,164, August 9, 1886. 6d.

JERUSALEM ARTICHOKE in a state of greater or less division is treated with sulphurous acid either alone or in admixture with carbonic acid or nitrogen gas. By this simple operation the juice is clarified, purified and bleached, and at the same time the levuline and inuline of the artichokes are converted into saccharine matter which is readily fermentable. After the reaction, which takes place at 100° C., is terminated the sulphurous acid remaining in the substance is expelled by means of steam, and the juice is filtered. For purposes of distillation the juice may be used as it comes from the filter. For breweries or wine factories it is concentrated to the consistency of a syrup. For the production of glucose it is further bleached by sulphurous acid.—A. J. K.

A Process for the Manufacture of Artificial Gum. M. Strasser, Germany. Eng. Pat. 10,481, August 16, 1886. 4d.

12·5KILOS. of sugar are powdered and boiled with a mixture of 750grms. of fresh cow's milk previously boiled and skimmed, 2·5kilos. of water and 500grms. of colourless 20 per cent. glycerin; into this mixture whilst boiling are strained 25kilos. of 36 per cent. borax, the whole is then cooled to 40° R. and poured into small moulds of sheet iron, in which it sets into hard lumps which may be broken up and used as a gum substitute. The boiling process lasts about three days.—A. J. K.

A Process for the Manufacture of Gum. A. Rossi and C. Hellfrisch, Offenbach, Germany. Eng. Pat. 10,873, August 25, 1886. 4d.

A SUBSTITUTE for gum arabic is prepared as follows:—Starch, water and an acid (preferably sulphuric) are boiled together under pressure until the originally pasty mass begins to get fluid. The material is then neutralised and again boiled, whereby the free starch is converted into gummy matter (gommaline). The product, consisting of dextrin, gommaline, traces of glucose, cellulose and the salts resulting from the neutralisation, is freed from cellulose and the salts in the Taylor apparatus, and is then filtered through animal charcoal. The limpid fluid so obtained may be concentrated by evaporation to a syrup or to dryness. The product "is clear as water, hard like glass, and not hygroscopic," and can be used for most purposes as a substitute for gum arabic, its adhesive power being nearly equal to that of the latter body.—A. J. K.

Improvements in Apparatus for Evaporating the Juice of Beet-root, Sugar-cane, and other Juices or Liquids. P. Labérie, Paris, France. Eng. Pat. 10,911, August 26, 1886. 8d.

FOR the evaporation of saccharine, or other liquors, the author uses a pan which may be in all respects like an ordinary vacuum pan. Hot air is rapidly drawn through the liquor by means of a pump or other exhauster. The air may be heated by waste heat from flues, and drawn into the pan along with the liquor, which is fed in continuously in the form of a spray.—A. J. K.

Improved Process for Converting the Syrups from Sugar-manufacture into Mono-saccharates. F. Harm, Kurtwitz-Prauss, Germany. Eng. Pat. 7259, May 18, 1887. 4d.

THIS invention relates to the treatment of waste liquors in raw sugar factories. "The process consists essentially in conducting the syrups from the first product in a diluted state, and with addition of sugar and sweetening waters, and, if required, further dilution with water, to a saturating station, in the admixture of a sufficient quantity of lime for the formation of mono-saccharate," and in the separation and purification of the sugar by carbonic acid gas.—A. J. K.

XVI.—BREWING, WINES, SPIRITS, Etc.

Recent Advances in Brewing. C. J. Lintner. Dingl. Polyt. J. **263**, 518—525.

ULLIK has investigated the cause of the viscosity or palate-fulness of beer; he criticises Michel's results and conclusions, and lays down the following three conditions as necessary to the investigation of this subject:—

1. A method is necessary by means of which determinations can be made with sufficient exactness, in order to be able to determine the relative viscosity of different liquids.

2. By the aid of this method determinations of the viscosity of aqueous solutions of different substances at varying degrees of concentration must be made, and every substance which occurs in beer and wort as an important constituent must be thus examined.

3. Comparative determinations of the viscosity of different beers and of a number of worts, prepared in various manners, must be made.

Ullik's determinations were made with a modification of the ordinary viscosimeter, the capillary tube of which was of such a size that between the limits of 15° and 28° a difference of 1° of temperature made a difference of only one second in the time occupied by 50cc. of water in passing through the tube. Determinations with varying strengths of solutions of the salts, acids, peptone, albuminoids, glycerin, etc., which are present in beer in quantities less than 1 per cent., showed that these exercised no marked influence on the viscosity, but that it was governed in the case of beers by the dextrin, alcohol and maltose, and in the case of worts by the dextrin and maltose. The determination of the viscosity of a number of beers and worts compared with the quantitative estimation of extract, maltose, dextrin and alcohol gave rise to the following conclusions:—1. The viscosity is the greater the higher the percentage of dextrin, and the latter depends on the method of preparation and the concentration of the wort. The viscosity is certainly not directly proportional to the amount of dextrin present, since it is dependent upon three unequal factors. 2. It is possible to prepare by certain methods infusion worts which have the same viscosity as decoction worts from equal quantities of the same malt. 3. By slow mashing at a low temperature, and prolonged digestion at 50°, a wort is obtained of less viscosity than by mashing quickly at 75°, a result directly opposite to that obtained by Michel. 4. Boiling the thick mash increases the viscosity, the highest result being obtained, together with the greatest amount of dextrin, when the mash is directly boiled. 5. A malt kilned at a high temperature gives, under the same conditions, a wort of greater viscosity than a low-dried malt; in each case, however, this is due only to an increased percentage of dextrin and a decreased percentage of maltose.

Ullik sought to calculate the viscosity of beers, etc., from the data afforded by the determination of maltose, dextrin, alcohol, etc., in the given beer, and the numbers obtained in the above-mentioned estimations of the viscosity of solutions of these substances. He found, however, that there were considerable discrepancies between the calculated and experimental numbers. This he attributes to the presence of small quantities of substances, such as O'Sullivan's α and β-amylans, gums and pectous substances. He has endeavoured to separate and estimate the viscosity of these and similar substances in beer and wort, and has succeeded in obtaining small quantities of a series of bodies with a high rotatory power and viscosity.

Stockheim has introduced a new filter for beer, which is connected with an air-pump and worked under reduced pressure. It is said to filter perfectly bright 20 to 30 hectolitres per hour, without in any way affecting the taste of the beer.

Delbrück has investigated the influence of carbonic acid on the preservation of bottled beer. In former experiments the author proved that carbonic acid exercised an important influence in checking the growth and fermentative power of yeast, and he therefore concluded that carbonic acid might be used as an agent for stopping yeast growth and fermentation at any given point. He has now made experiments to test the efficacy of carbonic acid in stopping the further growth of yeast and the fermentation of the beer when in bottle. The results obtained show that carbonic acid under a pressure of 3 to 4 atmospheres does possess this influence, and completely stops the growth of yeast and prevents the consequent yeast turbidity.—G. H. M.

Extraction of Fusel Oil from Raw Spirit. F. Pampe. Chem. Zeit. **11**, 313—314.

The purification of raw spirits from fusel oils (propyl-, isobutyl-, amyl-alcohols and higher homologues) by purely chemical means has not yet been successfully accomplished. It is known that alcohols, under the influence of chemical agents, undergo decomposition, hence it follows potash, soda and lime must act not only on the fusel oil, but also on the ethyl-alcohol, and the employment of calcined magnesia, as lately proposed, can form no exception. The addition of alkalis is only useful when the raw spirit contains organic acids which must be neutralised in order to prevent the formation of the corresponding ethers, and for the same reason the addition of various acids (sulphuric, acetic, etc.) should be avoided, except when a refined spirit for a special purpose, as for the manufacture of rum, is desired, and even then it is better to mix the ether required for flavouring and the neutral refined spirit together than to use acids in the rectification. The best filter spirit which is found in practice cannot be considered as absolutely pure ethyl-alcohol. In the case of filtered spirit, the aldehyde of the raw spirit has been changed into acetic acid by the oxygen absorbed in the carbon filter, and this, on distillation, forms acetic ether, which must be regarded as a by-product and impurity in the finest spirit. If the acid in the filtrate be neutralised with lime or an alkali, the formation of ether on distillation is avoided and a spirit obtained that contains only a small quantity of by-products. This, however, is seldom done in practice, since customers are accustomed to the agreeable characteristic taste, and suppose it indicates the fineness of the product.

In consequence of the greater acidity of the mash lees the distillate obtained from it has also a characteristic agreeable aroma, which is not quite removed by distillation. But there is considerable difference between the finest filter spirit and the rectified spirit from the press lees. By filtration over wood charcoal, the aldehyde being changed into acetic acid, the retification is made more easy.

In the case of corn spirit the aldehyde remains unaltered, and it is only owing to the greater acidity of the mash on distillation that ethers are formed which mask the disagreeable smell of the aldehydes and fusel oils. The difficulty of the process depends upon the quality of the raw spirit, hence corn spirit is not in favour with refiners. The process of purifying from by-products is rendered more difficult by the addition of acids to the raw spirit than by the acidity of the mash lees, hence this method cannot be recommended.

Neither alkalis, alkaline earths nor acids can be considered suitable for extracting fusel oils from spirit, because they act similarly on all alcohols and do not simplify the process of rectifying. They should be employed only to neutralise the liquors.

As already mentioned, the acetaldehyde is the substance in the raw spirit which renders the extraction of the fusel oil by distillation so difficult. This is owing to the fact that it is readily soluble in the other components of the mixture and boils at 21° C. If the solubility of the acetaldehyde could be lessened and the boiling point raised at a moderate cost, a great improvement would be effected. The conversion of the acetaldehyde into paraldehyde, which is only slightly soluble in dilute alcohol and boils at 125° C., has unfortunately no value in practice, since the acetaldehyde is re-formed on distilling. The only method which is successfully applicable for this purpose is that of oxidising the aldehyde to acetic acid, and this process has the disadvantage already mentioned—*i.e.*, the formation of acetic ether.

The process of spirit filtration also merits attention, and apparently offers a field for inquiry. In large factories where 40—50 filters are in daily use, only one or two filters are replenished daily with freshly-burned

wood charcoal. The amount of fusel oil in the raw product can be estimated and also the quantity contained in the saturated filter. According to this, on steaming the filter a considerable quantity of fusel oil should be liberated (the complete disappearance of fusel oil takes place when superheated steam is used for this purpose). How does it happen that on steaming the carbon so little fusel oil is obtained? This considerable difference is not to be found either as ether or fusel oil in the distillate, neither in the early or final distillates nor in the residue in the retort. What has become of this fusel oil? If we consider the characteristic differences of the alcohols formed by fermentation—*i.e.*, the various amounts of carbon and hydrogen—we are led to inquire whether it may not be possible to convert the higher homologues into ethyl-alcohol by abstracting the group nCH_2. The phenomena apparent on the filtration of spirit lead to the conclusion that the fusel oil is removed by the filter carbon by physical attraction and chemical action.
—J. F. C. S.

Removal of Fusel Oil from Crude Spirits. F. Pampe. Chem. Zeit. **11**, 379.

In reply to a criticism of Pfeiffer (this Journal, 1887, 514), the author remarks that only those defuselation agents are of value which oxidise the aldehydes and reduce the amount of fusel oil. These agents cannot be compared with animal charcoal, whose action is both chemical and physical. He recommends, however, an agent which may be less known. In former years the charcoal was treated with manganese dioxide and sulphuric acid, and a pleasant odour was thus gained for the product. The action of these agents obviously depends on the evolution of oxygen, oxidation of the aldehyde and the formation of ether. The employment of this is not to be recommended, unless it is for the production of a certain sort of brandy.—G. H. M.

Brandy Distillation in Switzerland. Ber. d. k.k. Consulates in Zürich. Österr-ungar. Brauer. Zeit. 1887, 118.

The total production amounts to 50,000 hectolitres, and it is obtained from potatoes, maize and residual matters from the brewery. Only in six distilleries is the raw spirit obtained by a continuous apparatus, and it then contains about 1·32 per cent. of fusel oil. The rectification is mostly insufficient; raw spirit filtered through charcoal showed 0·2 per cent. of fusel oil, rectified by distillation 0·06 per cent., and by filtration with subsequent distillation none. A brandy from a distillery in the Berne district contained 70 per cent. of alcohol and 0·75 per cent. of fusel oil. The residuary liquors are worth about 50cts. per hectolitre. The cost of production of absolute alcohol varies from about 90·6frcs. at small and medium sized works to about 60frcs. at the large establishments.
—W. G. M.

On the Delicacy of Hansen's Method of Detecting the Contamination of Bottom Yeast with Wild Yeast. C. Holm and S. V. Poulsen. Der. Bierbrauer, **18**, 80—82.

This method depends on the rate of development of ascospores in the different yeasts. The authors have made experiments with saccharomyces cerevisiæ, and the following wild yeasts:—S. Pastorianus I, S. Pastorianus II, and S. Ellipsoideus II. At 25° C. the last three form ascospores in 25—28 hours; the first only contains a few after five days. Experiments with mixtures of these, cultivated on plaster of Paris blocks, at 25° C. for 40 hours, were carried out, together with check experiments on pure cultures. It was found that the presence of wild yeast, representing only $\frac{1}{200}$th of the mass, could be detected by observing the formation of ascospores. This degree of delicacy, according to Hansen, is sufficient. The method can be employed with other forms as well, but it will not always be possible to work at the same temperature.—F. W. T. K.

On the Presence of Copper in Wine. Leopold Weigert. Die Weinlaube, **19**, 27—28.

Copper has been detected in wine from vines, the leaves of which had been treated with a solution of copper sulphate, an excellent protective against *Peronospora*. The fear that the drinking of such wine might lead to chronic copper poisoning seems to be groundless, as, according to experiments by Theodor Count G. de la Tour, one litre of such wine only contains 0·000002—0·000026grm. of copper.—F. W. T. K.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(*A*) CHEMISTRY OF FOODS.

Artificial Butter from a Sanitary Point of View. M. Schrodt and Fleischmann. Bied. Centr. **16**, 270—277.

The conclusions arrived at may be summed up as follows:—Artificial butter prepared from good fat may be looked upon as perfectly wholesome food; but as it appears to be somewhat less digestible than butter, the latter should be given to invalids and children in preference. No serious objection can, therefore, be raised against the sale of artificial butter, provided (1) that only good fat from healthy animals has been used in its preparation; (2) that it is sold as an artificial preparation, and that the word "butter" is left out of the name of the product, as its presence is misleading; (3) that it is not mixed with true butter for the purpose of preparing so-called "mixed butters" (N.B.—The sale of such mixed butters should be prohibited, as they are mainly prepared for fraudulent sale); (4) that vegetable oils are not used as an ingredient. Official supervision of the artificial butter factories is considered necessary, particularly for the purpose of seeing that proviso (1) is enforced. For though, no doubt, there are a number of honest artificial butter factories, which sell a carefully prepared wholesome article, there is very little doubt but that a large trade is carried on in artificial butter prepared from material of very doubtful quality. The latter is prepared from the fat obtained from unknown sources, and no precautions are taken to exclude the fat of unhealthy or diseased animals. Bad fat has even been used which had to be deodorised by treatment with sulphuric acid and saltpetre. The majority of patents recommend a temperature of 40—50° C. in the preparation of artificial butter. A high temperature is supposed to spoil the flavour. At these temperatures, however, animal and vegetable parasites are able to live; many of the latter would not even be destroyed at 100° C. Such living parasites may, therefore, occur in artificial butter, more especially if pig's fat be employed, and, in fact, Dr. Piper, of Chicago, has demonstrated their presence in artificial butter.—F. W. T. K.

Feeding Experiments with Dried Brewers' Grains. T. Schiller. Bied. Centr. **16**, 282. (Zeitschr. f. Spiritus Industrie **10**, 19.)

The quality and quantity of milk obtained from cows fed on dried returns (proteïn, 22·7 per cent.; fat, 7·8 per cent.; non-nitrogenous extractive matter, 39·4 per cent.) proved highly satisfactory. Analysis of the milk gave—water, 85·37 per cent.; nitrogenous matter, 4·7 per cent.; fat, 3·71 per cent.; milksugar, 5·42 per cent.; salts, 0·80 per cent. The milk, therefore, contained 2·05 per cent. of solids more than average normal milk. Good results were got with the following daily quantities per head (in lbs. German):—3lb. dried returns, 1lb. rye-bran, 1lb. linseed cake, and 25lb. of beets and mushrooms. 9½—10 litres per head of milk were obtained. Horses and ewe-lambs thrive well on returns.
—F. W. T. K.

The Freezing of Normal Cows' Milk. O. Hengold. Milchzeitung, **15**. 461—462.

THE author has analysed milk, samples of which were frozen either slowly or rapidly, whilst being stirred up or left quiet, and has found that the milk-ice always contains more water and less solid residue than the portion which has remained liquid. Frozen milk should therefore always be thawed and well mixed before being analysed.—F. W. T. K.

A New Adulteration of Linseed Cake. Ad. Mayer. Milchzeitung, **16**, 143—144.

THE author draws attention to the presence of the finely-ground husks of ground nuts in linseed cake as a sophistication. In the sample examined the husks were detected microscopically, and as the percentage of cellulose (Zellstoff-Rohfaser) was found to be 22 per cent., whereas good, pure linseed cake only contains 8 per cent. on the average, at least 14 per cent. of ground nut husks must have been added, for the latter do not by any means solely consist of cellulose.—F. W. T. K.

Improvements relating to the Preservation of Alimentary Substances. H. H. Lake. London. From M. Muller, St. Petersburg, Russia. Eng. Pat. 7644, June 7, 1886. 6d.

THE substance to be preserved is placed in a hermetically sealed vessel and heated to a temperature, previously determined experimentally, by means of a steam or hot-water bath. It is then removed and allowed to stand and cool; a succession of similar periods of cooking and cooling follow until the operation of complete cooking is concluded. If, after standing three weeks, the tins in which the material is sealed show no signs of convexity, the operation is deemed successful. When particular flavours are desired to be imparted the material is previously partially cooked by the usual method, which determines the flavour. The specification contains a table showing the temperatures and duration of cooking and cooling experiment has shown to be best or each particular substance.—C. C. H.

Improvements in the Manufacture of Liquid Extract of Coffee. M. Samuelson, New York, U.S.A. Eng. Pat. 17,017, Dec. 28, 1886. 6d.

COFFEE is first steeped in water at a temperature of 40° for three or four hours, "until the aromatic oils and fatty substances are extracted;" the extract so obtained is pressed out from the coffee, which is next saturated with water at 90° and allowed to stand 30 hours, in order to extract the caffeine and kindred substances; after the removal of the resulting infusion, as before, the coffee is finally steeped in boiling water for half an hour or so. The three extracts are mixed together.
—E. G. C.

An Improved Process for Producing Albumen-maltose or Dietary Malt Powder for Food. A. R. Leerbeck and J. F. Holm, Copenhagen, Denmark. Eng. Pat. 6285, April 29, 1887. 4d.

BY special treatment of wheat flour a very pure starch is obtained which is converted, by means of diastase at 65° C., into maltose and dextrose. To the solution of these two bodies are added albumen materials, chloride of sodium and sulphate of lime. The whole is evaporated and the residue dried and ground. From the impure residue of the wheat flour a second quality finishing starch is prepared.—A. J. K.

(B) SANITARY CHEMISTRY.

The Purification of Waste Waters. E. Reichardt. Arch. Pharm. 1887, 252.

THE author has made special experiments on the separation of arsenic from waters.

Separation of As_2O_3 by Lime.—The addition of a slight excess of lime water with rapid stirring produces an immediate deposition of an easily separable precipitate, only 2 per cent of the arsenic remaining in the liquid after treating a 0·1 per cent. solution of arsenic trioxide. The addition of ferric chloride causes complete precipitation, both of arsenious and arsenic acids.

Precipitation by Magnesia.—Even air-dried precipitated magnesium hydroxide added to the liquor left 66 per cent. of the arsenic in solution; other oxides were still less efficient. But when the mixture was warmed to 50—60° C. for some hours, only 1 per cent. of the As_2O_3 was unprecipitated.

Separation of Colouring Matter.—Magnesia was found to be preferable to lime, but the organic matter in the water experimented with was reduced only from 38·4 to 16 parts per 100,000.—W. G. M.

Experiments and Researches on the Use of Zinc-coated Iron Water-Pipes. H. Bunte. Schilling's Jnl. f. Gasbel. u. Wasservers.

AS the result of a discussion at a recent meeting of the German Society of Gas and Water Engineers, the author has collected information from various sources, which tends to show that the use of galvanised pipes should be in no way detrimental to health. According to Dr. V. Ehmann, late director of the water supply in Würtemburg, objection to such pipes cannot be taken on sanitary grounds and he considers them peculiarly suitable for use in the interior of buildings. Dr. Boardmann, of Boston, has found that newly-coated tubes give up zinc to the water flowing through them, but in quantities so small as to be perfectly harmless.
—W. G. M.

On the Increase of Bacteria in Water. G. Wolffhügel and O. Riedel. (Arbeiten a. d. kaiserl. Gesundheits. I. 455—480.)

AT temperatures between 3—23·8° C., water containing traces of nutritive matter showed a greater or less increase in the number of bacteria corresponding to the higher or lower temperature. A *decrease* in the number of germs was invariably observed in water placed in ice. Certain forms of bacteria are not, however, so easily affected by cold as others, for ice usually contains germs still capable of development. According to Gärtner mechanical motion aids the increase of germs even at 6—11° C. In water analysis these facts should be taken into account. Anthrax and typhus bacilli developed well at 30° C., and even at 12—15° C. in water taken from contaminated streams. Water which has satisfactorily passed chemical examination, may for weeks still be capable of providing the conditions necessary for maintaining the power of development of the typhus bacilli. These bacilli were also found to develop well in milk. Cholera germs present in water containing other germs as well were soon superseded by the latter. Cholera germs increased slowly in sterilised milk, but rapidly at 20—24° C. The rapid development of the organisms contained in non-sterilised milk produced an acidity which prevented the further growth of the cholera germs.—F. W. T. K.

Apparatus for and Mode of Clarifying Sewage and Filtering large Volumes of Water. T. Reid, Normanton. Eng. Pat. 4544, April 1, 1886. 8d.

THE sewage is received in tanks, worked three in a series, where it is settled and defecated and the effluent passed therefrom on to filtration areas, which are sometimes used singly and at others in duplicate. The details of the invention are claimed at length under twenty-four heads.—C. C. H.

Improvements in or Additions to Means or Apparatus employed in the Manufacture of Coke for the Desiccation and Incineration of Precipitants or Solids resulting from Sludge or other Substances liable to Putrefy. R. de Soldenhoff, Cardiff. Eng. Pat. 7482, May 23, 1887. 11d.

THESE improvements relate to the system of incineration described in Eng. Pat. 2721 of 1866 and Provisional

Specification 12,259 of the same year, and consist mainly of locating the incinerating furnace between two coke ovens, instead of above the coke ovens as therein proposed. A hopper is placed above the furnace, in which the sludge is received from the truck, and in which it undergoes a preliminary drying before incineration. The specification is accompanied by full drawings showing the disposition of flues, etc.—A. R. D.

XVIII.—ELECTRO-CHEMISTRY.

Improvements in the Preparation or Manufacture of Negative Elements for Voltaic Batteries. D. G. Fitzgerald, London. Eng. Pat. 7636, June 7, 1886. 6d.

This invention relates to an improved method of manufacturing the "lithanode" negative elements, described in Eng. Pat. 4671, 1885, and consists in obtaining the granular peroxide of lead by mixing litharge with a salt or acid, which causes it to set, and passing the plastic mass through a sieve before the reaction is complete; peroxidation is then produced by treatment with chlorine or a hypochlorite. These granules are mixed with plastic oxide of lead, formed into plates and allowed to "set," or placed in a frame of celluloid, or made to surround a suitable negative element such as carbon.—B. T.

Plates without Support, entirely made of Active Material, for Voltaic Batteries. E. Andreoli, London. Eng. Pat. 8842, July 6, 1886. 8d.

These plates are cast from a fused mixture of metallic salts, preferably composed of chloride of lead and chloride of zinc, with a paste of manganese peroxide and hydrochloric acid. To add to the conductivity of the plates, a skeleton of platinum wire or copper wire, contained in a leaden tube, may be surrounded by the fused mass. A leaden frame is then cast round the plates with terminals for connecting them, and the chloride of lead is reduced to a metallic state in a bath of chloride of zinc, the last traces of chlorine being removed by submitting the plates to an electric current. After the plates have been dried they are ready for peroxidation.
—B. T.

Improvements in and relating to Primary and Secondary Batteries. H. H. Lake, London. From W. J. Ludlow, Cleveland, U.S.A. Eng. Pat. 6869, May 10, 1887. 8d.

The time of formation of battery plates is lessened and the amount of their active surface increased by placing them in an air-tight vessel, exhausting the air and then introducing the electrolyte under pneumatic pressure, so that it is forced into the pores of the plates. Two modes of arranging the plates of a battery are described.
—B. T.

Secondary Batteries or Magazines of Electricity. J. S. Sellon, London. Eng. Pat. 3987, Sept. 15, 1881. (IV. Edition of Spec.) 8d.

An alloy of lead with antimony is used to give hardness and durability to the plates, which plates may be composed of perforated strips, tubes or woven fabrics of the above alloy.—B. T.

A Compound for Covering Electric Wires, applicable also for other Purposes. H. W. Merritt, Somerville, Mass., U.S.A. Eng. Pat. 6927, May 11, 1887. 4d.

The ingredients of this compound are silicate of soda, fir balsam or an equivalent, asbestos, sugar, oxalic acid and water.—E. G. C.

A Compound for Covering Electric Wires. H. W. Merritt, Somerville, Mass., U.S.A. Eng. Pat. 6928, May, 11, 1887. 4d.

This compound is an intimate mixture of quicklime, fir balsam, asbestos, sugar, oxalic acid and water.
—E. G. C.

XIX.—PAPER, PASTEBOARD, Etc.

Improvements in Waterproofing and Sizing Paper, and such like Material. C. Meygang, London. Eng. Pat. 7904, June 12, 1886. 6d.

For the purpose of producing a waterproof paper or paper material, the inventor adds to the fibrous pulp in the beater a resinous or fatty size, or a mixture of resinous, fatty and oily substances, such as resin, tallow and petroleum, also starch gelatinised by the action of a solution of caustic alkali. Various mixtures are described for different purposes.—H. A. R.

Improvements in the Manufacture or Treatment of Paper. C. Morfit, London. Eng. Pat. 8148, June 19, 1886. 6d.

The inventor claims that by this method of manufacture, paper is toughened differently from any other now in the market and that this applies more particularly to thin and inferior grades of news and wrapping papers. The soluble matter of sea-weeds such as Carrageen, Agar-Agar, etc., is to be extracted by means of boiling water, and the extract forms the bath with which the paper is to be treated. If desired, resin soap and aluminous cake may be added, but these rather serve to size the paper and increase the rustle than to toughen it.

The above mentioned liquor may be applied either to the web or to the pulp in the engine.—H. A. R.

Improvements in the Manufacture of Paper Pulp and Papier-Mâché. A. Wilkinson, London. Eng. Pat. 8493, June 28, 1886. 6d.

About 1cwt. of any vegetable fibre is placed in a "pit" with water after being sprinkled with quicklime and crystal soda. After a time, this material is removed and placed in a tank containing 1lb. each of sulphuric, hydrochloric and acetic acids to 40 gallons of water, "for loosening the gum and resinous matter in the fibre."

The next process is boiling with "a quantity of crystal soda, soap, common potash and bi-sulphate of sodium, the liquor being boiled for about eight hours, until the resinous and gummy matters are discharged."

According to the patentee, "fibre thus treated is fit for papier-mâché purposes, but any bleaching operation will fit it for ordinary paper. I prefer, however, to prepare a bleach composed of say 1lb. sulphohydrate and sulphuret of barium, 4oz. cyanide of potassium, and 4oz. of oxide of calcium, to which may be added a small quantity of ammonia. These ingredients are broken down in warm water, or I make a bleach of chlorine, chloride of lime dissolved at a boiling heat with 4oz. of soda, a little sulphur, 2oz. of cyanide of potassium and 1lb. of ammonia which is dissolved in 30 gallons of water at about 150° F."

A recipe is also given for what the inventor terms "dry bleach," consisting of sulphuric acid, "salts of lemon or of tin," and "solid ammonia."—H. A. R.

An Improved Method of and Apparatus for Treating Spent Hops for use in the production of Pulp for Paper and Millboard. E. Davies, London, and H. F. Harris, Fleet. Eng. Pat. 8936, July 8, 1886. 8d.

This invention relates to methods and apparatus for cleaning, drying, separating and sifting the spent hops as received from breweries. It is claimed that in this way pulp is produced suitable for the manufacture of paper and millboard.—H. A. R.

Improvements in the Manufacture of Paper Pulp from Moss Peat. A. J. Boult, London. From A. Ubbelohde, Hanover. Eng. Pat. 9178, July 14, 1886. 8d.

The main features of this invention are the manufacture of paper pulp from moss peat by soaking and agitating the same so as to separate it into its component parts, the detached moss leaves being separated from the stalks and other foreign matter by means of a sieve. Secondly, the manufacture of paper pulp from moss peat by means of the rag-engine, in which the said material is either used alone or else together with other stock.—H. A. R.

Improvements in Carbonising Wool, Rags and the like. G. Tolson, Dewsbury, and J. Illingworth, Batley. Eng. Pat. 13,498, Oct. 22, 1886. 4d.

THIS invention refers "to the use and employment of an oscillatory rotary cage or cylinder working horizontally in a machine employed for carbonising fabrics or fibres, so that the said fabrics are more effectually agitated within such cage or cylinder." (Compare this Journal, 1883, 476, and Eng. Pat. 13,497, 1886.)—H. A. R.

Improvements in the Manufacture of Paper from Wood, and in Apparatus therefor. G. Pitt, Sutton. From R. P. Pictet, Geneva, and G. L. Brélaz, Lausanne, Switzerland. Eng. Pat. 5269, April 9, 1887. 8d.

THE inventor claims to be able by his new method and apparatus to reduce to a point of exceptional cheapness the process of manufacturing cellulose from wood by the use of dilute SO_2 solution only, obtained by the combustion of pyrites and condensation of the gas produced in a peculiar tower. A recovery process is also described. For particulars the specification must be consulted.—H. A. R.

Manufacture of Waterproof and combined Water and Fire-proof Paper. L. Bastet, New Jersey, U.S.A. Eng. Pat. 5296, April 12, 1887. 4d.

PAPER stock, and more particularly asbestos stock, is treated during the process of manufacture with a waterproofing composition, consisting of mineral oil, stearic acid, tallow, fucus or Irish moss and caustic alkali at the rate of 5 to 15 per cent. on the material employed. When well saturated, the pulp is to be treated with sulphate of alumina. It is claimed that this composition has a hardening and strengthening effect upon the paper, more especially where asbestos is employed, and makes tougher paper for any use.

—H. A. R.

A Novel Xylonite, Celluloid or Pyroxylin Fabric, suitable for making Shirt Fronts, Collars, Cuffs, Hats and Bonnets, and for other purposes. The British Xylonite Company and Levi P. Merriam, Homerton. Eng. Pat. 7738, May 27, 1887. 4d.

THIS invention relates to the manufacture of a striped or lined xylonite, celluloid or pyroxylin fabric suitable for the above purposes by superposing in suitable order a number of sheets of these substances of the several colours required in the fabric, compacting these sheets into a solid block or body and then cutting this block or body into sheets at right angles to the strata.

—H. A. R.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

On a New Modification of Tannic Acid in the Berries of the Rowan-tree. C. Vincent and Delachanal. Bull. Soc. Chim. 1887, **47**, 492.

To isolate this new modification of tannic acid from the juice of the berries of *Sorbus aucuparia*, the juice was allowed to ferment, for the purpose of decomposing the glucose, then clarified with a little lead acetate and, finally, precipitated by an excess of the reagent. The lead salt was decomposed by sulphuretted hydrogen, and the filtrate evaporated in vacuo. The residue was then extracted with absolute alcohol and the solution again evaporated in vacuo. The tannic acid remained as a thick syrup, which could not be crystallised. It resembles mori-tannic acid, and particularly caffe-tannic acid, but unlike these acids produced in its solutions, a precipitate with lead nitrate of a pure lemon-yellow colour (caffe-tannic acid gives a white precipitate). Gelatin solutions are not precipitated (mori-tannic acid causes a precipitate in them) nor are quinine salts by this new tannic acid, termed sorbitannic acid by the authors. On distillation it yields a thick brown liquor, containing much catechol. In the potash-melt, protocatechuic acid and phloroglucinol were observed.—A. R.

Manufacture of Santonin. A. Busch. J. Prakt. Chem. **35**, 322—341.

Artemisia Cina or *Maritima*, the principal source of santonin, is found on the steppes of Kirghiz, and the cost of carriage is consequently an important item. To obviate this as far as possible a factory has been established at Orenburg, the terminus of the Russian railway; and in 1884 a St. Petersburg firm started a factory at Tschimkent, which is 3200 kilometres beyond Orenburg. The great advantages possessed by the latter manufactory are to some extent counterbalanced by the cost of and loss by transport across the steppes and desert of the necessary hydrochloric acid. In spite of this this factory can place santonin in the market at Hamburg at 18 marks per kilo. The santonin is extracted from the plant by treating the latter with very thick cream of lime. The mixture of seeds and lime is ground with water, the temperature rising so as to drive off the excess of water. Hot alcohol is now added to the cooled mixture, and the extracted juice after removing the alcohol is neutralised with hydrochloric acid. After a few days the crude santonin crystallises out and is washed with cold water. This process depends on the formation of a calcium salt readily soluble in alcohol; this on the addition of hydrochloric acid is split up, and santoninic acid ($C_{15}H_{20}O_4$) set free, which with the loss of a molecule of water is converted into santonin ($C_{15}H_{18}O_3$). In the extraction of santonin a quantity of resinous substance is formed, which on treatment with warm sodium carbonate solution yields a large quantity of santonin. It was found that animal charcoal, which is used to decolorise the alcoholic solution of the crude product, absorbs a considerable quantity of santonin. The amount of pure santonin obtained amounts to 1·8—2·0 per cent. of the plant originally taken.

Santonin crystallises in flattened columns or in feather-like radiating crystalline groups with a pearly lustre, sp. gr. 1·247 at 20°; it melts at 168—170°. It can be sublimed, but with difficulty, since the sublimation and decomposition points lie close together. Hydrochloric acid causes santonin to resinify; it is more soluble in hot than cold acid. Sulphuric acid dissolves santonin, and the solution in strong acid is completely decomposed on warming, with evolution of sulphur dioxide; dilute acid decomposes it with formation of glucose and other substances, showing that it is a glucoside. Nitric acid also dissolves santonin. The hydroxides of the alkalis and alkaline earths combine with santonin, forming salts more or less soluble in alcohol. The potassium salt is only obtained with difficulty in a crystalline state. When potassium hydroxide is mixed with santonin the characteristic carmine-red coloration is produced. The sodium salt $C_{15}H_{19}NaO_4$ is easily obtained in fascicular prisms. Both the sodium and potassium salts are easily soluble in water and absolute alcohol, and are decomposed by acids. The calcium salt, which is formed in the extraction of santonin, crystallises in colourless, very fine silky needles, soluble in water and dilute alcohol, almost entirely insoluble in absolute alcohol; acids decompose the salt with precipitation of santonin, but it is not decomposed by carbonic anhydride.

Barium santoninate $(C_{15}H_{19}O_4)_2$ Ba is analogous to the calcium compound.

When salts of the heavy metals are added to a solution of potassium santoninate the corresponding salts are thrown down; if these salts are boiled with water they are decomposed with formation of pure santonin and the oxide of the metal.

Santonin resin, which results from the action of acid upon santonin, and is most readily obtained by heating santonin with concentrated hydrochloric acid in sealed tubes, appears according to the author to consist of a number of substances which are formed by the decomposition of santonin. This resin prevents santonin from crystallising out, and the best method of separating the resin and santonin is by means of the metallic salts of the latter.—G. H. M.

On the Constituents of Calamus-root. H. Thoms. Chem. Zeit. **11**, 118.

THE author finds that the substance which was supposed to be an alkaloid, and which he had described in a previous communication (*Chem. Zeit.* **10**, 139) under the name calamine, is methylamine. The other constituent of calamus-root, acorin, appears to have the composition $C_{36}H_{60}O_6$. On treatment with dilute acids and alkalis in an atmosphere of hydrogen, or in contact with ferments, it splits up into sugar and the ethereal oil of calamus, according to the equation: $C_{36}H_{60}O_6 = C_6H_{12}O_6 + 3C_{10}H_{16}$. When the aqueous extract of calamus is distilled with caustic potash a large quantity of ammonia is evolved and the distillate is found to contain methyl-alcohol, due to a partial decomposition of the methylamine contained in the root into ammonia and methyl-alcohol. This explains the occurrence (pointed out by Gutzeit) of methyl-alcohol in the distillation-products of calamus-root.—D. E. J.

Short Notice on Saccharine. F. Witting. Chem. Zeit. **11**, 314.

THE author considers that saccharine was obtained by him in the course of the following experiments already in 1879. Paratoluenesulphamide was converted by oxidation into the corresponding acid, parasulphamidobenzoic acid, thus: $CH_3.C_6H_4.SO_2.NH_2 + O_3 = COOH.C_6H_4.SO_2NH_2 + H_2O$. The paratoluenesulphamide (melting point 135°, and not 137° as given by Wolkow) is ground together with pyro-chromate of potash and concentrated sulphuric acid, the best proportions being 4grms. of the amide, 9grms. pyro-chromate of potash, and an excess of sulphuric acid. The last must be added by degrees, otherwise the temperature is raised and the amide melts and is only attacked with difficulty. After about six hours the parasulphamidobenzoic acid was produced, which crystallises from water in small glittering rhombic tablets, melting at 245° C., but commencing to decompose at 235° C. On one occasion when making the above experiment, in addition to the parasulphamidobenzoic acid, there was produced an intensely sweet tasting oxidation product which was not obtained on again repeating the experiment. It dissolved readily in alcohol and ether, but with difficulty in water, and crystallised from various solvents in small, white, wart-like masses, the melting point of which was 111—112° C. A combustion of this body gave no clue to its constitution, probably because it was not thoroughly purified from the amide. Acid sodium sulphite gave with this sweet substance small needle-shaped crystals, insoluble in ether and possessing a bitter taste. If to the aqueous solution HCl and ether be added the original sweet substance is produced again. The author supposes from these results that he had thus prepared parasulphamidobenzaldehyde, whilst from later investigations saccharine is apparently sulphamidobenzanhydride.—J. F. C. S.

Timbo. Chem. Zeit. **11**, 315.

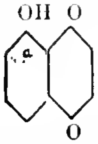
THIS is the name of a new narcotic medicine, the root rind of the *Conchocarpus Peckolti*. The rind appears in the form of tubes or rolls, is bright reddish brown on the outside and yellowish on the inside. The outer and middle rind break off short, but the inner rind has a long fibrous fracture and the interior colour is whitish. It possesses a weak aromatic taste somewhat like cascarilla bark, but has no special odour. A cross section shows an interrupted yellow zone near the outer side, whilst the inner rind is faintly streaked in radiating lines. Some of the cells contain crystals of calcium oxalate.—J. F. C. S.

New Drugs. Chem. Zeit. **11**, 379.

Radix Aristolochiæ Cymbiferæ.—The underground parts of very many Aristolochiæ are distinguished by a particularly strong and unpleasant smell and camphor-like taste. They have been long used as antidotes against snake bites and also in malignant fevers, etc. There are 13 species known in Europe and 14 species in America. The constituents of the Aristolochix have been very little investigated. The root in question, which is a native of Brazil, and occurs in pieces about 10cm. long, the thicker of which are split, is greyish brown, with longitudinal corrugations. A section shows a thick bark and considerable radiated woody tissue. The woody tissue contains wide spotted vessels and also spotted woody fibre. The bark and pith fibres contain much amylum, besides a mixture of yellow resin and ethereal oil in numerous slightly enlarged cells. In outward appearance thin pieces of the drug somewhat resemble *Rad. Aristoloch. long.*, which, however, contains much smaller and less numerous woody-tissue.
—G. H. M.

Constitution and Synthesis of Juglon. A. Bernthsen and A. Semper. Ber. **20**, 937—941.

JUGLON, or oxynaphthoquinone, gives on oxidation juglonic acid or dinitro-α-oxyphthalic acid. Juglon will, therefore, have the following constitution:—



Juglon may be artificially obtained by oxidation of $\alpha_1\alpha_3$ dioxynaphthalene. According to Armstrong, dioxynaphthalene is prepared by the action of chloro-sulphonic acid upon naphthalene dissolved in CS_2. The excess of CS_2 is driven off, the residue dissolved in water, treated with lead carbonate, the lead salt of the sulphonic acid converted into the sodium salt and the latter fused with caustic potash. On adding acid, the dioxynaphthalene separates as a crystalline precipitate. Dioxynaphthalene mixed into a fine paste with water, is oxidised with chromic acid mixture in the cold, the brown precipitate resulting brought on to a filter, washed and extracted with ether. To the ethereal solution a small quantity of petroleum ether is added to precipitate impurities which are filtered off and the filtrate evaporated to dryness. The product on re-crystallisation yields the characteristic needles of juglon, with the peculiar smell of nut-shells. It dissolves in dilute alkalis with characteristic purple colour, and in concentrated H_2SO_4 with an intense blood-red coloration. The other properties are identical with those of the natural product.—J. B. C.

Coccerylalcohol and Coccerio Acid. C. Liebermann and O. Bergami. Ber. **20**, 959—966.

COCCERIN is a crystalline wax obtained from the cochineal insect. This substance may be resolved into coccerylalcohol and cocceric acid. Coccerylalcohol when treated with acetic anhydride yields an acetic ether of the formula $C_{30}H_{60}(O.C_2H_3O)_2$. With benzoic anhydride the benzoic ether of analogous constitution is obtained on oxidising cocceryl alcohol with chromic acid in acetic acid solution; an acid is obtained containing a small quantity of an indifferent substance, probably a derivative of cocceric acid, from which it is with difficulty purified. The acid is pentadecylic acid $C_{15}H_{30}O_2$. Cocceric acid when oxidised with chromic acid yields, in addition to a large quantity of unchanged cocceric acid, a new acid, which may be separated by its much more ready solubility in acetic acid. This acid is likewise pentadecylic acid. The methyl ether has the formula $C_{15}H_{20}O_2CH_3$.—J. B. C.

New Drugs from the Namaqua Country (South-West Africa). Chem. Zeit. **11**, 755—819.

1. *Jon.* It forms transverse sections of a pulpous angular stalk of 2 to 3cm. diameter. The drug swells very much in water and has a sweet taste. It is applied against hemorrhoids. 2. *Naheib.* A thick root covered with a light brown bark. It is useful against diseases of the uterus. 3 *Rabass.* Fragments of stalk and leaves, which taste and smell like oil of thyme. 4. *Blue Shrub.* Fragments of a green bark, which is used as a "healing plaster." The bark is probably derived from *Rhus tomentosa.* 5. *Wild Gourd.* The drug represents fragments of a root, probably from *Cucumis Citrullus Ser.*, which is very common in that country. It is said to produce blisters like cantharides. 6. *Jabi.* A root with a thin reddish skin, the taste of which is sweet at first, but afterwards bitter. It is applied against gonorrhœa. 7. *Ici heib.* A wood-like stalk. 8. *Kau.* Brown seeds of the size of a pea and rich in oil. 9. *The Seeds of Acacia Giraffae.* They are oval and of a greenish-brown colour. There is on each side of the seed a light-coloured circle, the interior of which is brown. The roasted seeds are used as a substitute for coffee and furnish a beverage of pleasant taste and nutritious value. 10. *Klipswilt.* A brown, thickish extract of salty taste, soluble in water. On heating it gives off a smell of urine, and its preparation has probably a mysterious and unpleasant origin. It is applied against diseases of the uterus.—S. H.

The Manufacture of Cocaïne and the Valuation of Coca Leaves. H. T. Pfeiffer. Chem. Zeit. **11**, 783, 784 and 818.

COCAÏNE is manufactured from the dry leaves of the *Erythroxylon coca*, which grows in the valleys of the East Cordilleras of South America—*i.e.*, in the interior of Peru and Bolivia. The fresh leaves contain 0·003 to 0·006 per cent. of cocaïne, which percentage decreases considerably if the leaves are stored any length of time before being worked up. On the other hand, the alkaloid can be transported and kept without decomposition. This circumstance caused the author to devise a simple process for the manufacture of crude cocaïne on the spot, neither Peru nor Bolivia being suitable countries for complicated chemical operations. After many experiments, he hit upon the following plan:—The disintegrated coca-leaves are digested at 70° C. in closed vessels for two hours, with a very weak solution of sodium hydrate and petroleum (boiling between 200° and 250° C.). The mass is filtered, pressed, while still tepid, and the filtrate allowed to stand until the oil has completely separated from the aqueous solution. The oil is drawn off and carefully neutralised with very weak hydrochloric acid. A white bulky precipitate of cocaïne hydrochloride is obtained together with an aqueous solution of the same compound, while the petroleum is free from the alkaloid and may be used for the extraction of a fresh batch of leaves. The precipitate is dried and by concentrating the aqueous solution a further quantity of the hydrochloride is obtained: both can be shipped without risk of decomposition. The product is not quite pure, but contains some hygrine, traces of gum and other matters. Its percentage of alkaloid is 75 per cent., while chemically pure cocaïne hydrochloride ($C_{17}H_{21}NO_4.2HCl$) contains 80·6 per cent. of the alkaloid. The sodium hydrate solution cannot be replaced by milk of lime, nor can any other acid be used for neutralisation. Alcohol or ether are not suitable for extraction. A repetition of the process with once extracted coca leaves gave no further quantity of cocaïne, proving that all the cocaïne goes into solution by one treatment. The same process serves on the small scale for the valuation of coca leaves. 100grms. of coca leaves are digested in a flask with 400cc. of water, 50cc. of $\frac{1}{10}$ NaOH (10grms. of NaOH in 100cc.) and 250cc. of petroleum. The flask is loosely covered and warmed on the water bath for two hours, shaking it from time to time. The mass is then filtered, the residue pressed and the filtrate allowed to separate in two layers. The oil layer is run into a bottle and titrated back with $\frac{1}{100}$ HCl (1grm. of HCl in 100cc.) until exactly neutral. The number of cc. of hydrochloric acid required for titrating back multiplied by 0·042 gives the percentage of cocaïne in the sample. The following are some of the results with different samples of coca leaves of various age:—

	Contained per cent. of Cocaïne.	
Coca-leaves from Mapiri, 1 month old	0·5	Of the weight of the dry leaves.
,, ,, ,, Yungas ,, ,,	0·5	
,, ,, ,, Mapiri and Yungas 6 months old	0·4	
,, ,, ,, Cuzco (Peru) 6 months old	0·3	
,, ,, ,, Mapiri and Yungas 1 year old	0·3	
,, ,, ,, Cuzco ,, ,,	0·2	
,, ,, ,, Mapiri and Yungas 2 years old	0·15	

Coca leaves from Yungas and Cuzco, three years old, contained no trace of the alkaloid, whereas fresh green leaves from Yungas contained 0·7 per cent. of the weight of the dry leaves. The same process is also applicable for the manufacture of quinine from poor quinine bark, with the single alteration that weak sulphuric acid must be used for the neutralisation of the alkaline petroleum extract.—S. H.

Improvements in the Manufacture of Salicylic Acid "Esters." M. v. Nencki, Berne, Switzerland: and C. Kolbe, Dresden, Germany. Eng. Pat. 8018, June 16th, 1886.

THESE compounds, which are termed "salols," as well as their properties and manufacture, have been described at length in this Journal, 1886, 577—578.—E. G. C.

Improvements in the Production of Peptone from Nucleo-proteines. W. Merck, Darmstadt, Germany. Eng. Pat. 8468, June 28, 1886. 6d.

THE inventor claims:—(1) A process of eliminating the nucleïne by digesting the caseïne, for example, with water, dilute acid or dilute alkaline lye, under pressure and at a temperature of 150—170° C, and filtering: (2) a process of eliminating the nucleïne by digesting with dilute alkaline lye at 80—90° C., neutralising with acid and filtering: (3) the elimination of the nucleïne by digesting with a ferment, or ferment-containing substance, acting in an alkaline or neutral solution, neutralising and filtering.—E. G. C.

XXI.—EXPLOSIVES, MATCHES, Etc.

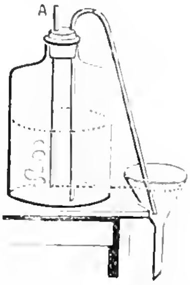
On Roburite. C. Roth. Chem. Zeit. **11**, 538.

ROBURITE belongs to the class of "combined" explosives. It is composed of two constituents, each of which is completely indifferent to friction, detonation and heat. Furthermore, the same can be said of the finished explosive. Thrown into the fire it burns quietly with a light flame, and it can only be exploded by an intensive flame such as is produced by a fulminating-mercury cap. One of the constituents consists of a nitrate, whereas the other is a mixture of the chloro-nitro compounds of the benzene-group. The mixture with the nitrate is in such a proportion that all the carbon burns to carbonic acid and all the hydrogen to water, while the chlorine combines with the alkali. The presence of chlorine in the nitro-compounds has not only a loosening effect on the nitro-groups of the aromatic series, but it increases the explosive power by at least 20 per cent. If roburite be mixed with water it loses its ability of exploding and becomes quite harmless. The principal application of roburite is in coal-mining, as it blasts the coal in large lumps with a small percentage of powder. Neither can it fire mine gases.—S. H.

XXII.—ANALYTICAL CHEMISTRY.

A Contrivance for Automatic Filtration. O. Billeter. Chem. Zeit. **11**, 509.

THE arrangement will be readily understood from the figure. The tube A is open at both ends, and its lower end is adjusted to the level up to which the liquid may rise in the funnel. In order to use the apparatus, the syphon is started by blowing into A, when the operation of filtering



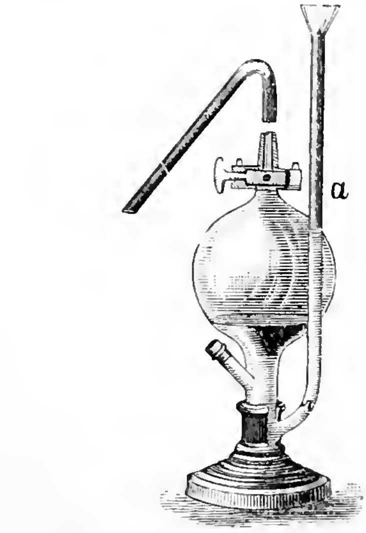
will proceed quite automatically. The liquid in the bottle may be heated if required and the funnel may be connected with a suction pump.—S. H.

A Simple Arrangement for the Regulation of Low Temperatures in Air-baths. M. Ekenberg. Chem. Zeit. **11**, 536.

A METAL CASING, provided with holes, is arranged below the air-bath. The source of heat is a gas burner, the flame of which must end about 4cm. below the bottom of the air-bath, so that the bath is not heated directly by the flame, but rather by warm air, which is partially retained by the metal casing. The key of the gas tap is elongated and made to play on a circular dial, which is graduated empirically. For temperatures up to 50° C. a small flame, provided with a well-fitting chimney, is employed; for higher temperatures a burner with several small flames should be used.—S. H.

A Spherical Gasometer. A. Ehrenberg. Chem. Zeit. **11**, 786.

THE apparatus is of glass, and rests after the fashion of the Gay-Lussac burettes in a wooden support. The accompanying illustration shows the shape given to it



and the gasometer is used in the usual manner, *a* being the tube containing the water to exert pressure on the gas.—S. H.

Improvements in Balances. P. Bunge. Chem. Zeit. **11**, 559.

IT is at first noted that in most balances the sensitiveness of a balance decreases uniformly with increase of load; this is conditioned by steel alloy used for the construction of the beam, which frequently contains pores invisible to the naked eye. To avoid this, and to produce the maximum sensitiveness with mean load, argentan alloy, drawn and rolled, is substituted for steel, which it approaches in solidity, while in elasticity it surpasses nickel alloy and aluminium bronze. In order to avoid vibrations of the pointer, the author adopts a peculiar sectional form, which is found to act better than the usual conical form. A cam arrangement is also described for opening the window of the balance case with one hand and for keeping it open in any desired position. The window opens out towards the observer, and the weights are introduced by side windows; thus the breath of the observer does not injure the balance. In conclusion, an arrangement is detailed in outline for transporting the weights wholly within the balance case, when it may be desired to conduct weighings in vacuo; such an arrangement also avoids a possible diminution in the weights by contact with pincers or the fittings of the box. The arrangement is not as yet completed.

—V. H. V.

A Reaction for Narceïne. P. C. Plugge. Nieuw. Tijdsh. Pharm. Nederl. 1887, 163.

IF a trace of narceïne be warmed with dilute sulphuric acid in a porcelain basin over a water-bath, a beautiful violet-red colour appears as soon as the solution is sufficiently concentrated: continued heating changes it to cherry-red. After cooling, the addition of a trace of HNO_3 or KNO_2 solution, produces bluish-violet streaks in the red liquid. 0·000015grm. of narceïne can be detected in this way.—D. E. J.

Hyposulphite of Sodium and Bismuth as a Test for Potassium. C. Pauly. Pharm. C.H.N.F. 1887, 187.

THIS reaction had already been pointed out by A. Carnot. The author, however, finds that the reaction is a delicate one and applicable as a test for the presence of potassium in very dilute solutions. An alcoholic solution of bismuthic sodium hyposulphite gives with potassium salts a strongly yellow crystalline precipitate of bismuth potassium hyposulphite $K_3Bi(S_2O_3)_3$, which dissolves in water to a colourless solution, but is reprecipitated unchanged by the addition of alcohol. Neutral solutions of sodium, lithium, calcium, magnesium and ammonium salts are without effect; barium and strontium salts give precipitates, but as the colour is white, they are sufficiently distinguished from the potassium precipitate.

The reagent is prepared in two solutions, which are kept separate until required for use. For the one, six molecules of sodium hyposulphite (1488 parts) are dissolved in the least possible quantity of water. For the other, one molecule of bismuth oxide, Bi_2O_3 (468 parts) is dissolved in hydrochloric acid and diluted with acidified water to a volume equal to that of the hyposulphite solution. The procedure recommended is the following:—One or two drops of the hyposulphite solution are placed in a test tube together with the same quantity of bismuth solution, and then 1cc. of water and 10 to 15cc. alcohol are added. If any cloudiness does not disappear on shaking, water is added in drops until the solution becomes clear. To this is added, drop by drop, the solution to be tested for potassium, which, if present, will produce a fine yellow precipitate after some lapse of time. The author obtained an unmistakable indication with 0·00005grm. KCl.—G. H. B.

On the Detection of small quantities of Lactic Acid. W. Windisch. Wochensch. Brauerei, **13**, 214.

LACTIC acid, when heated with potassium chromate and sulphuric acid, is decomposed into formic acid and acetic aldehyde. The solution to be tested is diluted to about 100cc.; 5—10cc. of concentrated sulphuric acid and a little potassium chromate are added and the mixture is submitted to distillation. The vapours are received in warm Nessler's solution. The presence of aldehyde causes a yellow precipitate, small quantities giving only a yellow opalescence. Formic, acetic, propionic, butyric, valerianic, succinic, malic, tartaric and citric acids do not give this reaction.—G. H. B.

A Reaction for Morphine. G. Vulpius. Arch. Pharm. 1887, **25**, 256.

ABOUT 0·00025grm. of a morphine salt is dissolved in a porcelain dish in about six drops of concentrated sulphuric acid, a few centigrams of sodium phosphate added and the mixture carefully heated. White fumes are evolved, and a violet colour appears. Water added drop by drop to the cold mixture produces at first a brilliant red, which, on further addition, changes to a dirty green; if the solution be then shaken with the same volume of chloroform, the latter is coloured blue.—A. R.

On the Detection of Boron in Milk and similar Liquids. M. Kretzschmar. Chem. Zeit. **11**, 476.

AFTER well shaking the milk, 5—6cc. are evaporated to about one-third their bulk in a platinum crucible. A few drops of hydrochloric acid are now added, and the evaporation continued, by means of the non-luminous flame of a Bunsen burner held in such a manner as to play on the top of the crucible. If boron be present the flame is coloured green, but the colour disappears as soon as inflammable gases are evolved. The author maintains that practically all the boron present is evolved in this manner, and that the test is therefore a very delicate one.—A. R.

A Novel Reaction of Chloroform. A. Jolles. Chem. Zeit. **11**, 786.

CHLOROFORM, if not quite free from water, gradually undergoes decomposition under the influence of daylight. An addition of 1 per cent. of alcohol effectually prevents oxidation. Nevertheless, the article in commerce frequently contains a high percentage of oxidisable matters, such as aldehyde, ethylene, and so forth, which may be readily detected in the following manner:—A few grains of chemically-pure potassium manganate (K_2MnO_4) are added to the chloroform to be tested. Pure chloroform does not act on it at all, whereas an addition of about 2 per cent. of alcohol or similar oxidisable matter quickly reduces the manganate, producing yellow-brown spots of potassium manganite (K_2MnO_3). The quicker the reduction and the more intense the spots, the greater was the addition of foreign oxidisable matter. The reaction is expressed by the following equation:— $K_2MnO_4 + C_2H_6O = K_2MnO_3 + H_2O + C_2H_4O$. Potassium permanganate ($KMnO_4$) does not act nearly so rapidly.—S. H.

The Estimation of Acetic Acid in Acetates by direct Titration. A. Sonnenschein. Chem. Zeit. **11**, 591—592.

THE method hitherto in use has been that of Fresenius, which involves a distillation, and to avoid this has been the object of several experimenters on the subject. The author claims to have devised a successful method of direct titration by availing himself of the colour reaction given by methyl-orange (Orange IV.). In testing a sample of sodium acetate, the solution is first titrated with normal hydrochloric acid in presence of phenacetolin in order to determine the sodium carbonate present, after which methyl-orange is added and the addition of acid continued until a red colour shows that the acetate has been decomposed. The sodium carbonate can also be removed by means of barium chloride as a preliminary to titration. The yellow colour of commercial calcium acetate is removed by treatment with animal charcoal; in other respects the procedure is the same as with the sodium salt. Using Fresenius' method as a standard, the author obtains closely-agreeing results by his direct method.—G. H. B.

Notes on the Blue Iodine-starch. F. Mylius. Ber. **20**, 688—695.

IF iodine combines with colourless substances which contain carbon, hydrogen and oxygen, the resulting compounds are, as a rule, either colourless or yellow. Iodine-starch is the only exception known, and this fact seemed to point to the probability of iodine combining with starch in a peculiar manner. The author has now found that the formation of blue iodine-starch is not caused by iodine alone, but by the simultaneous action of hydriodic acid or one of its salts. The properties of iodine-starch well agree with this statement. All the iodine solutions which colour starch blue, contain hydriodic acid or an iodine salt. If a compound be present which destroys hydriodic acid—*e.g.*, chlorine—no blue iodine-starch is obtained. A silver solution decolorises iodine starch; on the addition of iodine, the mixture becomes yellow, but hydriodic acid or one of its salts restores the blue colour. Again, an aqueous solution of iodine does not turn starch blue, whereas the addition of the smallest trace of hydriodic acid is sufficient for the formation of blue iodine-starch. As a consequence, all those substances which convert iodine in hydriodic acid, change yellow iodine-starch to blue. In analysing iodine-starch, it is not sufficient to estimate the total iodine present, but the proportion of iodine to hydriodic acid must also be ascertained. If starch solution be added to a solution of iodine in potassium iodide, acidified with sulphuric acid, a precipitate of blue iodine-starch is produced which quickly collects at the bottom of the vessel. By the titration of the filtrate, the relation of iodine to hydriodic acid can be ascertained; and if the proportion of iodine to hydriodic acid in the original solution is known, the quantities of iodine and hydriodic acid can be calculated which were absorbed in the formation of blue iodine-starch. A series of experiments showed that four iodine atoms and one molecule of hydriodic acid go to form blue iodine-starch, and if the formula $(C_6H_{10}O_5)_x$ represents the molecule of starch, the composition of blue iodine-starch is $[(C_6H_{10}O_5)I]_4HI$. On the other hand, the analysis of iodine-starch dried *in vacuo* yielded: C = 36·14 per cent., H = 5·66 per cent., I = 18·47 per cent. This best corresponds with the formula $(C_{24}H_{70}O_{20}I)_4HI$, which shows at the same time that the formula of starch is $C_{24}H_{40}O_{20}$. Pfeiffer and Tollens's formula, which is the same, and was obtained by another method, thus receives a confirmation. Iodine-starch contains a hydrogen atom which can be replaced by metals. These metallic compounds are obtained in the same way as the iodine-starch, by using the respective iodine salts. Several of these compounds are soluble in water—*e.g.*, the sodium and potassium compound, whereas others are insoluble—*e.g.*, the barium and zinc compound.

—S. H.

An Apparatus for the Estimation of Hydrogen in presence of Marsh Gas in Gaseous Mixtures. F. Hoppe-Seyler. Zeits. Physiol. Chem. **11**, 257.

THIS is an adaptation of the method of Winkler and Hempel, of passing the gas mixed with air over spongy palladium, when only the hydrogen burns, and the marsh gas remains unattacked.—G. H. B.

Titration of Phosphoric Acid with Uranium Nitrate. Ch. Malot. Monit. Scient. 1887, 487.

OXIDE of uranium gives a green lake with cochineal, which property may be utilised for a very exact determination of phosphoric acid. The phosphate is treated according to Joulie's method—*i.e.*, dissolved in HCl, the phosphoric acid precipitated with the citro-magnesium mixture and the precipitate dissolved in dilute nitric acid. A few drops of tincture of cochineal are added, then ammonia until the violet coloration just appears, and this in its turn is made to disappear with 1—2 drops of nitric acid. The solution is now heated to 100°, 5cc. of sodium acetate solution added and the mixture titrated with uranium nitrate. Each drop of the latter causes a greenish-blue zone, which, on agitation, disappears again. As soon as precipitation is complete, the solution assumes a lasting greenish-blue colour, remaining unchanged by excess of the uranium solution. The end-reaction is most distinct. By employing very dilute solutions of uranium nitrate, the determination is rendered very exact. The author uses solutions, 1cc. of which represents 0·002grm. of phosphoric acid. It is necessary to keep the temperature about 100 during the titration.—A. R.

Analysis of Sulphides. Fr. Weil. Ber. **20**, 695—697.

The sulphur in sulphides which are decomposable by hydrochloric or sulphuric acid can be rapidly estimated by passing the sulphuretted hydrogen evolved into a modified Fehling's solution, and retitrating the copper not precipitated with stannous chloride. The Fehling's solution used is prepared by dissolving 39·3375grms. of crystallised copper sulphate, 197grms. of Seignette-salt (sodium-potassium tartrate) and 125grms. of sodium hydrate per litre: this solution thus contains exactly 10grms. of copper. The finely-powdered mineral, wrapped in a piece of filter-paper, is quickly thrown into a flask which contains 50cc. of pure hydrochloric acid and heated on the sand-bath. The sulphuretted hydrogen is absorbed in 50cc. of the copper solution, which were previously diluted with 100cc. of a dilute sodium hydrate solution (70 to 80grms. of NaOH per litre). The distillation is finished in five minutes. The contents of the receiver are filtered, washed and a portion of the filtrate titrated back with stannous chloride. 1grm. of Cu = 0·50393grm. S.—S. H.

On the Detection and Estimation of Vanadium in Minerals and Ores. L. L'Hôte. Compt. Rend. **104**, 990.

In order to isolate the vanadium the author passes dry chlorine over a mixture of 4 parts of the substance with 1 part of charcoal heated in a tube to 250°. In the case of ores which contain arsenic, the mixture must first be made into a paste with oil and then heated to redness. Two Mohr's bulb tubes containing water are connected to the end of the tube. The presence of vanadium is indicated by a red colour in the first bulb due to the formation of vanadic acid, but the fluid remains colourless when only very little vanadium is present. The products of condensation are dissolved in dilute hydrochloric acid, the solution evaporated and the residue tested with a drop of colourless ammonium sulphide, producing the characteristic purple coloration of vanadium sulphide.

For the estimation of the vanadium, the author uses Margueritte's method for determining small quantities of iron, by reduction with zinc and titration with a dilute permanganate solution. The operations must be conducted at a somewhat elevated temperature, and special precautions must be taken in preparing the distilled water used.

If a larger quantity of vanadium be present, the contents of the first bulb will have a bluish-green colour, and in that case the acidified solution is treated with ammonia and evaporated to dryness; the residue, after heating to redness, is weighed as vanadic acid. The author found in bauxite 0·05 and 0·031grm., in Bohemian pitchblende 1·62 and 1·40grm., and in brown ironstone 0·083grm. of vanadium per kilo.—G. H. B.

The Influence of Barium Phosphate upon Acidimetric Analysis. A. Villiers. Compt. Rend. **104**, 1103.

Phosphoric acid can easily be estimated by means of caustic potash or baryta-water, using phenolphthaleïn as an indicator: a phosphate which has a neutral reaction being formed in the first case and insoluble di-barium phosphate in the second case. It might therefore be expected that in the volumetric determination of an acid, no difficulty would be occasioned by the presence of such a salt as di-sodium phosphate; this is true for caustic potash, but it is not so when baryta-water is used.

If HCl is neutralised with baryta-water in presence of phenolphthaleïn, so that a red coloration is produced, and if di-sodium phosphate (which reacts neutrally towards the indicator) is added, the same effect is produced as if there had been an addition of acid—*i.e.*, a further quantity of baryta-water is required to restore the red colour. This reappears at once, but again disappears in five or ten minutes and more baryta has to be added before it becomes permanent, the amount depending upon the relative amounts of di sodium phosphate and barium chloride. In presence of a large excess of di sodium phosphate the precipitate ultimately formed has the composition $BaNaPO_4$.

The main product of the reaction of barium chloride upon di-sodium phosphate is acid barium phosphate:—$Na_2HPO_4 + BaCl_2 = BaHPO_4 + 2NaCl$. On the addition of baryta-water the following decomposition occurs: $2BaHPO_4 + 2NaCl + Ba(OH)_2 = 2BaNaPO_4 + BaCl_2 + 2H_2O$.

Thus a free acid cannot be titrated with baryta-water in presence of Na_2HPO_4, even when phenolphthaleïn (towards which the salt is neutral) is used as indicator. This is also true for the estimation of phosphoric acid in presence of salts of the alkalis; but such determinations can be carried out when caustic potash is employed.

—D. E. J.

Estimation of Copper and Arsenic in Pyrites. R. Nahnsen. Chem. Zeit. **11**, 692.

It is supposed that the pyrites to be tested contain no more than 0·3 per cent. to 0·5 per cent. of copper. The mineral is powdered very finely and 12·5grms. of it are treated in a tall beaker with 10cc. of water and 1cc. of strong sulphuric acid. Nitric acid of 1·4 sp. gr. is then added until there is no further reaction, and the beaker covered with a porcelain dish. The liquid is made to boil, the porcelain dish removed after a few minutes and the beaker shaken very frequently, the boiling being continued until the liquid becomes very thick and commences to separate a yellow salt. The pasty mass is then dissolved in warm water. The solution, after cooling, is transferred to a 250cc. flask, filled up to the mark and 200cc. (=10grms. pyrites) are filtered through a dry filter. The solution, now free from silica and lead, is treated with sulphuretted hydrogen for several hours, until the precipitate forms small lumps and the liquid is quite clear. The former is then rinsed into a beaker, which contains a strong solution of sodium sulphide in sufficient quantity to dissolve all the sulphur on boiling. The solution is diluted with hot water, allowed to settle for some hours and filtered. The solution contains all the antimony and arsenic, whereas the cupric sulphide is on the filter and can be estimated as cuprous sulphide. By the addition of an acid to the sodium sulphide solution, antimony and arsenic is precipitated, the latter of which is extracted from the washed precipitate by ammonia.

—S. H.

On the Determination of Arsenic as the Pentasulphide. Le Roy W. McCay. Amer. Chem. Jour. **9**, 174—179.

The author strongly recommends that where arsenic has to be determined in an arsenate, it should be estimated gravimetrically as follows:—The solution containing from 0·1 to 0·3grm. of arsenic is placed in a flask with a well-fitting stopper, the capacity of the flask being about 200cc. It is then acidified with hydrochloric acid and diluted with freshly-boiled water until the flask is nearly full. H_2S gas is then passed in to saturation, the stopper inserted and fastened down, and the whole placed in a hot water bath for an hour. At the end of that time all the arsenic will be precipitated as As_2S_5, containing, as the author's experiments show, no free sulphur.—S. G. R.

Estimation of Hydrogen Peroxide. H. Thoms. Chem. Zeit. **11**, 118.

The two following methods for the determination of hydrogen peroxide are recommended as being both rapid and accurate:—(1.) The apparatus used is Fresenius and Wills's apparatus for the estimation of CO_2. Pour in 5cc. of the solution of hydrogen peroxide, and introduce a small tube nearly filled with coarsely-powdered MnO_2, without allowing the solution to touch this. Concentrated sulphuric acid is poured into the second flask, and after a little of this has been drawn over, the apparatus is shaken so as to bring the mixture into contact with the MnO_2. Oxygen is freely given off, and after the evolution of gas has ceased a stream of air is drawn through the flasks in the usual manner, after which they are weighed. The loss of weight indicates the amount of oxygen evolved; one-half of this comes from the hydrogen peroxide, according to the equation $MnO_2 + H_2O_2 = MnO + H_2O + O_2$. (2.) The second method depends upon the fact that hydrogen peroxide liberates from acid solutions of potassium iodide a corresponding quantity of iodine, which can then be titrated with $Na_2S_2O_3$. 0·5grm. of KI, 1grm. of dilute sulphuric acid (1:4) and 50grms. of water are heated to about 40°; to this is added 0·5cc. of the hydrogen peroxide (or, better, 5cc. of the solution diluted to a tenth of its previous strength) and the whole is allowed to stand, with frequent shaking, for about five minutes, after which it is titrated with decinormal thiosulphate solution. On further heating to 40° a slight brown coloration is produced, which is again destroyed by adding more thiosulphate. The re-action is as follows:—$H_2O_2 + 2KI + H_2SO_4 = K_2SO_4 + 2H_2O + 2I$; $2Na_2S_2O_3 + 2I = 2NaI + Na_2S_4O_6$. Thus 2I corresponds to H_2O_2 or $2Na_2S_2O_3$; and consequently 1cc. of decinormal thiosulphate is equivalent to 0·0017grm. H_2O_2.—D. E. J.

Notes on the Estimation of Morphia. H. Goebel. Chem. Zeit. **11**, 508.

5—10GRMS. of opium are digested with 110cc. of water at 55° C. and from 4 to 5grms. of quicklime are then added. The mass is allowed to stand with frequent stirring for one hour. It is then filtered, and 50cc. of the filtrate are shaken with 5cc. of 95 per cent. alcohol, 25cc. of ether and 3grms. of ammonium chloride. The mixture is allowed to crystallise over-night. The ether is then carefully decanted through a filter, the latter washed with pure ether, and the alcholic liquid is at last filtered into a graduated cylinder, using the mother liquor to bring the crystals on the filter. They are washed with cold water, until the filter is colourless. For every 10cc. of water 0·01grm. of morphia is allowed. The filter is dried at 100° C. and the weight noted down. The crystals are then removed from the filter and the latter is moistened with dilute sulphuric acid, and afterwards washed with water, until the washings give no reaction with starch solution and iodic acid. The filter is again dried and weighed, and the difference of the two weighings is the amount of morphia in the opium.

—S. H.

On the Estimation of Nicotine in Tobacco Extracts. Dr. R. Kissling. Chem. Zeit. **11**, 605.

THE following additional details are given by the author in further explanation of the method of determining nicotine, previously published by him (*Chem. Zeit.* **9**, 1336). 100grms. of the extract is a convenient quantity to work with; this is distilled in a current of steam until the contents of the distillation flask have diminished by about 25 per cent. (and not, as previously stated, until the volume is reduced to 10—15cc.). The flask must be very carefully heated over wire gauze, otherwise it may easily become over-heated owing to the precipitation of insoluble matters. It is found advantageous to grind up the mixture of ammonium and nicotine sulphates with 1cc. of concentrated caustic soda solution, then to add 40—50grms. of sand and as much powdered lime as is required to convert the whole into a pulverulent mass.—D. E. J.

Quantitative Determination of Lignin in Paper. C. Wurster. Ber. **20**, 808—810.

THE author has taken advantage of the fact that paper containing ground wood turns dimethylparaphenylenediamine an intense magenta colour, whilst paper made from linen or cotton fibre, or with chemically treated wood cellulose, only turns this substance slightly yellow. By taking a series of hand-made papers containing known amounts of ground wood the author was able to make a colour scale, the colours of which correspond to the colours given with dimethylparaphenylenediamine by papers of known strength. Test papers with the latter substance are employed, and since these and the scale can be carried on the person, this method forms a most convenient and quick means of estimating both qualitatively and quantitatively the amount of ground wood in paper. The author has also determined the amount of normal iodine solution corresponding to the scale colours.—G. H. M.

Chemical Examination of Silk. J. Persoz. Monit. Scient. 1887, 597.

DEVILLE first suggested that the quantity of pure silk present in silk fabrics might be estimated by determining the amount of nitrogen, and the method has been worked out by Moyret, who takes 2grms. of the material, bleaches, dries, cuts it up fine and determines the nitrogen by Will and Varrentrap's method. Moyret concluded, after making numerous analyses, that silk-fibre contained 17·6 % of nitrogen. The author recommends, in order to prevent loss in reducing the material to a finely-divided state, that it should be immersed for a few moments in HCl diluted with two to three times the volume of water, then exposed to the air for some time and dried at 120°, when it can easily be reduced to an impalpable powder. He now finds that silk contains 18 % of nitrogen and bases his calculations upon this result.

Silk fabrics often contain tin salts (especially the chloride): these can be detected by burning the silk and examining the ash before the blowpipe. Or the material may be warmed in a test-tube with just enough concentrated HCl to dissolve it completely, the solution diluted with water and H_2S passed through, when the presence of tin can easily be detected. To distinguish between pure mulberry-silk and the wild or Tussah-silk, the material under examination may be boiled for a minute with zinc-chloride solution of 45° B., which dissolves the mulberry-silk without appreciably attacking the other.—D. E. J.

Extractum Aconiti. A. Kremel. Pharm. Post. 1887, 253.

THE alkaloids in extract of aconite can best be estimated as follows: 7·5grms. of the extract are weighed into a porcelain dish, dissolved in 10cc. of water and carefully transferred, with 5cc. of water, to a flask graduated to hold 150cc. 95% alcohol is added in small quantities, with frequent shaking, until the flask is filled to the mark: it is then allowed to stand for three to four hours, after which 100cc. (=5grms. of the extract) are filtered from the precipitated albuminous matters. 25cc. of water are added to the filtrate, which is heated on a water bath to drive off the alcohol: after standing for a few hours, so as to allow of the precipitation of resinous matters, the liquid is filtered through a wetted filter, which should be carefully washed. The acid solution thus prepared (20—25cc. in volume) is shaken up with 15—20cc. of chloroform in order to remove free organic acids and any resinous matters which may still be present. The solution is separated from the chloroform, made alkaline with potassium carbonate and shaken up first with 15cc., then with 10cc. and, lastly, with 5cc. of chloroform. After each addition of chloroform, the mixture is allowed to stand for two or three hours; the chloroform-solution of the alkaloids is then transferred to a crystallising-dish, allowed to evaporate spontaneously and the residue dried over H_2SO_4. Other extracts can also be examined in this way.—D. E. J.

A Scheme for the Examination of Glue. R. Kissling. Chem. Zeit. **11**, 691 and 719—720.

(*a*) *Estimation of Water.*—2 or 3grms of glue shavings are dried at 110° to 115° C. until the weight remains constant. (*b*) *Estimation of Ash.*—The residue from the test *a* is burned in a platinum crucible, if necessary with the addition of a drop of nitric acid. (*c*) *Qualitative examination of the ash.*—The properties of the ash give a clue to the origin of the glue. The ash from bone-glue fuses by the heat of the Bunsen burner: its aqueous solution is neutral and it contains phosphoric acid and chlorine, whereas the ash from leather-glue does not fuse, owing to the presence of caustic lime. Leather-glue has an alkaline reaction and is free from phosphoric acid and chlorine. (*d*) *The determination of the Acid.*—30grms. of glue are suspended in 80cc. of water and allowed to stand for several hours. The volatile acids are then driven over by a current of steam. As soon as the distillate amounts to 200cc., the distillation is discontinued and the contents of the receiver titrated with standard alkali. Sometimes the distillate contains sulphurous acid, in which case the receiver should contain a known amount of standard alkali. (*e*) *Capacity of Drying.*—The solution of glue freed from volatile acids is made up with water to 150grms. and heated on the water-bath. 10cc. are spread on a watch-glass, and allowed to stand in a room which is free from dust and not exposed to frequent changes of temperature. The change of the glue jelly is observed for several days, and if possible the behaviour of this jelly is compared side by side with glue jellies of known quality, as the temperature and amount of moisture in the air has an influence on the consistency of the jelly. (*f*) *Foreign Matter.*—The rest of the glue solution from the test *e* is diluted with hot water and transferred to a cylinder holding 1000cc., and provided with a cc. scale. After filling up to the top, the contents of the cylinder are allowed to subside for 24 hours and the settlement noted down as "foreign matter." (*g*) *Smell.*—The smell of glue differs very much. Leather-glue smells least. Other glues do not smell in the solid state, while their jelly has an unpleasant odour. The above table shows the result of the examination of different kinds of glue.—S. H.

No.	Water per Cent.	Ash per Cent.	Qualitative Properties of Ash.			Volatile Acids per Cent.	Capacity of Drying.	Foreign Matter.	Smell of		Quality of Glue.	Price per 100kilos. Mark—*i.e.*, Shillings.
			PO_4H_3	Cl.	Reaction of Extract.				Solid Blocks.	The hot Jelly.		
1	15·7	3·05	none	none	(strongly alkaline)	none	very good	trace	very good	very good	Leather Glue	92
2	..	2·68	none	trace	alkaline	none	very good	trace	very good	very good		92
3	15·6	1·40	none	trace	alkaline	0·022	very good	trace	very good	very good		92
4	18·1	1·40	trace	none	alkaline	0·015	very good	3	good	good		92
5	17·0	2·16	much	none	neutral	0·110	bad	40·5	bad	medium	Bone Glue	66
6	15·6	1·26	much	much		0·831	good	..	medium	medium		66
7	14·9	1·43	..	..		0·262	medium	..	medium	medium		66
8	..	2·80	much	much		0·487	bad	6	very bad	very bad		50
9	..	2·63	much	much		0·172	good	trace	medium	bad		50
10	16·41	2·66	very much	trace		0·038	medium	trace	very good	very good		68
11	16·00	1·93	very much	little		..	..	..	..	..		70
12	13·24	2·00	very much	little		0·068	very bad	15	good	good		68
13	17·7	5·07	much	much	alkaline	0·082	bad	20	medium	bad		60
14	..	3·04	much	much	neutral	none	medium	..	very good	good		66
15	12·28	1·80	much	none		0·056	bad	trace	good	bad		66
16	13·56	2·80	much	little		0·113	good	20	good	good		68

Methods of Analysing Opium. E. Dieterich. Pharm. C. H. N. F. 1887, 219.

THE so-called "Helgenberger" method of estimating morphia in opium and its preparations was introduced by the author. Objections were raised to it, mainly on account of its difficulty, by Schlickum, who proposed a modified method. In a long paper, containing a large number of analytical results, the author compares the two processes, and shows conclusively that Schlickum's method is no improvement upon his own.—D. E. J.

Estimation of Morphia in Opium. J. Biel. Pharm. Zeit. Russl. 1887, 241.

THE author has compared the best-known methods—those of Flückeger, Hager and Dieterich—and he draws from his analytical results the conclusion that Dieterich's (the "Helgenberger" method—see previous abstract) is the best, because (1) it gives the largest yield of morphia; (2) the precipitated morphia is the purest; (3) the method is an easy and convenient one; and (4) the results obtained agree well with one another.—D. E. J.

Determination of Starch in Paper. G. Schumann. Papier Zeitung, 1887, 389.

THE author finds that diastase (malt extract) is a good solvent for the starch. A strip of the paper weighing 5grms. is boiled four times with dilute alcohol in an Erlenmeyer flask, in order to remove resins and soluble salts, the alcohol being changed every half-hour. The extract is filtered through a parchment filter in order to retain any fibres held in suspension; the strip of paper and the contents of the filter are then dried at 100° until the weight becomes constant. They are next digested with the malt extract at 65—70° until the starch is all extracted, then washed with hot water, again dried at 100° and weighed. The loss gives the amount of starch.

To prepare the malt extract, pour a mixture of two litres of water and four litres of glycerine over 3·5kilos. of freshly-pounded malt; let it stand, with occasional stirring, for eight days, then press and filter. The solution keeps well; five drops of it are sufficient to dissolve 1grm. of starch.—D. E. J.

Quantitative Determination of Theine in Tea-leaves. Lösch. Pharm. Zeits. Russ. 1887, 177.

10—20grms. of tea-leaves are twice extracted with boiling water. The leaves are filtered off and washed

with hot water until the latter is no longer coloured. The filtrates are then evaporated with 1½ times the weight of magnesia, calculated on the weight of tea-leaves employed. The residue is finely powdered, extracted with chloroform, the latter evaporated off, and the residue dried at 100—105° and weighed. All the theine is thus obtained in a perfectly colourless state.
—A. R.

Notes on Sugar Analysis. Seyffart. Neue Zeits. f. Zuckerind. 1887, 150.

THE article first treats on a method for taking samples of raw sugar, particularly as regards the systematic mixing thereof. For igniting, without addition of sulphuric acid, vaselin free from ash may be advantageously employed. 5grms. of the sugar are weighed into a platinum dish. covered over with vaselin and the dish is gently heated and finally made red-hot. The author also refers to the determination of alkalinity of juices, particularly as regards the use of normal alkaline solutions and indicators of constant composition. For the determination of caustic lime in burnt lime, 4·667grms. of the powder are weighed off, boiled for 30 minutes in a 250cc. flask with water, and mixed with a solution of 80grms. of sugar in 150cc. of water, previously warmed to 65°. The mixture is well shaken, and the solution filled to the mark, filtered after 5—6 hours and 50cc. titrated with normal acid solution. Treble the number of cc. employed gives the percentage of caustic lime present.—A. R.

Determination of the Melting Point of Paraffin. L. Weinstein. Chem. Zeit. 11, 784.

MANY methods exist for the determination of the melting point of paraffin. Although the matter is very simple, discrepancies in the test are very frequent owing to different points being observed as the point of fusion. The Halle-Association prescribes to melt a small piece of paraffin in warm water, observe the temperature of the water while cooling, and note that point as the melting-point when the paraffin-drop shows the first signs of solidification. In America a sufficient quantity of paraffin is melted in a small beaker and allowed to cool, stating that point as the melting-point when the mass commences to be stiff. Again in Scotland, the paraffin is melted in a small crucible and the liquid mass is stirred with a thermometer, until half of it has solidified. At this point the temperature is said to remain constant for a few moments. The author tried to ascertain the melting-point in the manner usually employed in scientific laboratories—viz., with a capillary tube—and found that the results obtained are very concordant indeed. He recommends this method as the simplest, and it is the method most generally used for other substances. The results agree with those of the Halle and American method, but are lower than those obtained by the Scotch process by 2° C.—S. H.

Quantitative Examination of Strychnine and Brucine. G. Holst and H. Beckurts. Pharm. C.H.N.F., 1887, 119.

THE authors have now discovered a method involving the employment of potassium ferrocyanide, which gives absolutely certain results. A similar method had not hitherto given good results. On adding to a strong hydrochloric acid solution of both alkaloids (not too dilute; about 0·5—1%) a solution of potassium ferrocyanide till a sample of the filtrate produces a blue colour on ferric chloride paper, the whole of the strychnine is separated as strychnine ferrocyanic acid $C_{21}H_{22}N_2O_2H_4Fe(CN)_6$, whilst the brucine remains completely in solution. By using a standard solution of potassium ferrocyanide, the strychnine may be easily determined volumetrically. 244 parts of potassium ferrocyanide are equivalent to 334 parts of strychnine. In a mixture of strychnine alkaloids, the total of the strychnine and brucine would in the first place be determined by gravimetric analysis, then the strychnine as above and the brucine would be obtained by difference.—W. R.

Testing of Bitter Almond Water. H. Beckurts. Pharm. Centr. H. N. F. 8, 131.

BY adding magnesium hydroxide to bitter almond water until the solution just becomes opalescent and then titrating with decinormal silver solution, after the addition of a few drops of potassium chromate, the results obtained are always too low. An aqueous solution of hydrocyanic acid gives accurate results when similarly treated. The author considers the above inaccuracy to be due to the slowness with which the benzaldehyde hydrocyanide is decomposed with formation of magnesium cyanide, and not to the gradual decomposition of the latter by the silver chromate. By allowing the bitter almond water to stand for half an hour after the addition of the magnesium hydroxide better results are obtained; while by replacing the magnesium hydroxide by magnesium acetate, according to Kubel's suggestion, the reaction takes place quickly and uniformly.—C. A. K.

The Examination of Officinal Bromides. G. Vulpius. Pharm. Centr. H. N. F. 8, 133.

ACCORDING to the Pharmacopœia, the bromides of potassium, sodium, and ammonium are tested by the amount of decinormal silver solution needed to completely precipitate 0·3grm. of the salt. This method is no guard against the presence of chlorides in sodium or ammonium bromide, should they contain potassium bromide as well, owing to the higher molecular weight of the latter bromide. Ammonium or sodium bromide contained in potassium bromide would, owing to their lower molecular weight, have an opposite effect on the results.
—C. A. K.

Examination of Lead-plaster. A. Kremel. Pharm. Post. 20, 190.

LEAD-PLASTER is readily tested by extracting it with ether. Plaster prepared from oleïc acid, consisting of lead oleate, is almost completely soluble in ether; that from olive oil contains 17—20 per cent. of lead salts insoluble in ether (lead stearate and palmitate), and that from pig's fat 40—50 per cent.—C. A. K.

The following letter, addressed to Mr. DOUGLAS COGHILL, *M.P. for Newcastle-under-Lyme, has been handed to us for publication:—*

NORTH STAFFORDSHIRE.

DOUGLAS H. COGHILL, ESQ., M.P.

HONOURABLE SIR,—Having read in the newspapers a report of the statements made by representatives from the South Wales district to the Home Secretary on the Coal Mines Regulation Bill, we, as certificated managers in North Staffordshire—the most dangerous, fiery, and dusty district in the kingdom—desired to attend as a deputation to explain our views and give our experience to Mr. Matthews before the rules of the new Act as to blasting are settled; but we understand it is too late to arrange for the reception of such a deputation, and we, therefore, beg you to take an opportunity of conveying to the Home Secretary a digest of what we should have said.

Blasting by means of ordinary powder has been given up as quite unsafe in some of the mines in this district for years; but since the introduction of the gelatinous compounds and the water cartridge with electric firing apparatus, we have been employing the system for nearly two years, and at this moment its adoption is daily increasing, and not one single case of accident has occurred, while some 200,000 shots have been fired.

In the question of cost, the new system compares favourably with the use of powder and old-fashioned fuse, and on the average the expense is no greater, while the coal is got in an equally good, if not better, condition; but above all is the sense of security experienced by the workmen and managers, owing to the killing of the flame on the explosion of each shot.

We consider that the clauses on shot-firing in the bill as drawn are wisely drawn, and with some slight modifications should stand.

We object to the permission of the employment of gunpowder in any ventilating district where gas has been found issuing or accumulated within four weeks previously, on the grounds—

1. That it is wholly unnecessary.
2. That it would be unfair to allow it in one district and not in another.
3. That it is certain very soon to result in serious explosions and loss of life.

We have the honour to subscribe ourselves, Honourable Sir, yours respectfully,

THOMAS ROBSON, Manager, Podmore Hall Collieries, Mr. Craig's Collieries (late M.P.)
W. ROBSON, Duke of Sutherland and others, Great Fenton.
BENJ. JOHNSON, Audley Coal and Iron Co.
WILLIAM MEADOWS, Madeley Coal and Iron Co., Ltd.
WILLIAM SCOTT, The Butterley Co., Silverdale.
ENOCH EDWARDS, Miners' Agent, President of Midland Miners' Federation.
JAMES POTTS, Manager, Mossfield Colliery, Longton.
SIMON BARKER, Mossfields and Berry Hill Collieries.
EDWARD MILLINGTON, Harrison and Woodburn.
WILLIAM BRIDGETT, Chatterley Iron Co., Ltd.
J. CADMAN, Stainer & Co., Apedale Collieries.
On duplicate letter.
W. OSWALD, Talk-o'th'-Hill Collieries.

The above certificated colliery managers are directly and personally responsible for the lives of over 14,000 miners.

1885.—Coals raised in North Staffordshire, 4,815,000 tons.

Trade Report.

(From the Board of Trade Journal.)

BOARD OF TRADE NOTICE.

THE INTERNATIONAL EXHIBITION AT BARCELONA.

With reference to the notification on p. 522 of the 11th Number of the *Journal*, a communication, dated the 30th July last, has been received from the Foreign Office, to the effect that Mr. Frederick Witty, unpaid British Vice-Consul at Barcelona, who is engaged in business at that port as a commission agent and broker, is ready to act as agent for British exhibitors at the Exhibition proposed to be held at that place next year, and to afford information in regard to the Exhibition to persons who may wish to obtain particulars with the view to taking part in it.

TRADE BETWEEN SPAIN AND THE UNITED KINGDOM.

Imports into the United Kingdom from Spain.

PRINCIPAL ARTICLES.	June, 1886.	June, 1887.
Chemical Products unenumerated ..... Value	£8,273	£8,420
Copper Ore and Regulus..Tons	6,204	4,366
Value	£95,426	£48,381
Manganese Ore ... . Tons	—	2,100
Value	—	£6 930
Pyrites of Iron or Copper..Tons	51,931	45,649
Value	£92,103	£78.338
Quicksilver .. ..lbs.	609,711	825,000
Value	£55,879	£72,375
Rags, Esparto ....Tons	5,584	3,601
Value	£32,178	£20,030

Total Value	1886.	1887.
June	£699,338	£718,561
July	£495,361	£681,501

Exports of British and Irish Produce from the United Kingdom to Spain.

PRINCIPAL ARTICLES.	June, 1886.	June, 1887.
Alkali .... Cwt.	21,963	18,867
Value	£8,737	£6,113
Caoutchouc Manufactures Value	£1,223	£885
Cement .... Tons	910	851
Value	£1,587	£1,581
Chemical Products including Dyestuffs .... Value	£3,375	£2,897
Coal, Products of, including Naphtha, etc. ....Value	£390	£868
Glass Manufactures ....Value	£635	£408
Manure .... Value	£21,955	£26,980
Painters' Colours and Materials....... Value	£2,671	£1,659
Paper of all sorts ....Cwt.	653	1052
Value	£1,505	£1,889
Soap ....Cwt.	279	80
Value	£228	£128

Total Value	1886.	1887.
June	£262,576	£302,019
July	£221,722	£261,5[illegible]4

TARIFF CHANGES AND CUSTOMS REGULATIONS.

SWITZERLAND.

Classification of Articles in Customs Tariff.

(*Note.*—Quintal = 220·4lb. avoirdupois. Franc = $9\frac{6}{10}$d.)

The following decisions affecting the classification of articles in the Swiss Customs Tariff have been given by the Swiss Customs Authorities during the month of June last:—

Peroxide of manganese; extract of oak and of oak bark, liquid. Category 16, duty 30 centimes per quintal.

Dualine (nitrite of soda); extract of oak and of oak bark, solid. Category 17, duty 1 franc per quintal.

RUSSIA.

Recent Customs Decision.

(*Note.*—Poud = 36lb. avoirdupois Rouble = 3s. 2d.)

The duty on ammonia and all salts of ammonia shall be raised as follows:—

Section 127. Ammonia and all salts of ammonia.

1. Salammonia (chloride of ammonia), carbonate of ammonia, and all salts of ammonia, excepting sulphate of ammonia, in a raw and refined state, as well as liquid ammonia, 1 rouble 20 copecks per poud.

2. Sulphate of ammonia, 50 copecks per poud.

NEW CUSTOMS TARIFF OF BRAZIL.

The following is a statement of the rates of import duty now levied under the New Customs Tariff of Brazil, which came into operation on the 1st July last:—

(*Note.*—Kilogramme = 2·201lb. avoirdupois. Litre = 0·22 Imp. gallon. Milreis = 2s. 3d., nominal value.)

No. in Tariff.	Articles, etc.	Rates of Duty.	
	X.—MATERIALS FOR DYEING, PAINTING, ETC.		Reis.
146	Ultramarine of every kind	Kilog.	200
147	Bistre	,,	300
118	Carmine	,,	6,000
150	Blue Ashes	,,	200
151	Cochineal	,,	400
153	Aniline or fuchsine colours of every kind, etc., liquid or solid	,,	1,000
151	Cork, pulverised, or Spanish black	,,	30
155	Artificial essences of every kind ..	,,	3,000
157	Indigo	,,	600
159	Lac of every colour	,,	800
161	Pastes or extracts for dyeing, liquid or solid—		
	Of pastel and gall-nut, Campeche, Brazil, sandal-wood, and sumac........	,,	120
	Not otherwise mentioned......	,,	500
162	Powders for gilding........	,,	30
163	Colouring materials, such as alizarin, anchusine, bichine, curcumine, indigotine, hematine, braziline, carthamine (extract of saffron), etc	,,	1,000
161	Size for gilding	,,	300
165	Indian ink........	,,	800

No. in Tariff.	Articles, etc.	Rates of Duty.	
	XI.—CHEMICAL PRODUCTS, PHARMACEUTICAL COMPOSITIONS, AND MEDICAMENTS IN GENERAL.		Reis.
183	Acetone or pyro-acetic spirit	Kilog.	1,000
184	Acetates or pyrolignites:		
	Of alumina	"	300
	Of ammonia, liquid or solid	"	240
	Of lead, liquid or crystallised, salt or vinegar of lead........	"	200
	Of copper, ammoniacal	"	4,800
	Do., crystallised or in powder .	"	250
	Of lithia	"	16,000
	Of silver	Gramme	50
	Of cobalt............	Kilog.	10,000
	Of iron	"	50
	Of mercury	"	7,000
	Of any metal, not otherwise distinguished	"	1,000
	Of alkaloids or organic bases ..	Gramme	100
185	Acids:		
	Acetic, strong or crystallisable, and pure of verdigris or glacial	Kilog.	80
	Arsenious, or white oxide of arsenic........................	"	80
	Benzoic or flowers of benzoin..	"	2,200
	Bromic	"	7,000
	Perchloric	"	2,400
	Formic...........................	"	2,000
	Hydrochloric, chlorhydric or muriatic, pure or colourless .	"	100
	Do., impure or coloured........	"	15
	Iodic, pure......................	"	3,500
	Lactic	"	2,000
	Nitric or azotic, pure, colourless	"	100
	Do., impure or coloured........	"	30
	Oxalic	.	80
	Phosphoric, solid or glacial	.	1,000
	Do., liquid	.	120
	Pyrogallic	.	5,000
	Pyroligneous, pyroacetic or vinegar of wood	"	80
	Sorbic	"	3,000
	Succinic, volatile salts of amber	"	2,400
	Sulphuric, oil or spirit of vitriol, pure or colourless	"	80
	Do., impure or common........	"	10
	Sulphurous, liquid	"	80
	Tartric..........................	"	300
	Valerianic......................	"	4,000
	Not otherwise mentioned	"	800
186	Aconite	Gramme	240
187	Waters:		
	English	Kilog.	800
	Distilled, of orange, rose and lettuce flowers	"	400
	Do., not otherwise mentioned..	"	800
	Hemostatic of any kind and vulneraric alcohol............	"	1,000
	Mineral, natural or artificial, of any kind	"	200
188	Albumen, animal or dried	"	1,600
189	Alkaloids or natural or artificial organic bases, etc., not otherwise mentioned........................	Gramme	100
190	Alcohol, amylaceous	Kilog.	800
191	Gun-cotton	"	4,000
192	Alumina, dry or gelatinous	"	2,500
193	Ambergris...........................	Gramme	400
194	Liquid ammonia, volatile alkali, or spirits of sal ammoniac	Kilog.	240
195	Amygdaline	Gramme	30
196	Amylene............................	Kilog.	10,000
197	Antimoniates of potash, plain or diaphoretic antimony, purified or not	"	1,000
	Do., of alkaloids..................	Gramme	100
198	Antipyrene	"	30
199	Carburet of potash, of any description	Kilog.	1,300
200	Anthraquinine and hydroquinine..	Gramme	30
201	"Apiol," pure	"	20
202	Arrobes for medicinal purposes....	Kilog.	800
203	Arsenates and arsenites:		
	Of potash or of soda, pure......	"	2,000
	Do., impure, for the arts and industries	"	200
	Of silver	Gramme	50
	Of any metal, not otherwise specified	Kilog.	2,000
	Of alkaloids or organic bases ..	Gramme	100
204	Asparagine, pure	"	20
205	Sugar of milk, salt of milk, or lactine	Kilog.	1,000
206	Balms, prepared, of any kind, not otherwise mentioned	"	1,800
207	Benzine	"	160
208	Benzoates, metallic, of any kind ..	"	10,000
	Do., of organic bases	Gramme	100
209	Medicinal biscuits of any kind	Kilog.	1,000
210	"Bolas de Nancy"	"	1,000

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS

OPENINGS FOR BRITISH TRADE IN MEXICO.

The following information, respecting openings for British Trade in Mexico, is extracted from a report, dated the 16th of July last, by Mr. Lionel Carden, Her Majesty's Minister at Mexico, which appeared in No. 202 of the Foreign Office (1887) Annual Series of "Diplomatic and Consular Reports on Trade and Finance":—

"In view of the great field which exists for agricultural and mining enterprise in this country, a fact which is at last beginning to be realised abroad, the machinery trade may be considered to be as yet in its infancy, and offers special inducements to business men, in that (most of the articles being free of duty) not so much capital, comparatively speaking, is required as in other businesses.

"In a secondary degree, it is probable that houses for the sale of English hardwares, which have been almost entirely superseded in this country of late years by similar German and American goods, might be established with a good chance of success.

"Another class of business in which English capital might be profitably employed, is that of ore-buying for shipment to England. There are already two American agencies established in the capital for that purpose, but the cheaper rates of freight to England, and the lower cost of reduction there, would enable English firms to compete with every prospect of success. This business is likely to be one of very great importance in the near future, in view of the large number of mines which are at present unworked on account of the heavy cost attendant on the establishment of reduction works, and from which large quantities of ore of moderate ley might be exported.

"In conclusion, it may be said that if English manufacturers are contented to leave the distribution of their goods in Mexico to merchants of foreign nationalities, though they may continue to retain a certain share of the trade, a considerable part of what they might have will unquestionably be wrested from them by their more active competitors. The superiority of English manufactures is not so unquestioned nowadays as to ensure for them a constant demand in foreign markets, and the indifference of the manufacturers to the special requirements of their foreign customers stands out in strong relief to the solicitude shown by American and German merchants to anticipate their wants and provide for them.

"With equal advantages as regards the prime cost of their productions and the expense of placing them on the market, it only requires the same tactics of advertising and canvassing, which have been so sucessfully employed by other nationalities, to secure to British merchants their due share in the trade of Mexico, the future importance of which can scarcely be overestimated.

CONCESSION FOR PAPER MAKING IN TURKEY.

The following information respecting industrial monopolies recently granted in Turkey is extracted from a report by Mr. W. H. Wrench, Her Majesty's Consul at Constantinople:—

"During the year 1885—86, six concessions for the establishment of factories in Turkey have been granted by the Ottoman Government, among which the following one is of interest:—

"A monopoly for the manufacture of paper, granted to a high palace official. Besides the privileges conceded to the foregoing monopolies, this concession enjoys a term of monopoly for 50 years for the whole empire, and the factory may be established in any part of Turkey the concessionary may select. If the site chosen should belong to the State it will be granted free and without purchase. At the expiration of the 50 years the concessionary is bound to give up the factory to the Ottoman Government, who will purchase the machinery, etc., but take over the building. The refusal for the future working of the affair will then be offered to the concessionary or his heirs.

"This concession is now in the market, and negotiations are being carried on with certain Austrian financial houses."

MISCELLANEOUS TRADE NOTICES.

THE NEW GERMAN SUGAR LAW.

On page 190 of the *Board of Trade Journal* for August will be found a dispatch from Mr. C. S. Scott, Her Majesty's Charge d'Affaires at Berlin, enclosing copies of the text of the new sugar law which was published in the *Official Gazette* on the 15th July, and of a memorandum thereon.

PRODUCTION AND EXPORTS OF CHILIAN NITRATE.

The following information respecting the production of Chilian nitrate during the month of April last, and the exports for the four months ended the 30th April, is extracted from the *Chilian Times* for the 21st May:—

"The total exportation of nitrate from all the nitrate ports in April was 968,654 Spanish quintals as compared with 712,266 quintals in the corresponding month of last year.

"The total loadings of nitrate at all the nitrate ports on April 30th amounted to 815,440 Spanish quintals, as compared with 806,304 quintals on the corresponding date of last year.

"The total production of nitrate in the province of Tarapacá in April was 512,237 metric quintals; the quantity sent down to the shipping ports was 438,080 metric quintals; and the stocks on hand at the works on the 30th April amounted to 456,346 metric quintals.

"The exports of nitrate to the United Kingdom directly amounted to 105,771 Spanish quintals for the first four months of 1887, as compared with 21,831 quintals for a corresponding period in 1886; the exports to the United Kingdom or to the Continent for orders amounted to 1,505,508 quintals in 1887, as compared with 1,346,667 quintals in 1886; the exports to Hamburg and Bremen 576,669 quintals in 1887, as compared with 205,282 quintals in 1886; those to the United States, east coast, reached 663,209 quintals in 1887, as against 422,137 quintals in 1886. The total amount exported during the first four months of 1887 was 3,311,742 Spanish quintals, as compared with 2,180,988 for the corresponding period of 1886.

THE POSITION OF THE CHEMICAL INDUSTRY IN CHILI.

The chemical products of Chili are as follow:—Sodium nitrate, iodine, copper, silver, gold, mineral acids, beer, alcohol, brandy, wine, matches and sugar. The nitre and iodine industries are very important, and both form the most important articles of the Chili export trade. The mining industry is considerable, as regards the production of copper and silver. The works are not managed by chemists, but rule of thumb assayers—ensayadores—make the necessary tests without having any notion of the chemical reactions. These ensayadores have a low social position, and are very badly paid. At Quilpué, near Valparaiso, there is a small works making sulphuric, hydrochloric and nitric acids, owned by an Englishman and managed by a German chemist. There are match works at Santiago and Rancqua. At Vina del Mar there is a large sugar refinery owned by a German and managed by a German chemist. Another similar works, which owes its origin to German enterprise, is in course of erection. All these establishments buy their engines and machines from England and Germany. At Valparaiso there are several engine shops and foundries, but it is cheaper to get engines from Europe. The mining industry is partly in the hands of Chilian and partly English capitalists. The mining engineers are chiefly natives, who received their training in Germany. Laws, taxes and fiscal conditions are very favourable to the establishment of chemical works, and the Chilian Government promotes the development of any industry. Foreigners enjoy the same rights as natives. However, the consumption of chemical products is still very small both in Chili, Peru and Bolivia.—*Chem. Zeit.* xi. 815.

CONSULAR REPORTS.

BRAZIL.

Chemical Imports.

During the financial year 1885—86 the imports of chemical and pharmaceutical products into the port of Ceará amounted to 23,961 reis value, of which 13,412 reis were received from the United Kingdom, the rest from the continent of Europe. The port of Pernambuco imported in 1885 £36,412 worth of chemical products, and in 1886 £40,775 worth.

BULGARIA.

Drug Imports.

English imported goods are mostly articles of the first necessity, which are not likely to be undersold by foreign importers, and include drugs and dyes. In these articles the demand has been considerably in advance of that obtaining in 1885, and still more of that of 1884. Turkish imports, though relatively greater than those of the year 1885, have in reality very much fallen off owing to the import duty of 8 per cent. *ad valorem* imposed on them since June of last year. Austria is making rapid strides, and at her present rate will soon compete with England in the value of her imports.

CHINA.

Dyestuffs.

The imports of dyestuffs into the Chinese port of Chin-Kiang increased from 244,245 bottles in 1885 to 271,139 in 1886. Foreign dyes are displacing native for dyeing silk and the finer kinds of cloth. They cost £6 a case of 250 bottles, whilst 133lb. of native can only be bought for the same sum. The foreign article can also dye a greater number of pieces than native, but the Chinese dyes stand washing better, and do not fade. Indigo is being grown in the neighbourhood of Chin-Kiang in increasing quantities, but the growers complain of the competition they have to endure from foreign bottles, reducing their profits and underselling their blue. Dealers in native dyes say, on the other hand, their business is as large as ever, but is confined more than was formerly the case to coarse foreign cloth and to native cloth; the quantity of these kinds of cloth sold increases, however, from year to year. Dyes come from Germany from Messrs. Lembke, Gipperich, Baumwaldt, and from Offenbach, the latter being the best.

FRANCE.

Corsican Industries.

At Bastia, on the island of Corsica, large works have been erected for the manufacture of tanning extract from the wood of the chestnut trees, and very excellent quality is produced, most of which finds a market in England, the total exports in 1886 being 390 tons. Sulphide of antimony is successfully worked in two small mines in the Cap Corse, owned and worked by Corsicans; their production might be much increased with more skilled management. An English company are also erecting sulphuric acid works, but the building of these has been greatly delayed through local opposition. Large quantities of mineral water (1195 tons in 1886) are annually shipped from Corsica to France.

GERMANY.

The Frankfort-o-M. Drug Trade.

The prices of nearly all pharmaceutical articles on the Frankfort-o-M. market declined without interruption till September, 1886, and the decided improvement which then set in was principally due to a more active demand. The low price of many articles procured them a sale in new districts, and a fresh impulse was also given by a conference of the manufacturers, held for the purpose of establishing a conformity in production of sale prices.

After a lapse of many years, during which the chemical industry had to struggle for sales, an improvement seems to have set in last year, most of the articles selling well, and obtaining even higher prices, as potash, prussiate of potash, borax, blue vitriol, spirits of sal-ammoniac, etc. The import of most British chemicals fell off seriously, caustic soda declining from 2621 tons in 1885 to 1645 in 1886, soda ash from 1566 to 1079 tons, soda crystals from 5538 to 894 tons, and chloride of lime from 5096 to 508 tons. On the other hand, the imports of ammonia sulphate from Great Britain rose from 25,170 tons in 1885 to 28,270 in 1886, cinchona bark from 2373 tons to 3170 tons, chromate of potash from 571 to 853 tons, and dyewoods from 2067 to 2679 tons.

The rise in the price of chlorate of potash which set in early in 1886, continued throughout the year; it appears that English manufacturers possess the power of regulating prices for this article, as well as for chloride of lime, as the rise in the latter, for which the condition of the market did not show any valid reason, was not at all objected to by German manufacturers, but, on the contrary, met with their full approval.

UNITED STATES.

The Petroleum Industry.

In 1886 there was a marked increase in the production of petroleum in the United States, but a steady decline in all the old reliable districts; a large increase in field operations, a material increase in domestic and foreign consumption, and necessarily a larger export of crude as well as refined oil than has ever been recorded in the history of the trade.

The grave feature of the American oil industry is that the yield of the old Bradford (Pennsylvania) district, long regarded as the mainstay of the industry, where the production in one day, August 31, 1881, reached 81,000 barrels, has greatly declined, and now produces only 25,000 barrels per day. The Alleghany (Pennsylvania) district, showing in 1882, 24,000 barrels per day, now yields but 5000 barrels per day. These two districts have been the chief producers, and their rapid decline causes apprehension, and seems to foreshadow a further general decrease in the production, so far as the present available sources of supply are concerned. The domestic consumption of petroleum was at least 8 per cent. greater in 1886 than it was in 1885. The exports for the year 1886 show an increase of 5 per cent. over the previous year, especially to the East Indies, India and Siam, and South America; but the shipments to China and Japan have fallen off. Holland, Norway, and Sweden have increased their consumption, while Great Britain, Germany, Denmark and Austria have taken less.

NEW OPENINGS FOR TRADE.

SPAIN.

Opening for British Goods.

Consul Wooldrige says that he would strongly advise the increased introduction of British manufactured goods into Barcelona, and adds that he can almost promise a sure success in the speculation, English articles being better and cheaper than native goods, if the country's wants are duly studied and considered.

Elsewhere in his report, the same Consul says that very few goods are imported from foreign countries into Barcelona that could not be so from England. New industries have lately cropped up in this busy corner of Spain, which are genuinely national, such as petroleum refineries. Large quantities of petroleum arrive from Russia, Germany, and the United Stakes; also large quantities of drugs and chemical productions come to this port, which, before the treaty, giving this country most favoured nation treatment, was signed, it was most difficult for England to compete with, as was shown by the insignificant quantities of these articles imported from here. The power of foreign competition is becoming lessened, and British success by no means depends, as before, on custom-house tariffs, enabling other foreigners to enjoy advantages denied to British traders, but on the commercial attainments possessed by British agents in opposition to German and French. The countries which at present compete with England in supplying goods to Barcelona are France, Germany, Belgium and Italy, and they compete strongly in, among other things, drugs.

Travellers must be Sent.

The British Consul at Malaga, in common with his fellows almost everywhere else, takes up the parable of the necessity for English traders to send out travellers. Something more, he says, than the mere reduction of the tariff on British goods is still apparently wanting to bring back from German, French, and Belgian competitors the trade which they were able to divert from us during the many years that British manufactures were handicapped by a differential tariff. So much has already been written on the subject of the imperative necessity of pushing our trade and commerce, by the means adopted by our foreign rivals, that it seems superogatory to insist again upon the matter, but unless our manufacturers are prepared to make some sacrifice in this direction by the employment of commercial travellers acquainted with the language of the country, and qualified to study the requirements of their customers, they can, it is feared, hardly regain the ground that has been lost in Spain. There are at Malaga a number of young German clerks who, on their return home, will be well prepared by knowledge of Spanish for employment in German firms having business with Spain, and some such system as this might doubtless advantageously be adopted at home.

High Price of English Goods.

The same Consul goes on to say that such British goods as do find their way to Malaga, although generally acknowledged to be of better quality than foreign manufactures of the same class, are usually complained of as being too expensive, and so the dealers are forced to fall back on the cheaper wares of other countries.

SWEDEN.

The Old Cry.

Our Consul at Gothenberg declares that British trade would no doubt greatly develop by commercial travellers visiting the country with samples, studying the requirements of the people, and meeting local tastes in the nature, quality, and value of the goods most in demand.

Cash Terms Favoured.

The same Consul says that the three to six months' credit in business transactions accorded to natives by European manufacturers is not recommendable. The English system of cash terms, though inconvenient to local tradesmen, is far more preferable, and may, if other facilities be afforded, cope successfully with the money concessions of France, Austria and Germany.

TURKEY.

Diminished Trade with England.

The import of petroleum into Turkey shows an increase for 1886. Consul Dickson, writing from Damascus, says that the decrease in the imports of British goods is attributable to the stocking of the market during the previous year, on account of the over-supply in England, and also to the efforts at competition of other European countries. As regards foreign competition, he goes on to say, efforts must not be neglected on the part of British manufacturing firms to promote their interests in the East, in the same way as other foreign houses. Costly and elaborately got-up circulars are sent out to Turkey by every post which arrives from England, and no opportunity is missed by Consul Dickson to bring them to the notice of native merchants and traders; but much more could be done in the interests of British trade by the periodical visits of commercial travellers.

Credit and Travellers.

The British Acting Consul General at Beyrout cautions firms at home against giving long credit. German traders are infinitely more accommodating in this respect than British, and it is due greatly to this fact that Germans hold in their hands as much of the trade as they do. But increase of trade does not always mean increase of profit, when on an unsound basis, and under these conditions it is more than doubtful whether in the end any profit will be realised. It would be impossible to do much business with Beyrout if cash payments were insisted on, but three months should be the outside limit of credit.

With regard to the question of commercial travellers, he says that it is undoubtedly a fact that whereas many German and French travellers visit Beyrout, a traveller on behalf of an English firm is a rarity. He thinks something might be done by catering for the requirements of the natives.—*Brit. and Col. Drug.*

STATISTICS.

TRADE STATISTICS FOR JULY.

The Board of Trade Returns for July show the following figures :—

Imports.

	July, 1886.		July, 1887.
Total value....	£29,452,497	....	£28,958,156

Exports.

	July, 1886.		July, 1887.
British and Irish Produce ...	£18,480,374	....	£19,181,595
Foreign and Colonial Produce (partly estimated)	6,097,107	....	5,541,601

Below are the details affecting drugs and chemicals :—

Imports.

		July 1885.	July 1886.	July 1887.
Drugs, unenumerated..	value £	58,712	46,226	54,517
Chemical manufactures and Products, unenumerated—		116,603	125,300	139,569
Alkali	cwt.	5,771	6,484	5,363
,, ...	value £	5,301	5,169	4,998
Brimstone	cwt.	31,391	59,204	48,642
,, ,, ...	value £	8,710	15,386	11,046
Nitre (nitrate of soda)	cwt.	65,510	137,718	78,480
,, ,,	value £	33,352	60,352	32,500
,, (nitrate of potash)	cwt.	10,062	12,963	12,349
,, ,,	value £	8,473	11,794	11,136
Quicksilver	lb.	32,025	334,317	356,525
,, ...	value £	2,515	30,420	30,801
Bark (Cinchona)........	cwt.	13,197	12,071	10,492
,, ...	value £	84,044	64,374	39,763
Gum Arabic	cwt.	8,058	2,783	4,112
,, ...	value £	24,053	10,826	19,269
Lac, seed, shell, stick, and dye	cwt.	13,384	5,112	10,162
Lac, seed, shell, stick, and dye	value £	41,507	11,359	26,551
Dyes and tanning materials—				
Bark (for tanners' or dyers' use)	cwt.	32,486	48,074	41,786
Bark (for tanners' or dyers' use)	value £	14,075	22,040	20,032
Aniline dyes	value £	17,683	22,809	25,895
Alizarin	value £	18,249	14,872	18,786
Other coal-tar dyes....	value £	194	—	1,103
Cochineal	cwt.	666	678	398
,, ...	value £	3,811	4,324	2,606
Cutch and gambier..	tons	2,073	1,368	1,075
,,	value £	44,788	34,174	25,787
Indigo	cwt.	1,309	2,472	2,166
,, ...	value £	27,374	32,542	37,072
Madder, madder root, garancine, and munjeet................	cwt.	1,408	951	1,845
Madder, madder root, garancine, and munjeet................	value £	1,918	1,365	2,521
Valonia	tons	1,358	3,602	2,654
,, ...	value £	21,534	51,002	39,144
Oils—				
Cocoa-nut	cwt.	7,524	4,307	730
,, ...	value £	11,709	6,378	1,148
Olive..................	tuns	1,276	1,544	1,634
,, ...	value £	52,438	55,885	57,088
Palm	cwt.	83,274	110,685	82,404
,, ...	value £	113,442	114,507	77,979
Petroleum	gals.	1,046,981	6,295,797	10,429,298
,, ...	value £	109,548	172,583	260,681
Seed, of all kinds	tuns	568	1,851	747
,, ...	value £	16,291	40,810	48,179
Train, blubber, and sperm	tuns	1,777	2,738	2,133
Train, blubber, and sperm	value £	53,353	55,638	40,733
Turpentine	cwt.	35,591	61,442	65,819
,, ...	value £	47,795	78,208	83,422
Rosin	cwt.	122,706	145,753	155,928
,, ...	value £	36,481	48,960	43,067
Tallow and Stearine....	cwt.	130,072	102,874	104,991
,, ...	value £	198,835	125,346	119,706

Exports.

		July, 1885.	July, 1886.	July, 1887.
British and Irish produce:—				
Alkali	cwt.	549,809	446,899	460,001
"	value £	162,942	134,176	137,070
Bleaching materials	cwt.	150,113	105,309	102,278
" "	value £	40,880	32,837	38,776
Drugs and medicinal preparations (unenumerated)	value £	68,136	73,887	64,982
Other chemicals and medicinal preparations	value £	165,891	158,455	180,091
Chemical manure	value £	180,254	112,667	118,470
Oil (seed)	tons	5,137	4,223	4,546
"	value £	120,243	92,952	98,788
Soap	cwt.	36,092	40,416	50,095
"	value £	42,036	40,073	46,687
Painters' colours and materials (unenumerated)	value £	109,168	107,465	112,111
Foreign and Colonial merchandise:—				
Bark, Cinchona	cwt.	9,051	7,541	7,290
"	value £	42,903	31,246	33,216
Chemicals (unenumerated)	"	16,203	18,443	17,487
Cochineal	cwt.	1,256	780	533
"	value £	8,275	5,309	3,447
Cutch and gambier	tons	830	896	901
" "	value £	19,604	23,830	23,398
Gum Arabic	cwt.	3,973	4,620	3,552
"	value £	12,822	15,176	14,624
Indigo	cwt.	4,929	2,483	2,863
"	value £	90,203	50,890	63,070
Lac, various kinds	cwt.	4,109	5,419	6,071
" " "	value £	13,195	15,136	15,335
Lard	cwt.	3,036	12,586	586
"	value £	6,067	24,617	1,048
Oils, cocoa-nut	cwt.	19,522	5,318	8,457
" "	value £	26,713	7,185	12,060
" olive	tuns	232	232	309
" "	value £	11,368	9,933	12,142
" palm	cwt.	27,250	76,180	27,703
" "	value £	38,410	78,171	27,116
" petroleum	gals.	74,270	28,040	25,430
" "	value £	2,878	1,352	1,351
Quicksilver	lb.	234,144	327,687	618,294
"	value £	18,223	28,658	54,837
Nitre (nitrate of potash)	cwt.	722	661	330
" "	value £	653	615	337
Tallow and stearine	cwt.	10,023	24,636	29,248
" "	value £	15,850	28,013	30,144

MISCELLANEOUS.

RESTRICTIONS ON THE RUSSIAN TRADE IN FOREIGN MEDICAMENTS.

The Russian Government some time ago adopted most stringent measures to restrict the trade in foreign medicinal preparations in Russia, which consumes very large quantities of these articles. Recently an official order has been issued reminding the customs officials of the provisions of the new law, and ordering them to be applied with the utmost rigour. The importation and sale of foreign medicinal preparations is only permitted if the preparations do not contain any noxious ingredients, and if they can be manufactured only by the aid of expensive or not easily obtainable appliances, or if special skill is required in their manufacture (a proviso obviously intended to foster Russian industry by excluding all preparations which can be manufactured in the country itself). The articles to be imported must be in good condition. All prepared medicaments, the importation of which is permitted, must be sold in Russia at a price fixed by Russian authorities. The formula of secret medicines must be published three years after their first importation. All newspaper and other advertisements relating to medicines must be approved by the authorities previous to publication.

SOAP-MAKING IN JAVA.

At Samarang, in Java, a soap factory is now in full swing; every preparation has been made, and all the raw material for the purpose are at hand. It is well known that of all animal and vegetable fats, cocoa-nut oil is the best for manufacturing certain kinds of soap in great demand in Europe. Mr. Steenberg, who has started the Samarang enterprise, is confident that he can turn out soaps equal in every way to the imported article, at moderate but remunerative rates. If the project succeeds there is a chance that the very large market for English soaps which now exists in Java may, to some extent at least, be lost.

THE CONVENTION OF GERMAN SODA MANUFACTURERS.

The firms which belong to the above syndicate are the Deutsche Solvay-Werke in Bernburg, the Chemische Fabrik Buckau in Magdeburg, Rob. Suermont and Co. in Bontwy, the Nurnberger Sodafabrik, Engelcke and Krause Trotha, the Rothenfelder Salinen- und Soolbad-Actiengesellschaft in Rothenfelde, the Actiengesellschaft Georg Egestorff's Salzwerke in Linden, and the Chemische Fabrik Schöningen in Schoningen. The syndicate hopes to succeed sooner or later in establishing a universal German soda association in the interest of all the manufacturers. At any rate the articles of association at present adopted leave it open to the works which have not yet joined to become members when they please.

DRUGS AND CHEMICALS FOR JAPAN.

A comprehensive review of the foreign trade of Japan in 1886 has jost been published. It is dated May 28, 1887, and is signed by Sir F. R. Plunkett, British Consul at Tokyo, who states that it has been prepared by Mr. Vice-Consul Longford. The report deals with all branches of trade, but contains several paragraphs relating to the importation of drugs and chemicals. These we shall quote verbatim, though it should be first stated that the total value of Japanese imports in 1886 was £5,577,817 and of Japanese exports £7,999,659, amounts largely in excess of any previous year.

The import trade was divided as follows:—

	£
Great Britain	2,599,753
China and Hong Kong	1,456,263
East Indies and Siam	729,615
United States and Canada	687,433
Germany	474,092
France	272,635

And the export trade as follows:—

	£
United States and Canada	3,326,103
France	1,605,009
China and Hong Kong	1,513,202
Great Britain	693,430
Germany	143,119
East Indies and Siam	107,531

Referring particularly to drugs and medicines, the Consul writes as follows:—

A considerable proportion of the import was of Chinese and Indian production, but the European portion was principally divided between Great Britain and Germany, the respective imports from each being: From Great Britain, to a value of £102,203; from Germany, to a value of £27,494. As compared with the figures for the previous year, the above amounts represent an increase of nearly £42,000 in the import of English drugs and medicines and of over £10,000 in those from Germany.

As this is not already an important trade, but one which is likely to assume in the future very considerable dimensions, I have made careful inquiry into it. I was induced in some degree to do so by various paragraphs which I have seen from time to time quoted from German trade journals, in which free expression was given to hopes that in a very short time the whole trade would become a German monopoly, and that all British drugs would be completely ousted from this market.

It is satisfactory to find that little or no foundation is afforded for these hopes by the figures contained in the customs returns for 1886, two-thirds of the total increase in the trade for that year having been in British manufactures. The customs returns have, however, to be taken with some modifications, some of the drugs which, owing to their having been imported by British merchants, are included under the heading of British manufactures, having been undoubtedly of German or French origin; while others again, entered as German manufactures, because imported by German merchants, were just as undoubtedly of British origin. As instances of these discrepancies, I may quote, salicylic acid, 5096lb., value £1782; iodide of potassium, 10,658lb., value £5572; and quinine, 36,833oz., value £5927, returned as among the British imports, but a great proportion of which was certainly of German origin; and, on the other hand, 14,700lb. of bicarbonate of soda returned as German, but, like caustic soda and other heavy chemicals, almost certainly of British manufacture. Making full allowance, however, for these and some other similar slight modifications, it is more than probable that the aggregate values above given of the import from the two countries are very nearly correct, in which case British manufactures have as yet no reason to dread the realisation of German anticipations on this trade.

The list on next page contains the principal drugs, not of Oriental origin, enumerated in the customs returns, and the approximate quantities of each imported during the past two years.

The only important items in this list in which, according to the Customs returns, the German exceeded the English import in 1886 were those of salicylic acid, cinchonine, santonine, and worm-seeds, but the modifications to which allusion has been made must be remembered.

Salicylic acid is made a specialty by large companies in Germany, holding patents for its manufacture, and the trade in it is entirely a German monopoly. The manufacture of santonine is in Russian hands, factories being established in proximity to Turkestan, where the flowers and seeds are produced, but German firms have control of its sale in Europe.

Iodide of potassium is an article not subject to any patent protection, but controlled by a trade combination; Scotch, Peruvian, and Scandinavian makers of iodine having agreed among themselves to a general course of action in regard to price and production. So far as cost of raw material is concerned, manufacturers of iodide of potassium of all countries are, therefore, on an equality; but the Germans make a nicer-looking crystal than English makers, and the Japanese, being particularly alive to appearance where, as in this case, not accompanied by inferior quality, give the preference to the German, and nearly all the trade in this article goes to Germany. German quinine is cheaper, but, though up to the necessary Japanese standard, it is doubtful if it is equal either in strength or purity to the English. Other drugs in which those of Germany have a preference to English make are cinchona, cinchonine, glycerine, and worm-seeds. Tartaric acid, glycerine, and quinine are to some extent obtained from France, and bromide of potassium from the United States. England, on the other hand, supplies carbolic acid, tartaric acid, bleaching powder, phosphorus amorphous, bicarbonate of soda, caustic soda, crystal soda, and bromide of potassium —all of which are very important items in the whole trade.

—	Import in 1886.	Import in 1885.		Increase or decrease in 1886, as compared with 1885.
	Lb.	Lb.		Lb.
Acid, carbolic	185,410	31,998	+	153,412
,, salicylic	22,878	18,653	+	4,225
,, tartaric	28,981	9,718	+	19,263
Bleaching powder	196,927	253,753	—	56,826
Cinchona	43,940	46,757	—	2,817
Cinchonine	2,596	2,044	+	552
Glycerine	160,793	114,213	+	46,550
Gum arabic	92,512	39,929	+	52,583
Morphine oz.	9,701	6,686	+	3,015oz.
Phosphorus amorphous	34,880	16,645	+	18,235
Potash, bromide	33,664	40,009		6,345
,, iodide	15,808	6,050	+	9,758
Quinine oz.	62,663	95,525	—	32,862oz.
Santonine	1,912	3,688	—	1,776
Soda, bicarbonate	1,768,127	1,161,708	+	606,419
,, caustic	3,644,117	1,727,692	+	1,916,425
,, crystal	1,012,396	1,003,624	+	8,772
Worm-seeds	84,573	15,037	+	69,536

In order to protect the people against the consequences of the sale by native dealers of inferior and spurious drugs, an analytical laboratory, carefully organised under foreign direction, was a few years ago established by the Government. Theoretically, this laboratory exercised no control whatsoever over foreigners, who were nominally left free to import any drugs they pleased, whether of good or bad quality. As far as drugs used for medicinal purposes are concerned, foreign importers are, however, practically entirely subject to it. No Japanese dealer is permitted to sell medicinal drugs that are not strictly in accordance with the vernacular Pharmacopœia which the laboratory has issued; and they, in consequence, decline to purchase from foreign importers any that have not either already passed through the laboratory, or that are unaccompanied by a certificate from a well-known chemist, or other satisfactory guarantee that they meet all the necessary requirements.

The tests used by the laboratory generally admit of a lower standard than is recognised by the English Pharmacopœia; but they are at the same time more severe in some details. They are, without exception, observed with the very utmost strictness, no latitude whatsoever being allowed, and any drugs, however pure and good in themselves, that fail in the minutest particular to conform to them are at once rejected.

British manufacturers are generally guided only by the British Pharmacopœia, and it is with the utmost difficulty that they can be induced to alter their productions so as to bring them into conformity with Japanese requirements. The English drug trade is very vigorously pushed by one English firm—the only firm of any nationality established in Japan whose business is exclusively in this line. A great portion of the whole trade is in their hands. A member of this firm has informed me that they are, in their own interests, in many cases forced, for the reason above stated, to have recourse to German manufacturers. In one which was quoted to me, that of bismuth, which, though included under the heading of "Unenumerated Drugs" in the Customs returns, is largely imported, he stated, "We are obliged to get all ours from Germany, as all our efforts to get from English sources an article which will satisfy the Japanese laboratory have failed, English makers considering the Japanese tests too severe, whereas we are able to get the article required from our German friends. Generally speaking, we find it more practical to do business with German makers. They are more alive to the fact of competition existing, and it is easier to do business direct with the manufacturers; while with the English it is often difficult to arrange transactions, owing to mere detail, and not price or quality."

The import of drugs is only an item in the business of those German merchants in Japan who deal in them, and cannot, therefore, receive from them the same attention and thought that the English firm just referred to is able to give to it. On the other hand, Japanese medical practitioners have been almost entirely educated by German professors, and, actuated by the spirit to which allusion has been made in another part of this report, no doubt, therefore, wherever possible, give a preference to German pharmaceutical preparations.

It is not, however, from an increase of the import of drugs of the latter class that an extension of this trade is to be expected in the future. The general adoption throughout the country of the European in preference to the old Chinese system of medicine, and the great increase that is yearly taking place in the number of skilled native practitioners trained under foreign professors, no doubt is creating a demand for European medicines; but there is no branch of Western science in which the Japanese have attained greater proficiency than that of chemistry, and they can already, and are yearly becoming more and more able to make themselves all extracts, tinctures, and other preparations prescribed by the Pharmacopœia. This trade will, therefore, always be a restricted one, even if it does not in time come to an end altogether, or if, as is not impossible, the Japanese do not become exporters rather than importers. But in all heavy chemicals, alkalis, and such as are required in manufacturing industries, the import is not only yearly increasing, but it promises to continue a progressive one, and to grow ultimately to very large dimensions. It is this class of goods which really interests British manufacturers most, and in it they need fear no competition to any serious extent, if they will only adapt themselves to the requirements of the Japanese market, rather than expect the latter to adapt itself to them.—*Chem. and Drug.*

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS AND MACHINERY.

APPLICATIONS.

10128 H. Appleby, London. Improvements in and connected with blast pipes. July 19

10166 J. Imray—From A. Moszczensky, Russia. Manufacture of refractory crucibles, pots, bricks, and lumps for furnaces. July 20

10203 H. C. Bull & Co., Lim., and H. C. Bull, London. An improved calcining oven. July 21

10205 H. C. Bull & Co., Lim., and H. C. Bull. Improvements in or connected with gas producers. July 21

10216 G. Downing—From F. Morin, L. van Effenterre, and P. Thiercelin, France. Method of and means and appliances for regulating the pressure of liquids and gases. July 21

10269 J. A. Breysse, London. Insulating pipes, etc., for the retention or exclusion of heat, and for like purposes. July 22

10301 W. Heidenhain and H. Hoffmann, Berlin. Platine presses. Complete specification. July 23

10393 F. W. Tucker, London. Hot-air bridge walls for furnaces. Complete specification. July 26

10401 J. Shone and E. Ault, Liverpool. Apparatus for raising and forcing liquids. July 26

10402 A. J. Boult—From W. C. Shaffer, United States. Application of the expansive power of heat, and apparatus therefor. Complete specification. July 26

10512 J. Stewart and T. Charlton, London. Method and means for storing volatile or inflammable liquids. July 28

10513 J. Stewart and T. Charlton. Method and vessels for storing and transporting volatile or inflammable liquids. July 28

10535 H. Davey, Westminster. Air-compressing pumps. Complete specification. July 29

10595 J. J. Hicks, London. Anemometers and pressure and vacuum gauges. July 30

10723 R. Cunliffe and J. Lund, London. Apparatus for calcining, drying, roasting or carbonising substances or materials and extracting gases, spirits or acids therefrom. Complete specification. August 1

10735 H. A. Snow, London. Means for connecting pipes and cocks to vessels of earthenware, stoneware, glass and other similar materials. August 4

10758 N. Clayden—From D. Francis, South Africa. An improved amalgamator. August 5

10862 W. H. Symons, London. Construction of cocks and valves. August 8

10957 L. Mond, London. Apparatus for treating solids by gases, also applicable to other purposes. August 10

10976 J. B. Hannay, Glasgow. Furnaces or heating apparatus. August 11

10991 J. H. Plant, Liverpool. Improvements in heads and lids of caustic drums, and for like purposes. August 11

11022 T. Nixon, Sheffield. An improved valve for water, steam or other fluids, and especially suitable for acids. August 12

11035 R. Clayton, London. Construction of filters. Complete specification. August 12

11050 G. E. Stead and T. W. Duffy, Leeds. Means or method for purifying water; applicable also for preventing incrustation in boilers. August 12

11139 R. Johnson, Bradford. Air compressors. Complete specification. August 15

11154 R. Howarth, London. Machines for drying granular, fibrous and like materials; also applicable for cleaning, bleaching, damping, germinating and disinfecting. August 16

11127 J. P. Jackson, Liverpool. Filters August 17

11292 J. S. Croft and G. T. Appleyard, London. Refrigerators. August 18

11310 E. Edwards—From E. M. Heiber, Germany. Improved boilers, and apparatus for preventing and removing deposit or incrustation therein. August 18

COMPLETE SPECIFICATIONS ACCEPTED.[*]

1886.

10037 E. Edwards—From G. Lunge and L. Rohrmann. Apparatus for effecting the absorption of gases by liquids or solids. July 30

11959 C. G. P. de Laval. Apparatus for supporting and working centrifugal machines. July 23

12018 A. M. Clark—From V. A. Pilloud. Apparatus for automatically compressing air. July 23

12061 H. R. Lipscombe. Composition for softening and purifying water. August 17

12352 J. L. Wade. Composition for preventing incrustation. July 30

12395 T. Hill. Apparatus for heating, cooling and condensing. August 10

12418 G. Best. Apparatus for condensing steam. August 13

12769 W. Burns. See Class III.

12975 F. H. Stacey and H. Wilkinson. Apparatus for blowing, exhausting and pumping. August 6

13799 W. G. Gard. Liquid for preventing and removing incrustation in steam boilers. August 3

14933 A. Cockey and W. Smith. Self-acting safety bye-pass gas valves for gas exhausters. July 23

16290 J. B. Hannay. Apparatus for condensing, absorbing or washing gases or fumes, etc. August 17

1887.

7723 O. Kruschki. Heating apparatus with air supply from above. July 30

7814 E. Palmer. Bricks and fire bridges for furnaces, etc. July 30.

9015 H. H. Lake—From A. P. Ligbthill. Atomisers. July 27

9047 O. Brunler and C. G. Rommenhöller. Pressure reducing valves for highly compressed gases, and especially for carbonic acid. August 6

9110 P. A. Newton—From R. A. Chesebrough. Hot air furnaces. August 3

9165 G. Blackwell. Rotary exhausters or pumps for gas and other fluids. August 6

II.—FUEL, GAS AND LIGHT.

APPLICATIONS.

10112 R. Haddan—From T. T. Prosser and H. Waller, jun., United States. Process for utilising products of heat. Complete specification. July 19

10127 J. J. Hood and A. G. Salamon, London. Improvements in the desulphurisation of gaseous and other products. July 19

10371 E. F. Gwynne, London. Improved combination of ingredients for lighting fires. July 25

10558 O. E. Guibout, Liverpool. Improvements in and relating to apparatus for lighting and heating by means of gas. July 29

10603 T. Fletcher and A. Clare, Manchester. Improvements in incandescent gas fires. July 30

10628 A. D. Mackenzie and G. G. Moncur, Glasgow. Improvements in radiators for heating purposes August 2

10686 T. H. Gray, Norwood. Improvements in the treatment of hydrocarbon illuminating oils. August 3

10684 E. Grahn, Liverpool. An improved process for treating gas liquor and other ammoniacal liquors. August 3

10743 J. H. W. Stringfellow and W. Brown, London. Improvements in carburetting or enriching gas or air, and apparatus therefor. August 1

10861 R. H. Michell, Wiesbaden. Consuming smoke, and thereby economising fuel. August 8

11119 J. Castle, E. Castle, and E. Braithwaite, London. A new or improved arrangement of reflectors for distributing, concentrating, increasing and shading artificial light. August 15

11195 O. Imray—From C. A. von Welsbach, Austria. Improvements in incandescence bodies for illuminating purposes, and in the treatment of mantles produced therefrom. August 16

11201 J. Tennent, Liverpool. Improvements in or appertaining to the transmission of heat from one fluid body to another. Complete specification. August 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

10861 T. P. Hollick. Apparatus for raising the covers of gas-purifiers and other weights. August 17

11833 J. M. Turnbull. Manufacture of gas from mineral oil, and apparatus therefor. August 10

12769 W. Burns. See Class III

14111 G. Sengrave—From P. Fougeron, jun. Construction and arrangement of carburetting apparatus. August 3.

14958 W. Burns. Distillation of tar, oil, resin and liquid hydrocarbons; the manufacture of illuminating and heating gases therefrom, and apparatus for that purpose. July 30.

1887.

7518 J. Belou. Process for manufacturing pure hydrogen. July 30

9391 C. S. Ellery and J. Chaflin. Preventing the choking of pipes between the retort and hydraulic main in gas-works. August 3

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

12769 W. Burns. Construction of retorts and apparatus for the destructive and cummulative distillation, carbonising and calcining of dry compound substances. August 6

14958 W. Burns. Distillation of tar, oil, resin and liquid hydrocarbons in the manufacture of heating and illuminating gases therefrom, and apparatus therefor. July 30

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

10223 S. Hallsworth and R. Bailes, London. Improvements in the manufacture or preparation of a certain material to be used for dyeing purposes. July 21

10554 J. A. Walton, London. A liquid blue. July 29.

11318 H. H. Lake—From Leonhardt & Co., Germany. Improvements in the manufacture of alpha-naphtholdisulpho acid, and in the production of colouring matters therefrom. August 18

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

12054 R. Ripley. Forming blacklead, blue and other like substances into packets.

12908 G. Pitt—From L. Cassella & Co. Manufacture of new naphtylaminemonosulphonic acids and of dyestuffs therefrom. August 10

13166 C. A. Bennert. Manufacture of Colouring compounds or materials. August 20

13473 C. A. Bennert. Treatment of certain colouring compounds to render them soluble, or more soluble, and suitable for dyeing and printing. August 20

1887.

10046 C. A. Bennert. Manufacture or production of colouring matters. August 20

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

10137 T. F. Wiley, Bradford. A new or improved process of, and apparatus for, waterproofing textile fabrics. July 20

10650 P. Cohnreich, London. Improvements in oiling or fatting wool, and apparatus therefor. August 2

10979 W. Marriott, Huddersfield. A new process and means for separating silk, cotton, or vegetable matter from wool. August 11

11182 W. J. Grawitz, London. Process for the treatment of textile materials dyed with aniline black. August 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

10035 A. Wilkinson. Treatment of plants, shrubs, barks and other fibres to be used in spinning processes, and to be woven into textile fabrics. August 6

13054 T. Honeywood. Preparation of fibre for textile and other purposes. August 17

1887.

6461 C. C. Kauffmann. Process and apparatus for treating ramie, jute and other fibres. July 23

8575 H. H. Lake—From C. Shrebler. Drying and carbonising wool, and apparatus therefor. August 17

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[*] The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

VI.—DYEING, CALICO PRINTING, PAPER STAINING AND BLEACHING.

APPLICATIONS.

10113 A. Gilliard, P. Monnet, and J. M. Cartier, London. Improvements in the production upon fibres and fabrics of colours varying from black or brown-black to blue-black and blue. July 9

10591 J. Robertshaw, London. Improvements in machines employed in dyeing, sizing washing, and wringing hanks. July 30.

10679 C. F. Young, Manchester. Improvements in the treatment or method of using certain dyes or combinations of dyes. August 3

11154 R. Howarth. See Class I.

11219 E. Sutcliffe and G. E. Sutcliffe, Manchester. Improvements in the production of grey and coloured cotton yarns. August 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

13,362 F. A. Gatty. Dyeing cotton, cotton yarns and cotton fabrics. August 17

1887.

9720 C. Meadowcroft and P. Denanhouer. Apparatus for dyeing skeins. August 13

9722 W. P. Thompson—From J. Meikle. Apparatus for cleaning and bleaching cotton and other fibrous and textile fabrics. August 13

VII.—ACIDS, ALKALIS AND SALTS.

APPLICATIONS.

10093 C. J. Bayer, London. Process or processes and apparatus for obtaining pure alumina compounds from bauxite and similar materials containing alumina. July 19

10141 S. Hallsworth and R. Bailes, Leeds. Improvements in or relating to the manufacture of copperas, and of ferric sulphate or sesqui-persulphate of iron, commonly called nitrate of iron. July 20

10153 J. Fleming, Glasgow. Improvements in connection with the calcining of sulphurous ores. July 20

10154 J. Fleming, Glasgow. Improvements in the construction of chambers or towers wherein acids are generated, or through which they are passed, the said improvements being applicable to the construction of condensers or tanks used in the manufacture of acids. July 20

10168 W. H. Knowles—From — Phol, United States. Improved apparatus for generating carbonic acid gas for forcing or raising beer and other liquids, and for other purposes. July 20

10222 S. Hallsworth and R. Bailes, London. Improvements in or relating to the manufacture of ferric sulphate, or sesqui-sulphate of iron, commonly called nitrate of iron. July 21

10295 C. Wigg, Liverpool. Improvements in obtaining ammonia and carbonic acid from the residual chloride liquors of the ammonia alkali process. July 23

10305 E. H. Hutchinson, London. Improvements in compressing sea-salt and chemicals having the same properties, and apparatus therefor. July 23

10307 P. Bateson and M. C. Arnoltz, Liverpool. Improvements in apparatus for the manufacture of bicarbonate and carbonate of soda by the ammonia soda process. July 23

10329 T. Bayley, Birmingham. Improvements in the treatment of waste acids. July 25

10346 J. F. Peasgood, Streatham. A specially pure and acid vinegar. July 25

10585 S. Wolf, Liverpool. Improvements in or connected with the application or utilisation of acid sulphate of soda in the manufacture of cellulose, and for other purposes. July 30

10610 T. O. Nesbit and T. Forster. See Class XII.

10759 H. W. Deacon—From C. Arnois, United States. Improvements in the manufacture of carbonic acid gas. Aug. 5

10818 J. Hanson, London. The utilisation of alkali waste for the manufacture of sulphuric acid. August 6

10900 J. B. Thompson, London. Improvements in the manufacture of soda, and in apparatus therefor. August 9

10955 L. Mond, London. Improvements in obtaining ammonia, chlorine and hydrochloric acid from ammonium chloride, and in apparatus therefor. August 10

10957 L. Mond, London. See Class I.

10966 T. Schloesing, London. Improvements in the treatment of hydrochlorate of ammonia resulting from the manufacture of carbonate of soda, with a view to the extraction of chlorine. August 10

10991 J. H. Plant, Liverpool. See Class I.

11022 T. Nixon. See Class I.

11156 T. S. Mathieson and J. Hawliczek, Liverpool. Improvements in the manufacture of caustic soda and caustic potash from their respective sulphates, the recovery of certain by-products therefrom, and apparatus employed therein. August 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

10298 F. Maxwell Lyte. See Class XII.

11891 A. Brin and L. Q. Brin. Manufacture of bleaching liquid. July 23

12070 A. Brin and L. Q. Brin. Treatment of copper and iron pyrites for the manufacture of sulphuric acid and oxides of copper and iron; and treatment of the said oxides for the production therefrom of metallic copper and the higher oxides of iron. August 3

12110 J. J. Hood and A. G. Salamon. Manufacture and purification of metastannic acid. July 23

12769 W. Burns. See Class III.

13001 J. I. Watts and W. A. Richards. A new sodium product and method of manufacturing same. August 10

16290 J. B. Hannay. Apparatus for condensing, absorbing or washing gases or fumes. August 17

1887.

9047 O. Brunler and C. G. Rommenholler. See Class I.

9048 O. Brunler and C. G. Rommenholler. Apparatus for using liquid carbonic acid in large quantities. August 13

9188 E. Banisch and M. Schroder. Process and apparatus for production of sulphuric anhydride. August 6

VIII.—GLASS, POTTERY AND EARTHENWARE.

APPLICATIONS.

10085 C. Toft, Newcastle-under-Lyme. The ornamenting and decorating of pottery and porcelain by an imitation of lead or metal mountings used for stained glass. July 19

10156 R. W. Willis and A. J. Willis, London. Improvement in enamelled letters and figures for fixing to glass and other polished surfaces. July 20

10258 J. B. Payne and R. Davison, London. A new or improved portable or fixed gas kiln for burning and staining glass, china, enamels, tiles and ceramic wares, also applicable to other purposes. July 22

10556 T. Buck, junr., London. Improvements in brick and tile making machines. July 29.

10735 H. A. Snow, London. See Class I.

10762 W. Lewis, Halifax. Improvements in the arrangement and construction of fire-clay, terra-cotta or fire-brick domestic fire-places. August 5

10812 J. Earle, G. Bourne, and T. Bourne, London. Improved apparatus for cutting and ornamenting glass. Complete specification. August 6

10811 H. J. Shawcross. See Class XIX.

10858 J. Gill, London. Improvements in machinery or apparatus for the manufacture of pottery, pressing bricks, and the like. August 8

10874 A. J. Boult—From P. Sievert, Germany. Improvements in glass furnaces. Complete specification. August 8

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

11870 R. Kelsall and W. Lee. Machinery for drying pottery ware. July 30

12793 H. L. Doulton and W. P. Rix. Production of ornamental pottery ware. August 20.

13209 W. Lutwyche—From A. Ceresa. Producing mosaics by means of enamel substances and coloured glass. August 20.

1887.

7516 H. Godwin and W. Hewitt. Making and connecting tile or ceramic fenders and ceramic mouldings generally on new and improved principles. August 10

IX.—BUILDING MATERIALS, CLAYS, MORTARS AND CEMENTS.

APPLICATIONS.

10236 C. A. F. Gregson, London. Improved means or appliances for use in the erection of walls of concrete or like material. Complete specification. July 21

10244 J. S. Rigby, Liverpool. Improvements in the manufacture of cement. July 22

10324 W. Matthews, London. Improvements in the manufacture of Portland cement. July 23

10377 W. Youlten, London. Improvements in fireproof floor construction. July 26

10385 E. Larsen, London. Improvements in the manufacture of slag cement and in the preparation of raw materials used therefor. July 26

10446 C. J. Howe, London. Improvements in the manufacture of plaster of Paris. July 27

10530 J. W. H. James and F. Ransome, Liverpool. Improvements in and connected with furnaces for burning hydraulic lime, cement and like substances. July 29

10764 F. W. S. Stokes, London. Improvements in the methods and apparatus for drying cement slurry, and the subsequent cooling of the burnt cement. August 5

10779 **E. de Pass**—From **J. M.** Danielli, France. A method or process for imitating, by casting, white and coloured marble. August 5

13898 **E.** Keirby, London. A new or improved compound or cement, and application of the same in making asphalte walks, in renovating and repairing old asphalte walks, in coating and protecting masonry, and for other analogous purposes. Complete specification. August 9

11274 J. S. Rigby, Liverpool. Improvements in the treatment of lime mud and like substances, to obtain whiting and cement, and in apparatus therefor. August 18

COMPLETE SPECIFICATION ACCEPTED.

1887.

857 A. C. Ranyard. Paving road and other ways. August 3.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

10152 J. Fleming, Glasgow. Improvements in treating copper matte. July 20

10153 J. Fleming. See Class VII.

10189 R. Bentham, Atherton. Miners' portable electric lamp. July 21

10206 H. C. Bull & Co., Limited, and H. C. Bull, London. An improved metallurgical process, and apparatus therefor. July 21

10266 J. Wilkes and E. Mapplebeck, London. Improvement in cores used in casting tubes of copper, brass and other metals and alloys. July 22

10276 C. Netts, London. Improvements relating to the preparation of sodium and potassium. July 22

10338 J. Routledge, Sunderland. The safe blasting of shots with a safety blasting cartridge. July 25

10387 J. W. Wailes, Liverpool. Improvements in and applicable to open hearth steel-melting and like furnaces. July 26

10400 W. J. Wilder, Liverpool. Improvements in process of coating metals. Complete specification. July 26

10406 H. J. Allison—From B. Atha and W. R. Hinsdale, United States. Process and apparatus for forming metallic ingots in a sectional bar. July 26

10443 C. P. Tabary, London. A new description of metallic cement and processes for its manufacture. July 27

10538 C. E. Miles, London. Improvements in furnaces for smelting ores. July 29

10552 H. Johnson, London. Improvements in hand punches for making bore holes for blasting and wedging operations in getting coal and other minerals, and for like purposes. July 29

10561 A. Neujean, London. Improved method of utilising and applying basic slag alone or in combination with other materials to various useful purposes. July 29

10570 A. E. Carroll and W. P. Burnley, Manchester. Improvements in compositions for use in the preparation of the moulds for steel and other metal castings. July 30

10588 F. Fenton, Batley—From J. Woolford, France. Improvements in extracting gold from simple, compound and refractory ores, or slags, or wastes, or cinders of ores or metals containing gold or gold blends. July 30

10594 C. T. J. Vautin, London. An improved method of extracting gold from the various auriferous ores. July 30

10614 L. Mellett, London. Improvements in means or apparatus for use in ascertaining and indicating the presence of mineral ores or metallic substances. Complete specification. August 2

10622 J. Gill, London. Improvements in apparatus for the manufacture of sleeves of refractory material for the stopper-bars of vessels containing molten metal. August 2

10659 W. P. Thompson—From G. L. Kobert, France. Improvements in converters. August 2

10738 A. W. Daw and Z. W. Daw, London. Improvements in rock drills. Complete specification. August 4

10815 W. P. Thompson—From M. G. Farmer, United States. New and improved process and apparatus for procuring aluminium. Complete specification. August 6

10817 J. Y. Johnson—From La Compagnie Anonyme des Forges de Châtillon et Commentry, France. Improved means and apparatus for tempering armour-plates and other massive articles of iron or steel. August 6

10820 T. Mallinson, London. Improvements in apparatus for use in the manufacture of tinned wire. August 6

10868 J. Toussaint, London. An improvement in the construction of furnaces for refining iron, steel or other metals. August 8

10893 M. H. Smith, Halifax. Improvements in apparatus for separating iron from other substances. August 9

10918 F. W. Dahne, London. Improvements in refining copper, copper regulus and copper precipitate, and more especially such copper products as contain arsenic and other volatile impurities. August 9

10922 C. Roth, London. Safety apparatus to be employed for igniting fuses especially adapted for use in blasting operations in coal mines for preventing explosion of fire-damp. Complete specification. August 9

10951 J. H. Lamprey, London. An improved armour for ships, floating structures, fortifications, targets, and the like. August 11

11025 J. Coombs, London. Improvements in ore separators or gold extracting machinery. August 12

11128 J. Foster and J. S. Caldwell, Liverpool. Improvements in miners' or safety lamps. August 15

11142 H. H. Lake—From B. Atha, United States. Improvements relating to the casting of metal ingots or bars, and to apparatus therefor. August 15

11210 H. H. Lake—From S. Heilbronn, Germany. Improvements in apparatus for boring or drilling earth, rock, or the like. August 16

11233 J. Hollnay, London. An electro deposition of metal. August 17

11267 W. Priestland, Chesterfield. An improved core barrel for making cast-iron pipes. August 18

11268 G. A. Jarvis, Wellington, Salop. The manufacture of sodium and potassium. August 18

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

11972 B. H. Thwaite. Purification of iron ore and fluid iron metal, and apparatus therefor. July 30.

12070 A. Brin and L. Q. Brin. See Class VII.

12128 R. Poole. Box and cover, for use in annealing sheet iron, etc. July 27.

12601 J. D. Ellis. Manufacture of iron or steel plates with ribs or projections, and apparatus therefor. August 6.

12692 H. W. Bessemer. Manufacture of malleable iron and steel, and apparatus therefor. August 6.

12866 J. Gilchrist and D. Ballardie. Miners' lamps. August 13.

13238 J. Havenhand. Ingot moulds. August 10.

13239 G. H. Lloyd, A. L. Lloyd and H. Bewlay. Manufacture of pipes of malleable metal. August 17.

13460 R. Heathfield. Apparatus for coating sheets and articles of iron and steel with zinc or alloys of zinc and other metal. August 10.

1887.

2780 J. Dahl. Annealing steel. July 30.

3531 T. Shaw. Method and apparatus for testing gases drawn from mines, and signalling results. July 27.

6370 S. T. Montagne. Process and apparatus for recovering tin from tinned cuttings and scrap. July 27.

7519 J. Belou. Treatment of ores. July 30.

7533 F. J. Clamer and J. G. Hendrickson. Process for cleaning, preparing and coating metal plates and surfaces. July 23.

8599 E. Walsh, jun. Method and apparatus for reducing zinc ores and collecting metallic zinc therefrom. July 30.

8712 J. Y. Johnson—From A. de Meritens. Process for browning or colouring iron or steel surfaces and protecting them from rust. July 27.

9499 A. J. Boult—From W. H. Larimer. Drills for mining purposes. August 20.

XI.—FATS, OILS and SOAP MANUFACTURE.

APPLICATIONS.

11021 G. Gourley, Glasgow—From T. Bell, Auckland. An improved lubricating oil, and the method of manufacturing the same. August 12

11115 W. P. Kelly, London. A new composition to be used as a lubricant. August 15

XII.—PAINTS, VARNISHES and RESINS.

APPLICATIONS.

10610 T. O. Nesbit and T. Forster, Newcastle-on-Tyne. An improved method of producing white lead and other compounds and combinations of lead. August 2

10656 A. J. Boult—From T. Rosenfeld, J. Zeleny and A. Weiss, Austria. An improved manufacture of paste for protecting metal alloys against rust. Complete specification. August 2

11068 J. J. Speakman, London. Improved compositions for use as "paint restorers," or paint or varnish removers, and for cleaning various surfaces. August 13

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

10298 F. M. Lyte. Manufacture of white pigment. August 3.

13416 J. B. Hannay. Manufacture and treatment of lead pigments and compounds, and apparatus therefor. August 17.

13799 W. G. Gard. See Class I.

XIII.—TANNING, LEATHER, GLUE and SIZE.

APPLICATION.

11253 T. Palmer, London. Improvements in tanning, and in tanning apparatus. August 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

11005 C. Wagner, jun. Machines for skiving or sharpening leather. August 17.

12681 E. P. Nesbit. Process for clearing hides, skins, hair, wool, or fur from lime. August 6.

13636 T. Palmer. Purifying and graining or bating hides and skins, and apparatus therefor. August 20.

XIV.—AGRICULTURE, MANURES, Etc.

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

12772 W. S. Squire. Obtaining manure from distillers' spent wash. August 10.

1887.

10060 T. Roxburgh. Process of making manure. August 29.

XV.—SUGAR, GUMS, STARCHES, Etc.

APPLICATIONS.

10158 J. T. Griffin—From R. J. Henderson, United States. The manufacture of soft or spongy material from rubber compound. Complete specification. July 27

10523 R. T. Lloyd, London. Improvements in and connected with syrup pumps. July 28

10812 L. E. A. Prangey, London. Improvements in the manufacture of sugar, and in the apparatus to be employed therefor. August 8

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

11048 F. Candy. Materials for use in purifying and decolourising liquids and solutions. August 3.

13168 E. M. Knight and A. H. Hobson. Manufacture of liquid cement or gum. August 17.

1887.

9751 E. J. P. Robet. Treating vegetable milky juices, and extracting therefrom indiarubber, gutta-percha, mangabeira, etc. August 13.

XVI.—BREWING, WINES AND SPIRITS.

APPLICATIONS.

10108 W. Wild, London. Improvements in or applicable to the manufacture of grape wines. Complete specification. July 19

11227 J. P. Jackson, Liverpool. Improvements in filters for wine and other liquids. August 17

11232 R. Ranger, London. Improved apparatus for regulating the surface-flow of wort from coolers used in the manufacture of beer.

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

12772 W. S. Squire. See Class XIV.

13259 G. Thornley and T. Buxton. Apparatus for expelling liquid from spent hops. August 20

1887.

9015 O. Brünler and C. G. Rommenholler. Means for impregnating beer and other liquids with carbonic acid in the cask. July 27

9016 O. Brünler and C. G. Rommenhöller. Process and apparatus for automatically mixing liquids with carbonic acid. July 27

9019 O. Brünler and C. G. Rommenhöller. Process and apparatus for the automatic mixing of liquids with carbonic acid. July 27

10018 W. Wild. Manufacture of grape wines. August 20

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

APPLICATIONS.

A.—Chemistry of Foods.

10117 A. Brin and L. Q. Brin, Westminster. Improvements in means and apparatus for producing pure oxygenated drinking waters. July 27

10647 J. Lyle, London. Smoke-curing fish, flesh and other food, and the application of tar and other substances for the purpose. August 2

10810 H. R. Romney, London. An improved process for desiccating cocoa-nut and other materials. August 6

10915 H. H. Lake—From H. C. Andrews, United States. Improvements in apparatus for drying or curing fruit, tobacco, and other substances. Complete specification. Aug. 9

10917 H. H. Lake—From T. C. Oakman, United States. Improvements in apparatus for drying or curing fruit, tobacco and other substances. Complete specification. Aug. 9

10918 W. F. Reid, London. A new or improved method or process for the preservation of fruit. August 10

10991 A. Dunderdale, Liverpool. Improvements in extracting the black colouring matter from pepper-corns, and obtaining light coloured pepper-corns thereby. August 11

11031 G. W. Charter, London. Improvements in manufacturing and preserving whole-meal, wheat and other crushed cereals used for bread, and preventing fermentation. Aug. 12

11051 G. F. Redfern—From A. Mosser and L. Chiari, France. Improvements in apparatus for preserving alimentary and other like substances. August 12

11311 G. Grout, Hornsey. An improved preparation of cocoa. August 18

B.—Sanitary Chemistry.

10901 A. H. Curling and J. Dunbar, London. Improvements in the deodorisation and disposal of sewage, and in apparatus therefor. August 9

10912 H. C. Bull and Co., Lim., and H. Clay Bull, London. Improvements in and connected with the treatment of sewage. August 10

C.—Disinfectants.

10306 E. H. Hutchinson, London. An improved method of compressing solid and liquid disinfectants, and apparatus therefor. July 23

10309 J. Hanson, London. Improvements in apparatus to be used in the generation of gases for disinfecting or deodorising. July 23

10747 A. Boake and F. G. A. Roberts, London. Improved means and apparatus for disinfecting and deodorising. Aug. 4

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1887.

1171 C. Kranz. A preparation for use as a food and condiment. July 30.

8962 F. Sievers and R. Damm. Manufacture of sausages from fish. August 10

B.—Sanitary Chemistry.

1886.

8999 W. Horsfall. Furnace for burning towns' or other refuse. August 6

12218 T. Ogden. Furnaces for desiccation, deodorisation and combustion of refuse. August 13

12382 W. B. Hallett. Preparation of materials for use in treatment of sewage, method of treatment, and apparatus therefor. August 10

XVIII.—ELECTRO-CHEMISTRY.

APPLICATIONS.

10177 E. L. Mayer and H. Leipmann, London. Improvements in the manufacture or treatment of porous pots, plates or partitions for electric batteries.

10201 H. C. Bull & Co., Limited, and H. C. Bull, London. Improvements in electric storage batteries. July 21

10217 J. Serson and J. Orville Whitten, London. Improvements in galvanic batteries. Complete specification. July 21

10322 C. Gassner, junr., London. Improvements in carbon manganese electrodes. July 23

10474 E. De Pass—From Cuénod, Sautter, et Cie., Switzerland. An improved dynamo-electric machine. July 28

10514 V. J. J. Hirbec, London. An apparatus for storing electricity and facilitating the utilisation thereof. July 28

10565 C. P. Elieson, London. Improvements in electrical batteries. July 29

10606 L. Gerard, London. Improvements relating to the distribution, storage, and regulation of electric currents. July 30

10611 R. P. Milburn, Newcastle-on-Tyne. Improvements in electrical batteries. August 2

10767 W. Lowrie, C. J. Hall, and H. W. Kolle, London. Improvements in instruments for measuring electric currents, and for regulating and controlling dynamo-electric machines and prime movers. August 5

10834 A. R. Upward and C. W. Pridham, London. Improvements in galvanic batteries. August 6

10919 E. Jones, London. Improvements in the construction of plates for secondary batteries. August 9

10952 L. Anspach and L. Gerard, London. Improvements in or connected with dynamo-electric machines and electromotors. August 10

11188 H. H. Lake—From W. E. Case, United States. Improvements relating to the conversion of chemical energy into electrical energy, and to apparatus therefor. Complete specification. August 16

11189 H. H. Lake—From W. E. Case, United States. Improvements in apparatus for the conversion of heat into electrical energy. Complete specification. August 16

11213 T. J. Digby, London. Improvements in electric accumulators or secondary batteries. August 17

11252 H. Mower, London. Improvements in secondary batteries or electrical accumulators. August 17

11315 H. H. Lake—From G. E. Cabanellas, France. Improvements in and relating to dynamo-electric machines. August 18

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

8693 W. J. Starkey-Barber-Starkey. Secondary batteries. August 6

11101 T. J. Jones and W. H. Tasker. Secondary batteries. August 3

11239 H. Carter. Electric battery, with means for regulating the amount of submersion or withdrawal of the positive plates. July 27

11242 D. E. Fitzgerald. Means for effecting the electro-chemical generation of chlorine in metallurgical operations for the extraction of gold from its ores, and for other purposes. July 23

12117 W. Maxwell. An electric furnace. July 27

12595 E. Andreoli. Secondary batteries. August 6

1887.

1648 C. L. Tweedale. Primary batteries. August 13

5720 C. Coerper. Dynamo-electric machines. August 3

9013 C. Coerper. Dynamo-electric machines. July 27

9726 W. P. Thompson—From G. Westinghouse, jun. Armatures for electric generators. August 17

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

10814 H. J. Shawcross, London. The preparation and treatment of paper, woven or tissue fabrics, glass or other material for the production of copies of drawings, designs, pictures, photographs, writings, and the like, by the action of light. August 6

11056 J. L. Lewis, London. An improvement in the manufacture of paper. August 12

11190 G. A. Wilkins—From L. H. Thomas, United States. Improvements in the manufacture of paper bottles. Complete specification. August 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

12217 R. D. Sinclair and J. G. Brown. Manufacture of paper, to render same antiseptic and germ-proof. August 10

1887.

8969 H. Gardner—From S. S. Stevens. Manufacturing pulp for paper, and apparatus for the purpose. July 27

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATION.

10260 C. Kolbe, London. Improvements in the manufacture of salicylic esters, called "Salols." July 22

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

11816 A. Brin and L. Q. Brin. Means for the manufacture or production of ozone. August 6

12610 P. H. Lecorme and Raynaud. Manufacture of perfumery. August 6

XXI.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

10518 J. Nicholas and H. H. Fanshawe, London. Improvements in the manufacture of explosives. July 28

10655 E. Turpin, London. Improvements in the production of explosives. August 2

10667 E. Turpin. Improvements in explosives. August 2.

10729 A. J. Boult—From J. S. Foley, United States. Improved match magazine and lighter. Complete specification. August 4

10821 A. Brock and G. J. Mayer, London. Improvements in the manufacture of gunpowder, and machinery or apparatus therefor. August 6

10822 A. Brock and G. J. Mayer, London. Improvements in the manufacture of quick-match and apparatus for covering the same, and other fire-work compositions. August 6

10905 H. Echberg, London. Improvements in and relating to channel torpedos. Complete specification. August 9

10922 C. Roth. See Class X.

10939 J. Boag, Glasgow. Improvements in the construction of blasting cartridges. August 11

11120 T. W. Newey, Birmingham. Improvements in matches and paper lighters. August 15

11286 J. Masters, London. Improvements in the manufacture of wax-matches. August 18

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

12561 H. S. Maxim. Manufacture of cartridges and explosive projectiles. August 3

12741 G. J. Smith. Method and material for rendering the coating of fuses incombustible. August 13

1887.

7603 G. S. Spencer. Detonating signal apparatus for railways. August 6

9209 L. G. Heusschen. A new explosive. July 30

XXII.—GENERAL ANALYTICAL CHEMISTRY.

APPLICATION.

10801 W. Devoll, Erdington. Improvements in apparatus for testing butter. August 6

UNCLASSIFIED.

APPLICATION.

10099 M. W. Hydes, Liverpool. Improvements in the treatment and utilisation of a hitherto waste, or nearly waste-product. July 19

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NOTICES.

Comment having been made on the delay in reprinting the numbers for January, 1882 and 1883, the Secretary begs to inform those whom it may concern, that the delay is due to the fact that up to the present not more than twenty orders for those numbers have been received. It is hoped that this notification may stimulate those who desire to complete their sets, to make early application with a view to expedite the consideration of the question of reprinting by the Council. Notice is also hereby given that the numbers for January and February, 1886, being exhausted, no orders for those copies, nor for complete sets of Vol. V., can be executed.

The Secretary is instructed to negotiate for the purchase of copies of the Society's Journal for January, 1882 and 1883, at the following prices:—January, 1882, 5s.; January, 1883, 2s. 6d. Members possessing odd copies of these numbers are particularly requested to communicate at once with Mr. Cresswell.

Authors of communications read before the Society or any of its Local Sections are requested to take notice that, under Bye-Law 43, they cannot receive the prescribed 50 copies of their communications unless they comply with the condition laid down in that Bye-Law—viz., that they give notice of their desire to receive such copies upon their manuscript before sending it to the Editor. Mention should also be made as to whether the Discussion is to be included in the reprint.

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Communications.

ON THE COMPOSITION OF SOME COKE-OVEN TARS OF GERMAN ORIGIN.

(Read before the British Association, Manchester, 1887.)

BY G. LUNGE,

Professor of Chemical Technology in the Federal Polytechnic School, Zurich.

THE composition of gas-tar—that is, that tar which is obtained as a "residual" in the manufacture of illuminating-gas, has been ascertained by many analyses, and is, moreover, thoroughly known from practical experience in the great industry of tar-distilling. But the case is quite different with the tar obtained as a by-product in the manufacture of coke, this industry having sprung up only within the last few years, apart from its isolated existence in the St. Etienne district. It is now placed beyond any doubt that the old mode of coke-making is very uneconomical, particularly when carried out in "bee-hive ovens," as it is almost universally in England, where the distillation gases freely escape and burn at the mouth of the oven, without as much as contributing to heat the ovens. But it is not sufficient to utilise the gases for heating purposes, as it has been done for many years past in the "Belgian" ovens and many other descriptions of coke-ovens, widely disseminated throughout Germany, France, and Belgium. Since the prejudice against the quality of the coke obtained in any other but bee-hive ovens has been thoroughly refuted by the practice of many of the foremost iron-smelters (which does not at all involve the *extinction* of that prejudice, no more than is the case with any other prejudice), it may be taken as an established fact that the only rational way of manufacturing coke is that in which all the products of the destructive distillation are utilised—tar and ammonia being condensed as liquids, and the gas being burned as fuel to carry on the process of distillation, without consuming any of the substance of the coke for that purpose.

It can be only a question of time when all the coke-works will be established on this basis. But it is self-evident that the enormous capital required for the reconstruction of all the old-fashioned coke-ovens now existing cannot be found all at once; nor is it even desirable that this reconstruction should take place with undue haste, for this would have a disastrous effect on the value of tar and ammonia, and completely disorganise all the industries in connection therewith. It can hardly be doubted that even the comparatively small quantity of those by-products which has hitherto come into trade has had a considerable share in the unprecedented fall in the value of those products, from which, fortunately, a reaction has taken place during the last few months. But it suffers no doubt that, as soon as any considerable and lasting rise of the prices of tar and ammonia should set in, there will be no lack of coke-works fitted up to meet the demand.

But it is not permissible to class coke-oven tar altogether with gas-tar without further enquiry. Undoubtedly an imperfect realisation of that fact has greatly contributed to check the expansion of the modern coke-manufacturing processes in England. This is owing to the circumstance that in this country the bee-hive coke-oven was pertinaciously regarded as the only one fit to turn out proper coke for iron-smelting, and that it was thought indispensable by most of those interested in this industry to connect any plant for recovering the by-products with the bee-hive oven, in the preconceived idea that the tar recovered from these must be of the same quality as that recovered elsewhere. On the other hand, in Germany coke-manufacturers had been familiar for a long time with closed coke-ovens, especially those on the Coppeé system, which are heated from without by means of burning the distillation gases, and it was a comparatively easy step to apply to those the Carvès process for taking out tar and ammonia, before burning the residual gas. It was soon found by practical trials that the quality of the tar obtained from Coppeé or Carvès ovens did not greatly differ from that obtained in the manufacture of coal-gas, and that the quantity of ammonia was about the same in both cases. English inventors jumped to the conclusion that these conditions must apply to coke-making generally, and that it was greatly preferable, in lieu of the Continental plan, to adapt some cheap recovery-plant to the ancient bee-hive ovens, both on account of the very much smaller outlay of capital, and of the assumed superiority of bee-hive coke, produced by internal combustion of part of the coal, to any coke produced by distilling the coal from without. But it soon turned out that the yield of ammonia from such modified bee-hive ovens (of which Jameson's are the most widely known type) was decidedly inferior; and matters were still worse with the tar, which could not by any means be employed in the same way as gas-tar, nor even for the production of illuminating and lubricating oils. This has been made very clear by the exceedingly thorough investigations of Mr. Watson Smith.* There were also other drawbacks connected with the working of the modified bee-hive ovens, and all this has evidently deterred the great majority of British coke-manufacturers from going into any improvements concerning the recovery of by-products. They preferred an expectant attitude, until the depression of prices made any further efforts in this direction altogether impracticable for the time being.

Fortunately in the meantime a few English coke-works had adopted the Carvès system (introduced into this country by Mr. H. Simon, of Manchester), and it was soon found that the tar produced by them is totally different from Jameson tar, and is comparable to gas-tar as to its yield of products useful in the manufacture of colouring matters. This tar has been repeatedly examined by Watson Smith.†

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*J. Soc. Chem. Ind., 1883, pp. 403 and 499; Industries, 1886, p. 162.

†J. Soc. Chem. Ind., 1883, p. 500; 1885, p. 451.

Now the general principle of the Coppée ovens is so similar to that of the Carvès ovens, much difference as there exists in details, that the tar from both descriptions of ovens might be expected from the outset not to offer any essential chemical differences. Experience has proved this to be the case, as is evidenced by an analysis of tar from his ovens, quoted by Dr. Otto in *Stahl und Eisen*, 1884, p. 399. But this analysis is not authenicated by any name, and is much too little detailed in comparison with those instituted by Watson Smith. When meeting with this gap in the course of preparing the new edition of my "Coal Tar and Ammonia," I resolved to fill it up myself. Through the kindness of Dr. Otto I procured large average samples of two descriptions of tar—viz., one from the "Germania" pit near Dortmund, where there is a set of 50 Hoffmann-Otto ovens, and another from the "Hibernia and Shamrock" pit near Bochum, where there is a set of bee-hive coke-ovens, modified by a system totally different from those tried in England—viz., by making flues below the bottom, adding a Siemens recuperator, and heating the ovens entirely from without (by means of the bottom flues) without any internal combustion. These bee-hive ovens thus enter into the class of closed coke-ovens, and we shall not be surprised to find that the tar obtained from them is very similar to, although not identical with, that obtained from the Hoffmann-Otto ovens. The system in question has been patented by Dr. C. Otto in common with the Hibernia and Shamrock Coal Mining Company (Germ. Pat. No. 37,280) I shall refer to it, for the sake of briefness, as the "Hibernia" system.

Before entering into a description of the analytical investigation of those tars, I have to state that most of the practical laboratory work connected with it has been carried out in the most painstaking and conscientious way by my assistant, Dr. Jacob Schmid.

Such an investigation cannot be expected to yield useful results, unless somewhat large quantities are taken in hand. But in a scientific laboratory it is difficult to employ more than a few kilograms for each distillation. The results thus obtained will never exactly coincide with those obtained in manufacturing practice, but experience proves that they give a very good idea of the general quality of the tar. It would be most convenient to employ for such quantities distilling vessels made of metal, and I would, indeed, strongly recommend this for factory laboratories, all the more as it is thus easy to work upon very much larger quantities. But in scientific laboratories, where for more reasons than one it is out of the question to distil a hundredweight of tar or some such quantity, it will be always preferred to accurately observe the progress of the operation, and this it is only possible to do in glass retorts. Especially the dehydration of the tar, such as will be described further on, can be hardly carried out in any other way, whilst it is comparatively easily done in glass retorts. Watson Smith has also used such for his investigations.

My retorts were tubulated, holding about 5 litres, and were heated in a kind of sand-air bath—that is, in a suitably-shaped thin wrought-iron dish, the bottom of which was covered by a layer of sand, one centimetre thick. About half of the retort was within the dish, and the whole of it, down to the sand, and including the upper part of the neck, was wrapped round with wire gauze. The heating was done by a Fletcher's gas-stove, placed in a large flat pan, partially filled with sand. Hence, in case of an accident, the tar would have first run into the upper pan, forming the sand-air bath, and anything boiling over from this would have been caught in the lower pan.

The tubulure of the retort was fitted with a twice-perforated cork, holding a thermometer and a tube, drawn out into a capillary at the lower end, with the object of passing a minute current of air-bubbles through the liquid, in order to prevent bumping. This precaution, first introduced by Dittmar, and also employed by Watson Smith, was found to be very useful indeed; but it seems possible that the air current might carry away a minute quantity of benzene.

The retort was, during the first part of the operation, connected with a Liebig's condenser, so long as the distillate remained entirely liquid. When it began to partly solidify—that is, between 170° and 180°, the cooler was removed; and since now the last portions of water had been volatilised, and no more bumping was to be apprehended, the current of air was discontinued. The last of the water escaped between 140° and 170° with explosive violence.

The distillation of 2½ or 3 litres of tar took about 8 hours. It is decidedly advisable to carry it right through without any interruption, both because the heating-up, after the contents of the retort have been semi-solid or solid on cooling, is always an awkward operation, and because during the cooling-down and the heating-up a considerable quantity of substance passes over far below the proper boiling-points.

The distillates were collected in tared, narrow, graduated cylinders, and after cooling down they were measured and weighed. The fractions were made in the way to be stated below. But although, as a matter of course, every precaution was taken to keep the temperature as constant as possible, still, without any recognisable reason, the thermometer showed considerable oscillations, and sometimes went down 20° without any diminution in the rate of distillation.

It cannot be said that such assays are exact analytical operations. The fractions will differ to some extent, as the distillation proceeds more or less slowly. Each time, when substances are poured from one vessel into another, small losses are unavoidable, although in the case of the higher-boiling substances the vessels were rinsed with ether, which was subsequently evaporated. In washing and drying, in the case of the first distillates also by evaporation, small losses will occur, which become all the more important when the absolute quantity of substance is only slight.

If the tar had not been previously dehydrated, the work must begin with that operation, which is of great importance. It was easy enough with the "Germania" tar, which reached me almost completely dehydrated, but in the case of the "Hibernia" tar it could not be effected by several weeks' rest, even at a somewhat elevated temperature. It is not feasible to go as far as 100°, because then the tar would lose many valuable portions, especially as the operation takes so much time. Hence, the dehydration was performed in the retort itself, turning its neck upwards and connecting it with a cooler, inclined downwards, in order to collect any benzene escaping along with the water. The heating was continued in this manner to 60—70° for a full fortnight; every morning, before re-commencing, the water collected in the meantime on the surface was removed by a pipette. For all that some water remained behind, evidently in chemical combination with phenol, pyridine, etc., and this could only be removed by distillation.

Previous to the distillation, and after completing the dehydration as much as possible, the specific gravity of the tar was taken by pouring it warm into a 200cc.m. flask, and filling this up to the mark on cooling; the quantity left in the (previously tared) retort was taken as the basis of the subsequent calculations.

The fractions were made as follows:—

1.—Light oil, up to 170°.

2.—Middle oil, up to 230° (Carbolic oil).

3.—Creosote oil, up to 270°.

4.—Anthracene oil, up to the close of the distillation, which was continued as long as anything would come over; this explains why the pitch was extraordinarily hard.

The above fractions were treated in the following manner:—The *Light oil* was first agitated with caustic soda solution of specific gravity 1·1, and the contraction of volume was calculated as "phenols." The oil was then washed with water, with concentrated sulphuric acid, and again with water, and the total contraction was calculated as "loss by washing." The residual oil was distilled, and the fractions coming over up to 100° and 140° were separately collected. The distillate up to 140° was considered as "crude aniline benzol," and its degree of purity was examined by nitrification with the ordinary mixture of acids. The portion remaining behind at 140° was calculated as "heavy naphtha"; it must, of course, leave a good deal of residue on rectification, and this residue will practically go to the creosote oil; but, on the other hand, some heavy naphtha will come back from the "middle oil," and on the small scale it was impossible to say how far this would compensate for the residue left on rectifying. The small quantity of liquid also made it impossible to separate the "aniline benzol" into benzene, toluene and xylenes.

From the *Middle oil* and the *Creosote oil* a quantity of naphthalene crystallised on cooling. This was filtered through calico, strongly pressed, and calculated as "crude naphthalene." The liquid portion of the oil (making allowance for the mechanical loss in pressing) was treated with caustic soda solution, and the contraction of volume again set down as "phenols."

The *Anthracene oil*, after cooling, was filtered through calico, the crude anthracene was pressed cold, then spread out upon porous earthenware slabs, heated in an air bath to 30—40°, pressed while warm, and weighed. It was now analysed by the "Höchst" test (washing the anthraquinone with sulphuric acid), and the percentage of pure anthracene was thus established. But since commercial anthracene is generally sold at 33 to 40 per cent, three times the weight of the pure anthracene was deducted from that of the crude anthracene oils, in order to find that of the liquid anthracene oil. In actual work, probably the distillation would not be carried quite so far as in our case, or at any rate some of the liquid oil would be employed for softening the hard pitch, so that for practical purposes the quantity of liquid anthracene oil would be considerably less, and that of pitch correspondingly more than in our tests.

The *Pitch* was tested for its softening-point, by heating a piece of the size of a pea, stuck upon a wire, in an air bath alongside of a thermometer, until on pressing with the fingers, it proved to be distinctly plastic. The water bath did not suffice for this purpose. It was further tested for "carbon"—one of the most tedious parts of the work. For this purpose it was extracted alternately with boiling benzene and carbon disulphide; but it took many days toil, the solvents did not show any but a faint colour, and left no more residue when evaporated on a watch-glass. This operation must be carried out with the greatest caution, since otherwise fine particles of carbon will pass through the filter; for this reason Soxhlet's extracting apparatus, otherwise so convenient, could not be employed.*

The results were as follows:—

First Distillation.	A "Germania" tar: Hoffmann-Otto Ovens.		B "Hibernia" tar Otto's modified Beehive Ovens.	
Specific gravity at 15°	1·1198		1·1368	
	wght.	vol.	wght.	vol.
Light oil up to 170°: per cent...	6·55	7·43	1·88	5·21
Middle oil „ 230 „	10·54	10·16	14·14	13·97
Creosote oil „ 270 „	7·62	7·23	9·99	9·77
Anthracene oil.... „	14·35	—	22·65	—
Pitch .... „	30·55	—	43·41	—
Water .... „	trace	—	3·84	—
Loss .... „	0·39	—	1·09	—
	100·00	—	100·00	—

By working up the fractions we obtained:—

	A "Germania" tar.	B. "Hibernia" tar.
LIGHT OIL.		
Phenols..........................	3·30 % vol.	5·32 % vol.
Total loss on washing	18·42 „ „	33·05 „ „
Distillate from 78–100	8·11 „ „	trace.
„ „ 100–140°...........	17·56 „ „	24·39 „ „
Sp. gr. of total distillate at 15°	0·869	0·862
Residue from distilling	55·91 „ „	42·56 „ „
MIDDLE OIL.		
Phenols (crude).....................	26·0 „ „	37·66 „ „
Naphthalene (crude)	43·0 „ w'ght.	7·76 „ w'ght.
CREOSOTE OIL.		
Phenols...	11·0 „ vol.	18·33 „ vol.
Naphthalene	43·6 „ w'ght.	4·40 „ w'ght.
ANTHRACENE OIL.		
Crude anthracene % on Tar	4·13	0·93
Containing pure anthracene......	12·90 %	25·57 %
PITCH.		
Softening point....................	165°	160°
Percentage of carbon	51·66	42·44

The *distillate from the washed light oil* up to 140° in the case of the "Germania" tar had the specific gravity = 0·869 at 15°; it could be nitrified without leaving any residue, and yielded 133 per cent. weight of nitro compounds of specific gravity 1·191. On distilling these yielded only 1·1 per cent. up to 190°, too small a quantity to be submitted again to the acid treatment. This distillate may, therefore, be set down entirely as "aniline-benzol," comprising within this term its percentage of xylenes. The portion distilling above 140° contained a good deal of naphthalene, against which should be set the naphtha coming back from the treatment of the middle oil. Since it was not possible to examine these small quantities of liquid more closely, I have set the whole down as "heavy naphtha"; but it cannot be expected to recover it all in the shape of commercial solvent or burning naphtha.

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* An attempt to substitute for this tedious process a simple coking of the pitch did not yield any trustworthy results.

On rectifying the washed naphtha from the "Hibernia" light oil, the thermometer rapidly rose above 100°, then slowly up to 140°; a somewhat considerable proportion distilled only above 170°. On nitrification the distillate up to 140° yielded 129·6 per cent. weight of nitro compounds of specific gravity 1·188. On rectifying these, 2·47 per cent. of oil distilled between 110° and 190°, along with a little water. When submitting this oil once more to nitrification, nearly the whole of it remained unchanged. Hence, this "aniline-benzol" is not as pure as that from "Germania" tar; moreover, it contains very little benzene and principally toluene and xylenes; its value must be a good deal lower than that obtained from the "Germania" tar. Unfortunately the quantity of benzene from 2·7kilos. tar is too small to admit of any more extended investigation.

The described data will enable us to make the following statement concerning the commercial products to be got out of the two tars examined:—

	A		B	
	"Germania" tar per cent.		"Hibernia" tar per cent.	
Aniline-benzol	—	1·68	—	1·12
Heavy naphtha	—	3·61	—	2·06
Crude naphthalene from middle oil	4·54	—	1·09	—
Crude naphthalene from creosote oil	3·15	—	0·11	—
Crude naphthalene total	—	7·69	—	1·53
Crude phenols from light oil	0·25	—	0·28	—
" " " middle oil	1·56	—	1·90	—
" " " creosote oil	0·42	—	1·75	
" " total	—	2·23	—	6·93
Anthracene, calculated as 33 per cent.	—	1·59	—	0·72
Creosote oil for pickling timber	—	8·21	—	15·67
Filtered anthracene oil	—	42·76	—	21·93
Pitch (very hard)	—	30·55	—	43·11
Water	—	—	—	3·83
	—	98·38	—	97·21

Always bearing in mind that the above are only laboratory results, we may, nevertheless, draw the following conclusions.

The tar from Hoffmann-Otto's modified Coppeé ovens is at least equal in value to the best descriptions of gas tar. The "aniline-benzol" contains a good deal of real benzene, and is almost free from non-nitrifiable oils. There is an abundant quantity of heavy naphtha. That of the phenols and of naphthalene is normal, also that of anthracene (0·53 of pure anthracene in 100 tar). An essential difference between this kind of coke-tar and ordinary gas-tar, and that in favour of the former, consists only in the smaller proportion of creosote oil and of hard pitch, and a larger proportion of filtered anthracene oil, which is more and more employed for pickling timber and for lubricating purposes, and part of which can be usefully employed for working up with the hard pitch into soft pitch, varnishes, etc. All this is easily explained by the fact that the coke ovens in question work at a temperature at least as high as that of gas retorts, and that the coal remains in them for a longer space of time.

The "Hibernia" tar, produced in *outwardly heated* beehive ovens, and evidently at a lower temperature than the "Germania" tar, is not as valuable. It contains less aniline-benzol of inferior quality, less naphtha, and less anthracene. Especially remarkable is the very small quantity of naphthalene and the large proportion of phenols. It is also awkward to dehydrate. Still, this tar undoubtedly belongs to the same class as gas tar, and can be worked up exactly in the same manner. It is most sharply distinct from the Jameson tar, which must rather be classed with brown-coal tars, but does not, like these, yield a large quantity of good burning oils and solid paraffin.

Tar distillers still complain that even in Germany (where tars of the Jameson type are not produced), coke-oven tars are of unequal quality, and on the average yield less benzene than gas tar. But it should not be overlooked that gas tars are also nothing like uniform in quality, and there is some risk in that respect, even with the tar from one and the same gas-works, because they may make changes in the coal employed, and very frequently the quality of gas tar is deteriorated by the addition of bituminous shales in gas making. Such additions can never happen in coke making, and the coal used at a certain part must be always very nearly of the same quality. The differences in coke oven tars noticed up to the present will be partly caused by the unavoidable difference in the description of coals coked, and partly by the fact that the tar produced by different systems of coke ovens is not identical, as we have seen. Otherwise, there is no reason why, in the manufacture of coke, there should be any more irregularities than in the manufacture of coal-gas.

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ON THE COMPOSITION OF THE BLAST FURNACE TARS FROM THE GARTSHERRIE IRON WORKS.

(Read before the British Association, Manchester, 1887.)

BY WATSON SMITH, F.C.S., F.I.C.,

Lecturer in Chemical Technology in the Victoria University, etc.

The first examination of tar from blast furnace gases obtained by the condensing process patented by Messrs. Alexander & McCosh, and adopted in the Gartsherrie Iron Works of Messrs. Baird & Co., at Coatbridge, I undertook in 1883, and the results formed the subject of a paper read before the Society of Chemical Industry (Liverpool Section) in that year. The specific gravity of the tar was found to be 0·954. It was a tar lighter than water, and consequently would be subject to the immediate suspicion of tar distillers, all true gas tars of value for the aromatic constituents being slightly heavier than water. Subsequent examination showed that about 1 per cent. of paraffin wax could be extracted from the blast furnace tar, the crude Scotch shale oils yielding about 9 per cent of solid paraffin. The ordinary process of oxidising with chromic acid in glacial acetic acid solution failed entirely to discover for me any traces of anthracene in the higher boiling products from this tar, but I am convinced some anthracene is present, and shall submit the product to treatment by another process very shortly, so as first to effect separation of the preponderating paraffin. But the phenols presented a remarkable feature in this tar, on account of their abundance, as has been more recently confirmed by A. H. Allen and L. Archbutt ("Commercial Organic Analysis," vol. ii. 572 : Allen). However, my first experiments quantitatively aimed rather at a comparison of the amounts of crude phenol (carbolic acid) obtained by the commercial method of undersaturation with caustic soda of 18° Tw. It was then found that whilst—

(1.) Ordinary Lancashire gas retort tar oils, known as the carbolic oils, yield about 5 per cent. by volume of good crude phenol containing 65 per cent. (volume) of crystallisable phenol, that—

(2.) The blast furnace oils nearly corresponding to the above, gave by the same treatment no less than 17½ per cent. of phenols, containing, however, very little carbolic acid. The creosote oils gave 14·3 per cent. of phenols.

By a more recent trial (1885) I found that on exhaustive treatment with stronger caustic soda of the oils in the blast furnace tar of Gartsherrie analogous to the carbolic and creosote oils of ordinary coal tar, about 23 to 24 per cent. by volume of crude phenols could be extracted. Allen and Archbutt extracted from their samples of blast furnace tar oils even larger quantities.

It was also found that on extracting the same blast furnace oils with sulphuric acid of specific gravity 1·2, exhaustively, 11·09 per cent. by volume of crude basic constituents could be extracted.

K. E. Schulze (*Annalen*, 227, 143) propounded the theory that the aromatic coal-tar hydrocarbons are formed by the breaking up at higher temperatures of first-formed phenols into the elements of water and hydrocarbons, and this theory would, of course, pre-suppose the possible existence of certain *transition tars*, if we may so call them—*i.e.*, *transition* from the predominance of the paraffinoids to that of the benzenoid and allied products. Such a link of logical connection is supplied by the existence of a tar like that of the Gartsherrie iron furnaces, as well as those of certain coke ovens, which contain considerable quantities of benzenoid hydrocarbons and phenols. Schulze's theory being accepted as correct, we ought, moreover, to be able to find amongst the phenols in the transition tars those members most nearly corresponding to the hydrocarbons which predominate in what we may term *normal coal tar*, or perhaps, better, *gas tar*, as produced in gas retorts at the highest temperatures. In order to test this question an investigation was instituted in conjunction with Messrs. Coutts & Brothers (*J. Chem. Soc.* January, 1886; see also this Journal, 1885, p. 738) for the purpose of discovering which are the principal constituents of the blast furnace tar phenols. These were found to be ordinary phenol, the cresols (chiefly metacresol), xylenols (chiefly metaxylenol 1:3:4), pseudocumenol and the naphthols. It has been mentioned that an exhaustive extraction with dilute sulphuric acid yielded 11 per cent. by volume of basic constituents—*i.e.*, nitrogen bases. A more recent examination of these bases shows that aniline is present amongst them. The odour of the mixed bases is just that of the crude bases extracted from ordinary gas tar, reminding one of the pyridine and quinoline series. It was now of great interest to discover what hydrocarbons, especially of the aromatic series, are present in the blast furnace naphthas, since following Schulze's theory, and having detected the predominating presence of phenol, cresol and xylenol, more especially metaxylenol, also pseudocumenol and naphthol, we now ought to be able to find amongst the naphtha constituents the corresponding hydrocarbons.

In a recent investigation with the object of isolating the benzenoid and other aromatic hydrocarbons from the mixture, in which the paraffinoid hydrocarbons largely predominate, the hydrolytic method of Armstrong and Miller was made use of (*J. Chem. Soc.* 1884, 148). I desire to record here my opinion, after an extended experience of this method, that it is one of the simplest and at the same time most valuable solutions of a hitherto tedious and difficult problem that has been put into the hands of chemists for a long time, and Messrs. Armstrong and Miller deserve the thanks especially of technological chemists, whose vocations necessitate the frequent examinations of coal tars, naphthas and tar oils. The hydrocarbons thus isolated in the pure state are toluene, xylene containing 70 per cent. of metaxylene, pseudocumene and mesitylene. Also, I have identified the presence in the higher boiling oils of small quantities of naphthalene.

Benzene I have never been able to discover in the light naphthas, specimens of which have been kindly sent me from time to time by Mr. Andrew McCosh, of the Gartsherrie Works. However, I believe firmly that benzene is present in the crude gas used as fuel, and with the kind permission of the firm, I shall make this subject a further matter of experimental inquiry. The question, "Is bisulphide of carbon formed at the temperature at which such a low temperature tar as this is formed?" I shall try to answer at the same time, and it would doubtless be of practical interest to the gas industry.

It is certainly interesting, and so far confirmatory of Schulze's theory, that not only xylene and the other hydrocarbons corresponding to the aromatic phenols are present in the coal fed blast furnace fumes, but that the xylene is substantially of the same composition as that found in gas tar—*i.e.*, it contains about 70 per cent. of the meta-isomer. That this is the case was proved by means of Levinstein's method based on the reactions of Brückner and Jacobsen, as well as by the fact of the xylene obtained furnishing dyestuffs of the azo class. Thus, I have here a specimen of xylidine scarlet R. obtained from about 20cc. of the xylene of the blast furnace tar.

Mr. Hamilton, my assistant, whose valuable aid in this research I desire to acknowledge, will dye a piece of flannel with this scarlet, and I think I may assure you that no one has seen before a piece of fabric dyed with a colour derived from the waste gaseous products hitherto escaping in flames from coal-fed blast furnaces. Though I believe there is much truth in Schulze's theory of the formation of the aromatic hydrocarbons, I should be slow to ascribe this formation exclusively to the decomposition of the phenols, but would be most inclined to believe that the reaction is one running concurrently with several others. For example, the theories proposed by Berthelot, O. Jacobsen and Anschütz may all likewise, at least to some extent, hold good in the formation of the aromatic constituents of crude coal gas (see *Compt. Rend.* 62, 905; *Ber.* 1877, 853; *Ber.* 1878, 1215).

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A NEW APPARATUS FOR CONDENSING GASES BY CONTACT WITH LIQUIDS.

BY G. LUNGE.

The problem of condensing gases by contact with liquids is one which is presented in a very large variety of cases, only a few of which are enumerated here:—The condensation of hydrochloric acid, both when its manufacture is a principal object, and when it is only done to prevent pollution of the atmosphere; the condensation of sulphurous acid as a "noxious gas;" the manufacture of nitric acid, and its recovery from nitrous vapours by means of water and air; the condensation of ammonia in the shape of liquor ammonia; the absorption of chlorine in the manufacture of chloride of lime, of chlorates, of ferricyanides; the recovery of nitrous acid in the Gay-Lussac apparatus, and many others. We must also class herewith the drying of gases (chlorine, sulphur dioxide, atmospheric air, etc.) by means of sulphuric acid, as required for the Deacon chlorine process, and for the manufacture of sulphuric anhydride; the condensation of carbon disulphide by contact with cold water, and so forth.

For some of these processes special apparatus has been invented, according to the specific nature of the compounds to be treated, and with these we shall not occupy ourselves hereafter. We will confine our attention to that most numerous class of processes where, up to the present time, manufacturers in this country have almost exclusively employed the well-known coke tower, whilst continental manufacturers in many cases prefer a string of three-necked stoneware receivers or "tourilles." The latter are now generally supplemented by a small coke tower, mostly constructed from large stoneware pipes, and this combination, properly carried out, would seem to be the most favourable where the highest possible yield, along with the greatest possible concentration, are principally looked for, whilst the coke tower is found more suitable where the largest possible quantity of work is the primary object. Both kinds of plant have their advantages and their drawbacks. The tourilles system owes its success in producing very concentrated liquids to the systematical way in which the water or other condensing liquid travels from the further end of the set of receivers to the end nearest the furnace, always rising from the bottom of each receiver on to the top of the next receiver; the large cooling surface of the stoneware jars and pipes also comes into play here. On the other hand, the contact between the gas and the liquid takes place exclusively at the surface of the latter; the great bulk of the liquid participates but indirectly in the work of condensation, and some of the gas entering at the top of the receiver and leaving it at the opposite side does not come into contact with the condensing liquid. Hence a long string of receivers, often fifty and upwards, must be employed, and even then experience has proved that very perceptible quantities of condensable gases escape condensation, being carried along with the bulk of inert gases over the top of the liquid. Therefore, in the manufacture of hydrochloric acid the tourilles are now always supplemented by a small (sometimes even a large) coke column; and where the proportion of condensable gas in the total volume of gases is but small, as in the recovery of nitrous compounds in the manufacture of sulphuric acid, the tourilles system has been entirely superseded by the coke tower.

The manufacture of nitric acid by the ordinary method does not come under this head, for here the compound in question is itself a liquid, and the vapours need only be cooled down in order to yield the final product, therefore a smaller number of tourilles suffices, and they may be almost entirely superseded by stoneware worms, or the like.

The coke-tower is too well known to need any description or any specification of its merits. It is agreed that this apparatus has been instrumental in procuring the excellent and almost absolute condensation of the hydrochloric acid vapours in alkali works. But far superior as the coke tower is to the tourilles for taking out a small quantity of condensable gas from a great bulk of inert gases, it is not altogether beyond reproach. It has been found practically inefficient for washing sulphur dioxide out of furnace gases by means of water, nor is it a *perfect* condenser for the nitrous vapours in the Gay-Lussac process, even when made of very large size. Just these large dimensions, and the great attendant cost, form one of the drawbacks of the coke tower.

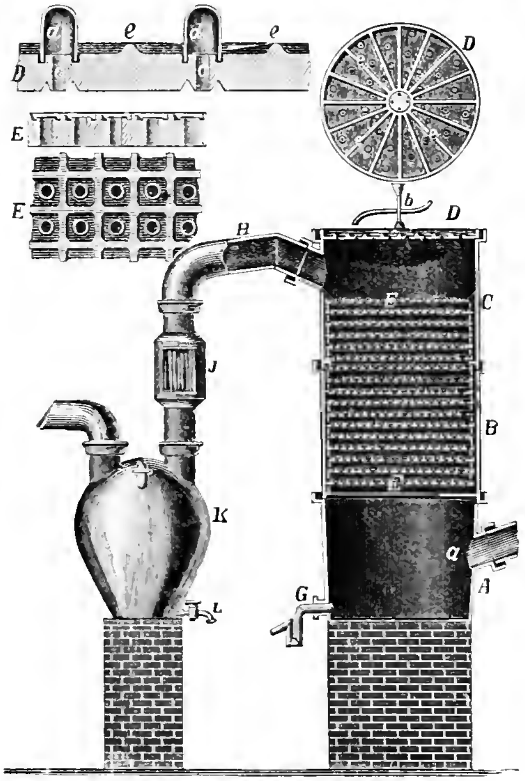
Let us consider in which manner a coke tower, say a hydrochloric acid condenser, acts. It is filled with large pieces of coke, about a foot long, at the bottom; then follow pieces of the size of a child's head, and at the top pieces of the size of an apple, but everything is kept out which passes through a sieve with 2in. meshes. The interstices between the pieces of coke thus must be pretty large, and very irregular. The coke is moistened by a shower of water, but this must not be too abundant, lest the acid should become too dilute, and it is therefore resolved into a number of drops, occupying a very small portion indeed of the channels left between the pieces of coke. These drops during their fall will therefore have but little action; almost the whole action of the tower depends upon the moisture covering the surface of the coke. Unless the latter is very well "packed," so that the gaseous current is constantly compelled to change its way, the tower acts very badly indeed; for naturally the gas ascends by preference in the widest and straightest channels, and just these are evidently least supplied with water in comparison to the air space. But even in a properly-packed tower the channels are comparatively very large, and, especially, very irregular; for this reason it is necessary to procure a very large condensing area, and to leave the gases in long contact with water, by constructing the towers of very large dimensions.

Of course all this has been very well known long ago, and attempts have not been wanting to diminish the size of condensing towers by substituting for coke regular pieces of perforated tiles, bundles of tubes, and similar objects. But not much has come of this; the remedy has never been a thorough one, and occasionally very expensive. Probably such apparatus are mostly in use only in such cases where coke is too rapidly destroyed by the agents at work within the condenser.

The just mentioned failures have deterred many from attacking the problem. Still I did not like to submit to coke towers as a finality, and I have tried to work out another system which should be founded on rational principles throughout. I have in this benefited by the co-operation of a manufacturer of chemical stoneware, Mr. Ludwig Rohrmann, of Krauschwitz, near Muskau, in Prussian Silesia, who has the command of most suitable material for acid and heat resisting stoneware, as well as great experience in the manufacture of chemical apparatus made from it, and untiring energy in overcoming the manifold difficulties which accompanied our first efforts. But success has not been wanting, and the apparatus which we have ultimately constructed has more than fulfilled the hopes I had entertained of it.

The following description and diagram will give an idea of the new apparatus, which I have styled the "Plate column," because its essential feature is in the perforated plates with which it is filled. It can be carried out in many shapes, and can be made of any suitable material, but so far it has only been made of that kind of stoneware which is the speciality ot Mr. Rohrmann. It is unnecessary to say that the material must offer the greatest possible resistance both to the action of acids and to changes of temperature, but it should also admit of a great deal of nicety in moulding every detail. For some purposes such apparatus might be made of metal, or even of wood lined with lead, especially when it is made of a larger size than can be well done with stoneware.

The plate column, in that shape which is now preferably made, consists of a number of earthenware cylinders of as large diameter as can be conveniently turned out. It is at present made 72 centimetres (say 2ft. 5in.) wide. The bottom is formed by a trough, A, with an outlet for the liquid, and an inlet for the gas, *a* (compare diagram). This bottom trough is surmounted by one or more cylinders, B, C, which contain the perforated plates, and at last by the top cylinder D, provided with an outlet for the gas, H, and an arrangement for spreading the condensing liquid. That liquid (in the majority of cases, water) is run from a store tank on to the cover of the column, and is spread out by means of the self-acting "acid-wheel" *b* all over the divisions, produced on the cover by the radial ledges, as seen on the plan D. The water runs off by the holes *c*, closed by the cups *d*, serving as hydraulic seals, and the bottom of the cover is so shaped that the liquid must drop out of each single hole without spreading along the under side of the plate. By this means the liquid is forced to drop quite regularly all over the area of the column, and to cover the whole surface of the uppermost of the plates EE.



Except the last-mentioned arrangement, there is nothing novel in the construction of the cover, indeed any other suitable means for spreading the liquid quite evenly all over the area of the column might be employed. But the peculiar feature of my apparatus appears in the plates EE. Each of these is covered with a network of small ledges, and in each of the squares thus formed there is a perforation, with a somewhat raised margin. The height of that margin is not quite as great as that of the ledges, hence there is always a layer of liquid, about ⅛in. deep in each of the squares, and as there is always more liquid dropping in, the excess is forced out through the perforations drop by drop. The plates are not identical in shape, but differ as to the position of the holes. To each perforation in any one plate there corresponds the point of union of the ledges in the plates above and below. Hence the liquid cannot drop straight through the holes in the following plates, but strikes the solid portion of the next plate, is scattered about, and is divided among the adjoining squares. This action is repeated from plate to plate. Thus the thin layer of liquid resting upon the plates and clinging to the holes is constantly renewed, and by the scattering about of the liquid another absorbing surface is created.

The gases and vapours rising within the column pass through the numerous holes of the lowermost plate, and are thus divided into a great number of fine jets. Immediately on issuing through the holes of this plate, they strike against the solid places in the next plate above, which correspond to the holes, and are thus divided and mixed again; and this process is repeated as many times as there are plates provided. Whilst the gases and vapours thus travel upwards in continuously renewed mixtures they come into the most intimate contract with the absorbing liquid, which they meet within the narrow holes on the plates and scattered all over in fine drops. By the incessant changes in the direction of the current, and the equally incessant renewal of the surface of the liquid, the most favourable conditions are produced for a mutual action of the gaseous and liquid substances. Owing to the principle of the apparatus, no false channels can exist, in which the gases or liquids would travel separately without coming into proper contact with each other.

This circumstance partly accounts for the enormous difference in condensing power between the "plate column" and a perfectly well constructed and packed coke tower, or any similar apparatus, fitted with pieces of pottery and the like. The liquid within a coke tower is never quite evenly distributed; there are always many places where it drops down a considerable height without meeting a piece of coke, and where, on the other hand, the gases find channels in which they can ascend without for some time getting mixed and coming into contact with liquid. Moreover, the individual gas channels are too wide, and the inner portion of the gaseous current does not enter into reaction with the absorbing liquid. This is unavoidable, because the interstices between the pieces of coke are quite irregular, and therefore the section of the tower must be made wide enough, and the pieces of coke large enough to secure a sufficiency of draught for the worst case. Nor, as experience has demonstrated, have any arrangements of pieces of pottery hitherto had a better effect than coke. Hence, coke towers must be made very wide and high, thus offering a long time and corresponding opportunities of mixing the gases and contact with liquid; and in this way the reaction is certainly very complete at the end. But this enormous enlargement of space can be avoided by the systematical way in which, in my new apparatus, the gaseous current is split up into upwards of a thousand very thin and exactly equal jets, which must continually alter their direction, and must, therefore, be thoroughly mixed every time they pass through a new plate. On their way they come into the most intimate contact with constantly and systematically renewed thin layers of liquid. The network of ledges prevents any unequal downward passage of the liquid, differently to the action of coke towers or of any other hitherto known form of similar apparatus. Perhaps a still more important difference is the following:—That there is a very thin and constantly renewed layer of liquid standing on each plate, and that the gases, in passing through the perforations of the plate, must frequently break through the drops of liquid. This seems to produce an action somewhat similar to the Coffey still, or other "rectifying" apparatus, and it may to a great extent explain that such an intense action takes place in so small a space.

Undoubtedly, with respect to the condensing action one of the most important conditions is this: that the gaseous current, holding small drops of liquid in suspension, should be exposed to very frequent *shocks* against solid surfaces. It is very well known that such shocks enormously assist the precipitation of extremely minute particles of liquid, existing in the shape of a mist, and not uniting into real drops under ordinary circumstances. This action is made use of in the Pelouze and Audouin process for purifying coal-gas from tar; it is at play in the vitriol chambers, and explains several phenomena unintelligible in other ways, as proved by Dr. Naef. It is also most certainly at work in the ordinary coke tower; but nowhere that I know of has it been so systematically and thoroughly brought about as in my apparatus, and this must go far towards explaining its great efficiency. It is unnecessary to say that these continuous shocks also greatly promote the mixture of the gases.

In one respect only the plate column is inferior to the tourilles system, and perhaps, even to the coke towers, namely, that the cooling action of the air has comparatively little scope. In the tourilles this action is very considerable; in the coke towers, with their thick stone walls, it cannot be anything like so complete; but the slow passage of the gases through these towers makes up for this to some extent. Whether the thin walls of the plate column do not compensate for the very much greater speed with which the gases pass through, I have no means of judging. In any case this cooling action is nothing like so important as the other considerations mentioned before, and it can be partly replaced by a good preliminary cooling of the gases before entering the columns. But for such cases where it is desirable that there should be good cooling in the columns themselves, I have constructed a special form of column, provided with an external water-cooling arrangement. This, of course, makes the apparatus much more complicated, and the simpler form of apparatus, as shown in the diagram, will be found sufficient for most purposes.

It is hardly necessary to say that several modifications of my apparatus have been arranged in order to adapt it to the special requirements of various technical operations; but I would not trouble the meeting with such details, confining myself to an explanation of the general principle. I may, however, be allowed to conclude with a short report of the work done by the first and necessarily imperfect form of apparatus at one of the best conducted German alkali works. They have there salt-cake furnaces, consisting of a combination of two pans with one roaster. The charge is 7cwt. of rock salt (98 per cent.) to each pan, or 14cwt. in all, and there are 7 charges made in 24 hours. The average proportion of HCl in the roaster-gas, as determined by a very large number of analyses, is 1·26 per cent. in one set, and 2·64 per cent. in another set (minimum 0·4 per cent., maximum 4·4 per cent.); the average proportion of HCl in the pan gases was 11·73 and 31·78 per cent. respectively (minimum 1·2, maximum 85·0 per cent.). The present condensing plant for the pans (we will leave the roaster gas out of consideration, as I have not tried any operations with it) consists in one case of 12 stone cisterns, with a water surface of 38·88 superficial metres; in the other case of 49 tourilles, with a water surface of 21·56 superficial metres. Although the air cooling in the latter case is far more thorough than in the former, the tourilles being connected with one another by U-tubes, a metre high, yet the cistern apparatus performs much better work, thus proving that the external cooling is nothing like so important as an efficient contact with water. The condensation in these cisterns or tourilles still being imperfect, the residual gases are carried into a coke tower, 100 feet high, which serves for the whole works. There was supplied to that works a set of five plate columns, consisting of 11 plates each, and possessing a total surface of only 1·36 square metres per column, or 6·8 square metres in all. A great deal of difficulty arose from this cause: that it proved practically impossible to equally divide the gases issuing from the bottom column among the four columns placed at a higher level. But just this circumstance led me to a brilliant demonstration of the efficiency of my system. I caused first two of the top columns to be cut off, and when it proved to be the case that there was still sufficient draught, and that the condensation was still good, a third column was cut off, so that all the gas from the pans passed only through the bottom column and *one* top column, thus applying a condensing surface of only 2·72 square metres, or about one-fifteenth of the surface of the water in the stone cisterns. But even then the acid came out between 23° and 36° Tw., the average strength being 32·4° at 15° C., and the quantity condensed amounted to 90 per cent. of that calculated from the salt charges. The trials were continued through 27 hours consecutively. Now, if it is considered that in this, the first attempt on a working scale, the apparatus still contained several imperfections, which could not possibly be remedied on the spot (the most important being a faulty system of feeding the columns with water, which caused great irregularities), it will be granted that the result obtained was most encouraging, and proved a great superiority of the plate columns over any other apparatus of similar size and cost. It cannot be doubted that, if it had been possible to apply half as many plates again, that is, about 33 plates in lieu of 22, in a consecutive set, and with a better system of water feeding, the condensation would have been as perfect as in all the cisterns or tourilles and the coke tower combined. But it was not feasible at the time to alter the apparatus in that manner, and only now it has become possible to turn it out in an improved form, guided by the experiences made in those preliminary trials. I hope to be able, at no distant time, to report the results obtained with the plate column in that improved form, as shown in the diagrams. But even as it stands now, I thought that a short report of a condensing apparatus, devised on more scientific principles than those previously existing, would not be unwelcome to those members of the Section who are interested in technological chemistry.

SACCHARINE: THE NEW SWEET PRODUCT FROM COAL-TAR.

(Read before the British Association, at Manchester, September 5, 1887.)

BY DR. CONSTANTIN FAHLBERG.

The subject which I am going to bring before you is one which may, perhaps, be known to many of you, at least, by name. In the first place, I think it well to give you a short history of this new and interesting compound, stating how I came to discover it, and what my principal work was during the period of nine years, in developing it for purposes of manufacture on a large scale.

When, in the year 1879, I became connected with the Johns Hopkins University of Baltimore, part of my work was to repeat the older experiments of Latchinow, Anna Wolkow, Remsen, Beckurts, and others, on the toluene sulphamides. I prepared first the toluene sulphamides, in order to study their oxidation products; some of them, the "para" and "meta" compounds, had previously been studied by others, but the "ortho" compound had not been investigated up to that time.

By oxidising pure orthotoluene sulphamide, I found that it yields a remarkably sweet compound, but the amount obtained by the process employed was so small, that it was hopeless to think of making the laboratory experiment fit for a manufacturing process. Not discouraged by this fact, I set to work to study other reactions, in order to get a better yield of the sweet body.

In the first place, the costly anhydrous or fuming sulphuric acid was not fit for yielding sufficient orthotoluene sulphonic acid: it was found that by treating toluene with anhydrous sulphuric acid the parasulphonic acid was the principal product formed. Experimenting with different strengths of acid, it was found that sulphuric acid of 66 Baumé answered the purpose best at low temperature, converting almost one-half of the toluene into the orthosulphonic acid.

The next step in the process was the treatment with phosphorus pentachloride—a reaction which cannot be carried out on a large scale. I therefore experimented with phosphorus trichloride, employing a current of chlorine gas, and found by this method of treatment that the action was less violent and more under control, but it gave the same results as when phosphorus pentachloride was employed. In order to manufacture phosphorus trichloride a new apparatus had to be devised, this compound not having been manufactured up to that time in sufficient quantities to warrant the hope of obtaining a continuous supply for my purpose.

The apparatus which I have devised for effecting this object is made of cast-iron, and the phosphorus used is the yellow and not the red modification; the apparatus being so constructed as to allow of continuous flow of phosphorus into it through a funnel. With this apparatus an unlimited quantity of the trichloride may be manufactured, the cost of production being comparatively small, whilst the purity of the article is very high.

In my laboratory work I made use of aqueous ammonia for transforming the orthosulphonic chloride into the amide, but I found that the water was very dangerous, changing the sulphonic chloride frequently back into the sulphonic acid and not into the amide as desired, and so rendering this step of the process very uncertain. To avoid this inverse reaction, water had to be excluded, and dry ammonia gas had to be used, which again required complicated apparatus and study of the conditions under which the reaction progressed most favourably.

My apparatus as now constructed, and the knowledge which I have gained by patient study of this part of the reaction, have so overcome this inverse reaction as to make the yield almost a theoretical one.

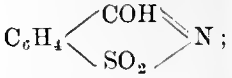
The oxidation of toluene orthosulphamide into saccharine requires great precaution, and it was found necessary to change very materially the work at this stage of the process from the laboratory method to that necessary for a manufacturing operation. In my previous work I had stated that toluene sulphamide yields on oxidation with potassium permanganate two products—namely, saccharine and orthosulphobenzoic acid. At that time I had assumed the reaction to take place with elimination, not of ammonia as a chemist would be inclined to suppose, but in that of nitrogen. Now I find that this reaction is an entirely different one; that neither ammonia nor nitrogen is formed, but that by oxidation, part of the amido group is changed into nitrates in the presence of potassium permanganate.

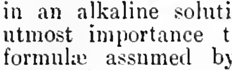
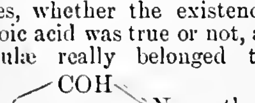
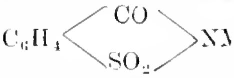
To check this formation, very dilute solutions have to be employed, and the subsequent evaporation becomes a very expensive operation.

A discovery which took place at this time helped me greatly to utilise the sulphobenzoic acid formed during the process, by transforming it into saccharine. This discovery consisted in the following reaction:—If a neutral salt of sulphobenzoic acid be treated with phosphorus pentachloride or with trichloride in a current of chlorine gas, the bichloride formed in this reaction yields, on treatment with ammonia, not as might be assumed, a diamid, but an ammonium salt of saccharine, from which saccharine can be easily separated, like from any other salt of it, by the addition of a mineral acid. The parasulphonic chloride, which forms a bulky mass, in order to carry through the operations to separate the orthosulphonic chloride, is now transformed in autoclaves under pressure, and by super heated steam into toluene and sulphuric and hydrochloric acids. The toluene is made use of again, and by this reaction almost all the substance started with is transformed finally into saccharine.

Works of such an extensive character as those at Salbke Westerhüsen, Germany, erected to supply the whole world with saccharine, require very large quantities of potassium permanganate and phosphorus, and to work economically it is necesssary to utilise the manganese hydroxide obtained as a by-product for reconversion into permanganate. It may also be necessary to utilise the phosphate residues for making phosphorus later on, if this material continues to be sold at its present high price, but I hope that the existing phosphorus manufacturers will be able to supply me for some time to come.

From the above statements you can easily conclude that there was much work to be done to put me in the position in which I am at present, to supply the world with a sufficient quantity of saccharine.

My previous publications on saccharine, although of an entirely theoretical value, had not been accurate enough in their statements, so as to leave no doubt about the constitution of saccharine. Remsen, Maumené, and others, had speculated on various formulæ for this new body. The former had assumed the formula to be  $C_6H_4\left<\begin{array}{l}COH\\SO_2\end{array}\right>N$; whereas Maumené had thought to find a similarity between saccharine and taurine, probably through his manipulative errors in the determination of sulphur.

For the formulæ of the salts of saccharine I had assumed the non-existence of the orthosulphaminebenzoic acid, and had thought the salts of saccharine corresponded to the formula belonging to sulphaminebenzoic acid. Later on the existence of orthosulphaminebenzoic acid was proved by Noyes, who had oxidised sulphamide with ferricyanide of potassium in an alkaline solution. It now became of the utmost importance to decide between the two formulæ assumed by Remsen and myself; and taking into consideration the work published by Noyes, whether the existence of orthosulphaminebenzoic acid was true or not, and which of the two formulæ really belonged to saccharine—namely,  $C_6H_4\left<\begin{array}{l}COH\\SO_2\end{array}\right>N$, or the formula suggested by me,  $C_6H_4\left<\begin{array}{l}CO\\SO_2\end{array}\right>NH$. I repeated the work of Noyes, and found that he was correct in all his statements. At present I have an investigation in progress, which will prove that the above orthosulphaminebenzoic acid of Noyes can also be made in a different way, and with a better yield, which reaction I will make known at a future time. The formulæ for the salts of saccharine, as assumed by me, were accordingly wrong in some respects, as it is impossible for two isomeric orthosulphaminebenzoic acids to exist. On re-examining my salts of saccharine I found them all to correspond to the formula  $C_6H_4\left<\begin{matrix}CO\\SO_2\end{matrix}\right>NM$, in which the hydrogen atom of the imide group is replaced by monad metals, or monad-organic radicles. The ethers which in my first attempts I found impossible to prepare, I have finally succeeded in forming, and these were greatly instrumental in helping me to prove the constitution of saccharine and its salts, without any doubt whatever. If any of these ethers be enclosed in a sealed tube in the presence of hydrochloric acid an alkylamine and sulphobenzoic acid are formed. I have proved, in one instance, the existence of ethylamine by the isonitrile reaction of Hofmann and the formation of the double salt of platinum chloride. This transformation proves beyond any doubt the constitution assumed by me, as given above, for saccharine and its salts, as well as for its ethers.

According to the above facts we must look upon saccharine as an inner-anhydride or benzoylorthosulphonic imide, which yields salts and ethers entirely different from the orthosulphaminebenzoic acid; in fact I have succeeded in transforming one into the other, and *vice versâ.*

If orthosulphaminebenzoic acid be heated, it changes into saccharine (*i.e.*, benzoylorthosulphonic imide) with the elimination of water; if, on the other hand, saccharine be subjected to a current of hydrochloric acid gas in the presence of alcohol, the ether of orthosulphaminebenzoic acid is formed, which also yields, on heating, saccharine, with the exception, that in this case not water but alcohol is eliminated. A further interesting reaction of the ether of saccharine, and not of orthosulphaminebenzoic acid, is this, that it forms by saponification with an alcoholic solution of potash a double potassium salt of ethylsulphaminebenzoic acid, having the formula $COOK—C_6H_4—SO_2N.KC_2H_5$. If this compound be treated with hydrochloric acid, or any mineral acid, the potassium is eliminated, and an isomeric compound of the ether of orthosulphaminebenzoic acid is formed, which I have designated as ethylsulphaminebenzoic acid, and which is isomeric with the above-stated ether of orthosulphaminebenzoic acid. I have an investigation in progress which will prove that these reactions hold good for all sulphimides; as, for instance, terephthalic and mesitylenic sulphimides, and other bodies of the same constitution.

Having mentioned the first difficulties which I met with, and having given you a short outline of the chemical side of the saccharine question (the material which has been of late so prominently before the public notice), I wish, at this stage of my paper, to call your attention to the uses of saccharine in the arts, in the household, and in medicine. I may say that there are at the present moment a number of manufacturers using saccharine already for the purposes of sweetening bread, cakes, champagne, lemonade, oils, essences and medicines of all kinds. Its sweetening power being three hundred times greater than that of sugar, you can imagine that it will serve for many purposes to which sugar cannot be applied, such as disguising the unpleasant taste of medicines, and be used in flavouring the food of patients to whom the use of sugar would be injurious.

One very important fact must be here pointed out with respect to saccharine, and that is, its non fermentable character, distinguishing it from the sweetening materials belonging to the carbohydrate class or sugar family proper; it is in no way altered by the action of yeast or other ferments, in the way that the carbohydrates are degraded, in fact, it rather acts in such a way as to prevent fermentation, so that saccharine retains its sweetening property under all conditions for an indefinite time.

In addition to the high sweetening power of saccharine, it has also antiseptic properties, which will make it useful in preserving articles of food, as I have frequently seen suggested in the newspapers; it is nothing more than a condiment or spice, and should never be tasted in the pure state, because taken in too large a quantity it will act upon the nerves in such a way as to paralyse the sense of taste, just as powerful music stuns or deadens the auditory nerves, or a very bright light acts upon the optic nerves.

I may inform you that almond and other breads are now to be had sweetened with saccharine, as well as champagne similarly sweetened, for diabetic patients and those suffering from fatty degeneration.

Nottingham Section.

Chairman: Lewis T. Wright.

Vice-Chairman: Frank Clowes.

Committee:

L. Archbutt.
Jas. H. Ashwell.
J. B. Coleman.
H. Doidge.
R. Fitzhugh.
E. Francis.
T. W. Lovibond.
S. J. Pentecost.
H. J. Staples.
E. B. Truman.
R. L. Whiteley.

Treasurer: W. H. Parker.

Hon. Local Secretary:

Jno. R. Ashwell, Midanbury Lodge, Bentinck Road,
Nottingham.

October (date to be fixed).—Opening Meeting: Address by the Chairman, Lewis T. Wright, Esq.

November.—C. Spackman, Esq., on "Portland Cement."

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS AND MACHINERY.

Improvements in Chemical Fire Extinguishers. J. Haslam Tonge. Eng. Pat. 12,253, Sept. 27, 1886. 8d.

This invention relates to that class of apparatus wherein a bottle containing acid is placed in a solution of a carbonate, and broken when the occasion for use arises, and consists in providing means for readily charging and breaking the said bottle. The extinguisher case is provided at the top with a metallic nozzle closed by a

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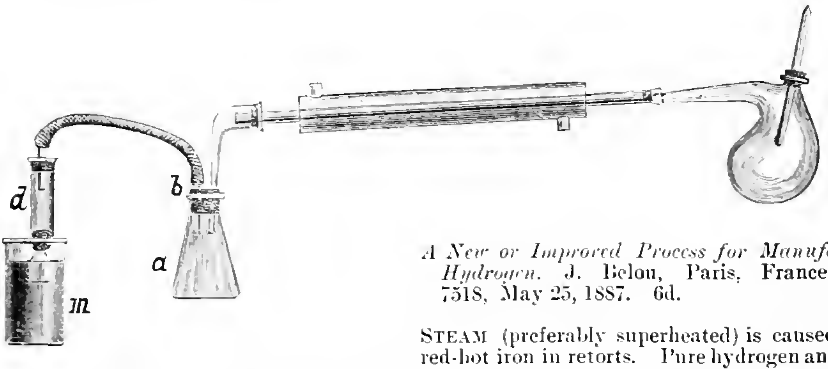
* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.........	½d.
Above 8d., and not exceeding 1s. 6d...	1d.
,, 1s. 6d., ,, ,, 2s. 4d...	1½d.
,, 2s. 4d., ,, ,, 3s. 4d...	2d.

swivel lid or cover, the joint being made tight by an indiarubber ring. Attached to the underside of the nozzle is a wire cage containing the bottle of acid, and on the side of the extinguisher case is inserted a bar or plunger passing through a suitable stuffing box and provided with a convenient handle for driving it sharply against the bottle inside and effecting the breakage thereof. The same end may be attained by the use of an eccentric mounted on a spindle passing through a stuffing box in the case side. An outlet pipe delivers from the bottom of the casing and is of course controlled by a tap.—A. R. D.

Method for Distillation in an Indifferent Gas. P. Raikow. Chem. Zeit. **11**, 572.

The apparatus is filled with gas by means of the generator *d*, the cork of the retort being removed. This having been effected the cork is replaced and the distillation commenced. The evolution of gas is stopped by the pressure within the apparatus, but whenever this diminishes, the acid in the beaker rises in *d*, and the evolution of gas recommences.—A. G. G.



II.—FUEL, GAS AND LIGHT.

Improvements in the Manufacture of what are known as Mantles used in what is called Incandescent Gas Lighting. A Paget, Loughborough. Eng. Pat. 11,287, Sept. 4, 1886. 6d.

The patentee describes his improvements under four heads. 1. He temporarily strengthens the mantles (after due incineration and preparation) by immersion in a solution of some resinous, glutinous or farinaceous substance, 2. He attains the same end by immersion in some melted substance such as paraffin wax or beeswax, from which the mantles can be removed while hot. 3. He proceeds as under head 2, but allows the wax to cool with the mantle embedded in it. This entirely removes risk of breakage in transport. The surrounding substance left on the mantles by the above methods of treatment is easily burnt off previous to use. 4. To prevent the mantle from oscillating he drops upon its point of attachment to the suspending hook a drop of one of the well-known solutions of glass. The liquid is evaporated when the burner is lighted, and the residue, vitrified by the heat, cements the mantle to the suspending hook.—A. R. D.

Improvements in the Distillation of Tar, Oil, Resin, and Liquid Hydrocarbons in the Manufacture of Illuminating and Heating Gases therefrom, and in Apparatus for that Purpose. W. Burns, Leith. Eng. Pat. 14,958, Nov. 18, 1886. 8d.

This specification, which is unsuitable for abstraction, contains two sheets of drawings. The claims are:—1. "The particular mode of making gas from liquid hydrocarbons by distilling the said liquids in a double distilling retort and in mixing the vapours under hoods placed inside the retort and then decomposing the said vapours in a separate retort by passing them through red hot charcoal contained therein." 2. "The use of a fluted perforated pipe surrounded with charcoal inside the decomposing retort for distributing the hydrocarbon vapours and steam equally through the charcoal." 3. "The blowing of air through fluted and perforated pipes inside the decomposing retorts and surrounded by charcoal." 4. "The mixing of the fresh hydrocarbon liquids with distilled naphtha in the hydraulic main and then distilling the mixture in a low temperature still, placed on the top of the high temperature distilling retort, and then distilling the heavier portions in the high temperature still.—D. B.

A New or Improved Process for Manufacturing Pure Hydrogen. J. Belou, Paris, France. Eng. Pat. 7518, May 25, 1887. 6d.

Steam (preferably superheated) is caused to pass over red-hot iron in retorts. Pure hydrogen and oxide of iron are thus formed. The hydrogen passes on to a gasholder for use, and the oxide is reduced to metallic iron again by the introduction of charcoal dust. This latter operation generates so much heat that the retort is again immediately ready for decomposing steam. By using a number of retorts and carrying on the two processes of decomposition and revivification alternately, the production of hydrogen may be made continuous. Suitable provision must, of course, be made for the removal of the carbonic acid and carbonic oxide formed during the revivification.—A. R. D.

Improvements in Apparatus for Producing Gas or Vapour from Hydrocarbons, and for utilising Gas or Vapour for Lighting or Heating and for Igniting Gas. J. A. Marsh, Cleveland, U.S.A. Eng. Pat. 3418, March 5, 1887. 8d.

This specification is unsuited for useful abstraction. It has fifteen drawings explanatory of the patentee's twenty-one claims.—A. R. D.

Improvements in Regenerative Hydrocarbon Lamps or Lanterns. L. Chandor, St. Petersburg; and C. H. Nölting, London. Eng. Pat. 8790, June 18, 1887. 6d.

The lamp proper is contained within a casing provided with a double bottom. Air is admitted into the lower part of the casing, but cannot make its way direct to the lamp flame, as this is protected by a sheath. It therefore rises through a funnel kept hot by the escaping products of combustion, and then passes downwards by tubes to the hollow bottom of the casing, where suitable provision is made for causing it to circulate around the oil reservoir (which stands upon this case bottom) and then to pass through the upper part of the wick sheath to the flame. Glass chimneys are dispensed with, but the upper part of the lamp is provided with two sheet metal cowls, one within the other, whereby the draught can be regulated. Drawings accompany the specification.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Improvements in Apparatus for Petroleum Distillation. Dingl. Polyt. J. **264**, 227—229.

THE usual forms of apparatus do not allow of a sufficient separation of the products by one distillation; the large quantity of raw naphtha to be operated upon in each still causes the lower layers to be overheated, and a continuous distillation necessitates a regular system of stills. O. K. Lenz, of Baku, has patented two distinct apparatus in which these objections are avoided. The one consists of a long four-sided boiler of thin iron or copper plate, on the two longest internal sides of which shallow gutters are horizontally fixed, along which the naphtha is made to flow from one end to the other, and thence on to the next lowest gutter, until the bottom of the boiler is reached. In this way only naphtha with a high boiling point runs out at the bottom of the last of a series of such apparatus, from each of which oil of certain special boiling points is obtained. To obtain constant regular results in working these boilers the inflow of raw naphtha must be accurately regulated, as also the heating. Lenz, by the use of two zinc rods fixed to one side of the boiler, passing out through stuffing boxes in the other side, and connected with levers which regulate the taps for the raw naphtha supply to the stills and the supply of naphtha residues to the fires, has rendered this apparatus entirely automatic.

The second apparatus consists of a long, four-sided metal box made up of two parts resting one above the other and bolted together. The lower one, which receives the raw naphtha for the distillation, is divided into numerous chambers by means of upright cross-walls projecting alternately from either side almost to the opposite side, so that the naphtha which flows in at the end furthest removed from the fires has to make a long zig-zag passage to the other end of the still. The upper vessel is likewise divided into a corresponding number of chambers; these, however, are not at all connected with each other, but each chamber is provided with a separate condensing apparatus. With this form of still a continuous fractional distillation can easily be carried on, raw naphtha entering at one end and the heavy residues being drawn off at the other. The still is fired by the gasoline vapours from the first compartment.—T. L. B.

Improvements in Apparatus for Washing or Treating Mineral Oils with Acids or Alkalis. A. C. Thomson, Edinburgh. Eng. Pat. 11,300, Sept. 6, 1886. 8d.

THE liquids which are to be agitated together are caused to flow through a series of turbines placed one above the other in a vertical cylinder. By another modification the process goes on in a horizontal or inclined cylinder divided into compartments and traversed by a central shaft, on which are fixed discs provided with bars or studs. As the shaft revolves these studs work in between corresponding bars or studs projecting from the partitions of the cylinder, and cause a thorough mixing of the contained liquids. The compartments communicate with each other, and the liquids travel from one end of the cylinder to the other.—A. R. D.

IV.—COLOURING MATTERS AND DYES.

On the Orange Azo-colours. Dr. Otto Mühlhäuser. Dingl. Polyt. J. **264**, 181—187 and 238—244.

THE paper opens with a short historical sketch of this class of colouring matters, ranging from the discovery of azo-benzene by Mitscherlich in 1834, and that of the diazo-bodies by Griess in 1858, to the investigation and manufacture of chrysoidine, and the tropœolins or oranges by Caro, Roussin, and Otto N. Witt in 1876—77. The author then proceeds to give details of the technical production of four of the most important simple members of this class of oranges, which are known under the names of orange I., or tropœolin OOO No. 1; orange II., or tropœolin OOO No. 2; orange R, and orange RR. The first operation in the manufacture of these bodies is the production of the amido-sulphonic acids of benzene, toluene, and xylene. In the case of the benzene and toluene compounds, the sulphates of aniline, or *o*- and *p*-toluidine, are decomposed by the aid of heat at 190—200°, according to the equation:

$$C_6H_5.NH_2.H_2SO_4=H_2O+C_6H_4.NH_2.(SO_3H).$$

An iron pan provided with cover, lead cooler, and stirrer, serves to mix the aniline and sulphuric acid together in; 49kilos. H_2SO_4 (66° Bé.) are placed in the pan, and 46·5 kilos. pure "aniline for blue" poured in a thin stream through the cooler into the acid, whilst well stirring for about twenty minutes. The cover is then removed and the acid aniline sulphate is equally divided among three shallow sheet-iron trays, 75cm. square and 25cm. deep, provided with slides to facilitate the drawing in and out of the oven. One of these trays at a time is then placed in an iron oven, 100cm. square and 50cm. high, which is built in a muffle-furnace so as to receive the heat at the bottom, at the two sides, and the end, the top being provided with an opening to allow the steam to escape. The temperature of the oven must be kept between 220—230°, for if raised above this, charring will ensue, and if allowed to fall below, there will be some of the sulphate left unconverted. In about three hours' time the reaction will be complete, and the cakes on the trays should, whilst still quite hot, show no sticky centres when broken up by an iron tool, but should be quite hard and brittle. The yield of crude sulphanilic acid averages 80kilos. from the above quantities. In the case of the toluidine sulphonation the proportions are 53·5 kilos. toluidine to 49kilos. H_2SO_4, but the temperature should not exceed 220°, and be maintained for from five to six hours. The xylidine sulphonic acid, which is used for the production of the orange RR, is obtained from *m*-xylidine by the action of fuming sulphuric acid. 175 kilos. 20 per cent. fuming acid are placed in an iron jacket, provided with stirring gear (20 revolutions per minute), and connected with both steam and cold water mains. Whilst well stirring, 50kilos. metaxylidine are slowly added, care being taken that the temperature of the mixture does not exceed 50°. The whole is then heated for four hours to 105—110°, until a sample thrown in water and made alkaline dissolves completely and gives no smell of xylidine. Hereupon the melt is blown by air pressure into a 3000-litre vat containing a solution of 64kilos. sodium sulphate in 1000 litres of water, the mixture made alkaline by the addition of about 120kilos. lime, raised to the boil by free steam and then say 500 litres of cold water added to cause the gypsum to crystallise. After being forced through a filter-press, the lime cakes are re-boiled, again put through the press, and the united filtrates evaporated to about 600 litres, then treated with about 5kilos. sodium carbonate to precipitate any lime still remaining in solution, when after another filtration the solution of sodium *m*-xylidinesulphonate is ready for further treatment. The crude sulphanilic acid is, after dissolving in the requisite amount of soda and water, boiling to remove aniline, and after filtration, also ready for subsequent operations.

The amount of sulphonic acid contained in these solutions is determined by normal nitrite solution, the reaction being

$$C_6H_4.NH_2(SO_3H)+NOOH=2H_2O+\overbrace{C_6H_4.N_2.SO_3}.$$

A solution containing say 2 per cent. of the acid, is acidified with excess of hydrochloric acid, and in the cold the nitrite solution slowly added until a sample dropped upon potassium iodide and starch paper gives the blue iodide of starch reaction. The normal nitrite contains 69grms. $NaNO_2$ per 100cc., 1cc. corresponding to 0·173grm. sulphanilic, 0·187 toluidinesulphonic, or 0·201 xylidinesulphonic acid. The nitrite solution may be standardised by the same reaction, using a $\frac{1}{10}$ normal sodium sulphanilate solution (19·5grms to 1000cc.), 1cc. of which equals 0·0069grm. $NaNO_2$.

In the actual manufacture of the colours, the amidosulphonic acids are by the action of nitrite of soda converted into diazo-sulphonic acids, and these then combined with either α-or β naphthol in alkaline solution, the quantities being so chosen as to correspond as exactly as possible to the theory as expressed in the following equations:—

$$\text{I.}\quad SO_3Na-R-NH_2+H_2SO_4+NaNO_2=Na_2SO_4+H_2O+\overline{R.N_2.SO_3}.$$

$$\text{II.}\quad \overline{R.N_2.SO_3}+C_{10}H_7.ONa=SO_3Na.R.N_2.C_{10}H_6.OH.$$

It is to be noted that excess of acid, *acid and nitrite*, or of naphthol, are prejudicial to a good result; it is advisable therefore to always have a small excess of diazo-compound and some 3 per cent. excess of alkali present.

Manufacture of Orange II., Tropæolin OOO No. II. $NaSO_3.C_6H_4.N:N\ C_{10}H_6.OH.(\beta)$. — 100kilos. sulphanilic acid are dissolved in an iron vessel in 400 litres of water containing 26kilos. solid caustic soda, and the solution boiled during twenty minutes till no smell of aniline is noticeable. The solution is passed through a six-chambered filter-press into a vat arranged upon a scale, the weight taken, the analysis made, and then run into the diazotising vat. This is provided with stirring gear, and should hold 2000 litres. The sulphanilic acid is then thrown down in a fine crystalline condition by the careful addition of 64kilos. H_2SO_4.(66° B.) whilst well stirring, and the mixture left over night to cool. Supposing the analysis gave 98·7kilos. sulphanilic acid, that would require 41·3kilos. nitrite of soda containing 95 per cent. $NaNO_2$ and 82·1kilos. β-naphthol. This naphthol is dissolved in 30kilos. caustic soda and 400 litres water, also being allowed to cool over-night. The next day it is run through a filter-press into the precipitating vat, which should hold 4000 litres and be provided with rapid stirrers. The stirrers of the vat containing the sulphanilic acid being put in motion, ice is added until the temperature of the mixture is reduced to 4°; the solution of 41·3kilos. $NaNO_2$ in 200 litres of water is then run in during say 10—15 minutes, until the starch papers show a slight excess of nitrite. If necessary more ice must be added, so that the temperature does not exceed 10°. After stirring for some five minutes or so longer, this diazo-benzene sulphonic acid solution is run carefully into the naphthol solution in the precipitating vat, which has been cooled with ice to 4°, stirring vigorously. This operation takes about forty minutes to accomplish, during which the temperature of the mixture must not exceed 12°. After stirring for about an hour the mass of golden yellow glistening needles is lowered into a montejus placed in the ground, forced through two 18-chambered filter-presses, and the mother-liquor well blown out of the cakes, which are then placed on zinc trays, cut up, and dried at 60—70° during three or five days. The yield of dry ground colour from the above quantities averages 200kilos. The mother-liquors are run to waste.

Manufacture of Orange I., Tropæolin OOO No. I. $NaSO_3.C_6H_4.N:N.C_{10}H_6OH(\alpha)$. — All the proportions and operations are exactly similar to those described for orange II., with the exception that in this case α-naphthol takes the place of the β-naphthol. Further, the mother-liquors are not run to waste, but are raised to the boil in a suitable vat, and the colour they contain salted out. When sufficient of this residual colour, say 10 lots, has collected, it is boiled up in about 2000 litres of water and again salted out, forming when dry one of the acid brown colours of commerce, *Acid Brown R.* The yield of orange I. averages 170kilos.

Manufacture of Orange R, $(NaSO_3)CH_3.C_6H_3.N:N.C_{10}H_6OH(\beta)$.—This colour, which is a combination of the diazo-sulphonic acids of ortho- and para-toluidine with β-naphthol, is made otherwise exactly in the manner described under orange II.

Manufacture of Orange RR, $(CH_3)_2SO_3Na.C_6H_2.N:N.C_{10}H_6OH(\beta)$ $[CH_3{:}CH_3 = 1{:}3]$. — In this case also the formation and combination of the diazo-*m*-xylidine sulphonic acid with β-naphthol takes place as described for orange II., but the resulting colour being gelatinous must be raised to the boil and then precipitated with strong brine before it can be filter-pressed. The yield from 50kilos. *m*-xylidine averages 155kilos.—T. L. B.

Manufacture of Acid Magenta. P. Schoop. Chem. Zeit. **11**, 572—573.

The sulphonation of rosaniline cannot be effected by means of ordinary H_2SO_4, even at high temperatures. A variety of sulphonating agents have been proposed for this purpose, but the only method at present in use consists in the employment of fuming sulphuric acid.

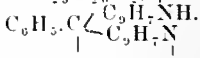
In performing the reaction the points to be taken account of are: (1) the concentration of the fuming sulphuric acid; (2) the temperature; (3) the length of time taken. As the quality of the product greatly depends upon the rapidity with which the operation is carried out, it is best to work with small quantities and to add the powdered rosaniline hydrochloride to the fuming acid, allowing the temperature to rise spontaneously. The operation is performed in a series of small pans, of about 15litres capacity, into each of which is put a mixture of 3½kilos. of 20 per cent. fuming sulphuric acid and 1kilo. of 40 per cent. acid. To each is then added, all at once, with vigorous stirring, 1kilo. of finely-ground magenta crystals, dried at 120—130 for 12 hours. The stirring is continued till all the magenta has dissolved: the temperature meanwhile quickly rises to 170° and the sulphonation is complete in about a minute. The cooled melt is diluted with water (1500 litres to 10 pans) and boiling milk of lime added till alkaline and colourless. The liquor is forced through a filter-press, and concentrated in a wooden vat by means of a steam coil. To the concentrated liquor is added sufficient hydrochloric acid to convert it into the acid salt and give it a bronzy appearance. The syrup is finally dried upon enamelled iron trays in a chamber at 100°. The press cakes are re-boiled, and the liquor used for diluting a second charge. When the sodium salt is required instead of the calcium salt, the concentrated filtrate is mixed with sufficient Na_2CO_3, filtered from $CaCO_3$, and the filtrate treated in the same way as above. 10kilos. of magenta give on an average about 20kilos. of acid magenta of ordinary strength. The strength of fuming acid required for the sulphonation varies very much with the quality of the magenta; thus maroon and cerise are far more easily sulphonated than crystallised magenta, and require an acid of lower value in SO_3 than given above.

—A. G. G.

On Rosindoles. E. Fischer and P. Wagner. Ber. **20**, 815—818.

By heating bodies of the indole series with benzoyl chloride, red colouring matters are formed of great similarity to rosaniline, and have hence been named rosindoles. The same compounds are also formed by oxidation of the benzylidene derivatives of the indoles. They probably stand in near relation to the triphenylmethane derivatives.

Dimethylrosindole $C_{25}H_{20}N_2$, probably



$$C_6H_5.C\begin{cases}C_9H_7.NH.\\C_9H_7N\end{cases}$$

—Obtained by heating equal weights of methylketole and benzoyl chloride with $ZnCl_2$ on the water-bath; or by oxidation of benzylidene-methylketole (from methylketole and benzaldehyde). The hydrochloride $C_{25}H_{20}N_2HCl$ forms small green-glistening crystals, sparingly soluble in water. It dyes silk and wool red. The base is precipitated from a cold solution of the salts in the form of a bright yellow amorphous powder, which by boiling with water darkens in colour and becomes crystalline; recrystallised from hot alcohol it forms orange-red prismatic crystals. It dissolves in alcoholic NaOH with a magenta-red colour, which disappears on addition of water. By zinc-dust and alcoholic NH_3 it is reduced to benzylidene-methylketole.—A. G. G.

Methylation of Indoles. E. Fischer and A. Steche. Ber. **20**, 818—820.

If methylketole (1 part) is heated with methyliodide (2½ parts) and a little methyl alcohol at 100° for 15 hours, a new base of the formula $C_{11}H_{13}N$ is obtained in nearly theoretical quantity. This compound is not an indole derivative, but is probably a derivative of quinoline (*i.e.*) dimethyldihydroquinoline. It boils at 243–244° at 746mm., is readily soluble in alcohol, ether, etc., very slightly in water. It does not redden a pine-wood shaving, is not affected by nitrous acid, and is a strong base. The sulphate crystallises from alcohol in small plates, the picrate in beautiful golden-yellow plates. Other indole derivatives behave with methyliodide in a similar manner, producing bases which are probably derivatives of quinoline. Ethyliodide also acts similarly.—A. G. G.

The Tartrazines, a New Series of Colouring Matters.

J. H. Ziegler and M. Locher. Ber. **20**, 834–840.

DIOXYTARTARIC ACID $\begin{array}{c}C(OH)_2.CO_2H\\ \vdots \\ C(OH)_2.CO_2H\end{array}$ is capable of forming a mono- and a diphenylhydrazide, which are termed by the authors mono- and diphenylizindioxytartaric acids. The di-sulphonic acid of the latter is the yellow dyestuff called tartrazine

Dioxytartaric-acid Monophenylhydrazide

$$\begin{array}{c}C_6H_5.N_2H : C.CO_2H\\ (OH)_2\dot{C}.CO_2H\end{array}$$

is formed at the ordinary temperature by mixing equal mols. of dioxytartaric acid and phenylhydrazine in dilute HCl solution, and separates on standing as a crystalline precipitate. It is readily soluble in hot alcohol and acetic acid, nearly insoluble in cold water, slightly in hot; it melts at about 218° C. It is decomposed by water or dilute acids only on long boiling. By sodium amalgam it is reduced to aniline and an amido acid. The sodium salt forms yellowish plates, the silver and barium salts yellow precipitates.

Dioxytartaric-acid Diphenylhydrazide $(C_6H_5N_2H)_2C_2(CO_2H)_2$. Obtained by heating the monophenylhydrazide (1 mol.) with a solution of phenylhydrazine hydrochloride (1 mol.), or directly from dioxytartaric acid (1 mol.) and phenylhydrazine (2 mols.). It is an orange-yellow crystalline powder, readily soluble in warm alcohol and acetic acid, very sparingly in water. It melts with decomposition above 200°. With alkalis it forms easily soluble neutral salts and sparingly soluble acid salts. The neutral Na and NH_4 salts crystallise in yellow plates, the acid salts in red needles. The *monoacetyl anhydride* $C_{18}H_{13}N_4O_4$ is formed by heating the acid with acetic anhydride. It crystallises on adding alcohol in glistening red needles which melt at 234°. It is insoluble in most solvents.

Dioxytartaric-acid Diphenylhydrazide Disulphonic acid (Tartrazine) $\begin{array}{c}C_6H_4(SO_3H).N_2H.C.CO_2H.\\ C_6H_4(SO_3H).N_2H.\dot{C}.CO_2H.\end{array}$ Prepared by dissolving 10 parts of phenylhydrazine-sulphonic acid in 40 parts of water with sufficient NaOH, and adding the solution to 5 parts of sodium dioxytartrate in 10cc. of water and 10cc. of hydrochloric acid. On warming the tartrazine separates out as an orange precipitate of the sodium salt. The yield amounts to 97 per cent. of the theoretical quantity. It dyes wool a beautiful greenish yellow, which is very fast to light.

—A. G. G.

A New Mono-sulphonic Acid of β-Naphthylamine.

Fr. Bayer and C. Daisberg. Ber. **20**, 1426–1435.

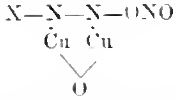
BY heating β-naphthylamine with three parts of ordinary H_2SO_4 at 100—105° C., a mixture of three isomeric mono-sulphonic acids (α, β and γ) is obtained, which differ considerably in their properties and colour reactions (Germ. Pats. 20,760, 22,547, and 29,054). Of these the β is also prepared by heating Schaeffer's β-naphthol-β-sulphonic acid with NH_3 under pressure. The γ-acid is the chief product when the sulphonation is carried out at 15—20° (Germ. Pat. 32,276). In addition to these the authors have found that by heating β-naphthylamine sulphate with much sulphuric acid at 150° or above, a fourth isomer is obtained. This δ-acid is also formed when either of the other three isomers is heated with sulphuric acid to this temperature. It is best prepared by adding 1 part of β-naphthylamine sulphate to 5 or 6 parts of ordinary H_2SO_4 at 150—160°, and keeping the mixture at this temperature for about 1½ hours. The hot solution is then at once poured into ice, allowed to stand some time and filtered. By repeatedly boiling the precipitate with water the δ-acid goes into solution and crystallises out again on cooling. It is obtained pure by conversion into the barium or sodium salt, which are sparingly soluble in cold water. The δ-sulphonic acid is sparingly soluble in hot water, nearly insoluble in cold, and crystallises in long silky needles ($+H_2O$). In their colour reactions with tetrazodiphenyl and tetrazoditolyl, the four isomers differ greatly. The α-acid gives with both these tetrazo compounds easily soluble yellow dyestuffs, very fugitive to light; the β- and γ-acids give with tetrazodiphenyl, yellowish red sparingly soluble products; with tetrazoditolyl the β-acid gives a fine red (benzopurpurin B), whilst the γ-acid gives an orange. The new δ-acid gives with tetrazodiphenyl an easily soluble yellowish-red dyestuff (δ-purpurin G), with tetrazoditolyl a splendid red (δ-purpurin 5B). The δ-acid also differs from the α-acid in the solubility of its sodium salt in alcohol, from the β-acid by the solubility of the free acid in boiling water, and from the γ-acid by the sparing solubility of its barium salt. By diazotisation and boiling with dilute H_2SO_4 it is converted into a δ-sulphonic acid of β-naphthol, which is identical with the β-naphthol-sulphonic acid F of L. Cassella & Co., obtained by heating naphthalene-α-disulphonic acid with alkalis. Conversely the β-naphthol δ-sulphonic acid prepared in the latter way can be converted into β-naphthylamin-δ-sulphonic acid by heating with NH_3 under pressure at 200°. The *barium salt* $[C_{10}H_6(NH_2)SO_3]_2Ba+4\frac{1}{2}H_2O$ crystallises in small plates, soluble in 400 parts of cold water. The *sodium salt* $C_{10}H_6(NH_2)SO_3Na+4H_2O$ forms small white needles, readily soluble in hot water and in hot alcohol, sparingly (1 in 70) in cold water.

—A. G. G.

Replacement of NH_2 by NO_2 in Aromatic Compounds.

T. Sandmeyer. Ber. **20**, 1491—1497.

THE conversion of aromatic amido-compounds into nitro-compounds can be effected by the action of precipitated cuprous oxide upon the nitrites of the diazo-compounds, possibly by intermediate formation of addition-products



$$\begin{array}{c}X—\overset{}{N}—\overset{}{N}—ONO\\ \dot{C}u\ \ \dot{C}u\\ \diagdown\ \diagup\\ O\end{array}$$

The amine is dissolved in exactly 2 mols. of dilute HNO_3 (or 1 mol. of dilute H_2SO_4, but not HCl), and to the mixture, cooled with ice, is added one half of a solution of 2 mols. of $NaNO_2$, the remainder being added when the diazotisation is complete. This solution of the diazo-nitrite is then added to the suspended cuprous oxide; nitrogen is evolved in the cold and the reaction is complete on standing for about an hour. As an example the conversion of aniline into nitrobenzene is performed as follows:—A cold solution of 20grms. of NaOH in 60cc. of water is added to a boiling solution of 50grms. of crystallised cupric sulphate (2 mols.) and 15grms. of ordinary glucose in 100cc. of water. As soon as all the cupric hydrate is converted into cuprous oxide the mixture is quickly cooled and the excess of NaOH neutralised with acetic acid. A solution of diazobenzene nitrite is prepared by adding 15grms. of $NaNO_2$ in 50cc of water to an iced solution of 9grms. of aniline in 50cc of water and 20grms. of nitric acid (sp. gr. 1·4). This is then slowly added to the cuprous oxide with cooling and allowed to stand for an hour till the evolution of nitrogen has ceased. The nitrobenzene is distilled off with steam and freed from phenol and nitrophenol by shaking with aqueous NaOH. The yield was 42 per cent. of the theoretical quantity. With *p*-bromaniline and β-naphthylamine the yield was still smaller. The product from the latter crystallised in yellow needles of melting point 78–79°, and had all the properties of the β-nitronaphthalene, as given by Lellmann and Remy.—A. G. G.

Indulines and Azophenines. O. N. Witt. Ber. **20**, 1538—1541.

AZOPHENINE $C_{30}H_{24}N_4$ is an intermediate product in the formation of induline. It is very readily prepared by heating a mixture of amidoazobenzene (2 parts), aniline hydrochloride (1 part), and aniline (4 parts) at 80—90° for 24 hours. The melt solidifies to a mass of azophenine crystals, which are separated by washing with alcohol (in which they are insoluble), and obtained pure by crystallisation from aniline or nitrobenzene. Ammonium chloride and *p*-phenylenediamine are constant by-products of the azophenine formation, a proof that a phenylation and reduction of the amido-azobenzene has taken place. If the melt containing the azophenine is further heated to 125—130 for some time, indulines are obtained. In the azophenine formation the amidoazobenzene can be replaced by other azo- and nitroso-compounds, such as phenylamidoazobenzene, azobenzene, chrysoidine, nitrosodimethylaniline, etc., without altering the product; but if toluidine is substituted for aniline, azotoline is obtained. This shows that azophenine is not a transformation product of amidoazobenzene, but is simply an oxidation product of aniline. A convenient method for the preparation of azophenine and its homologues consists in dissolving nitrosodimethylaniline with excess of aniline (or homologues) in acetic acid and warming slowly to 80°. The liquid solidifies to a crystalline magma of the corresponding azophenine, the mother-liquor containing dimethyl-*p*-phenylenediamine. Azophenine itself forms unstable salts of a violet colour; it does not appear to have any replaceable hydrogen attached to N, for it cannot be acetylated. By heating alone to 360° it is converted into aniline, and *fluorindine*, a splendid blue crystalline dyestuff, whose solutions exhibit a fine red fluorescence and a remarkable absorption spectrum. Azophenine is reduced by tin and HCl to aniline, and the sparingly soluble hydrochloride of a new base; the latter when set free by alkalis is rapidly oxidised by the air, forming phenylcarbamine and a red base whose salts are of an indigo-blue colour. The indulines, like azophenine, are probably condensation products of aniline formed by removal of hydrogen. If ordinary induline is distilled with CaO, the distillate consists chiefly of carbazol; this would seem to indicate that induline belongs to the class of diphenyl derivatives.—A. G. G.

Roshydrazine and a New Class of Colouring Matters. J. H. Ziegler. Ber. **20**, 1557—1558.

THE colour- and leuco-bases of triphenylmethane, when diazotised and treated with $SnCl_2$, are readily converted into hydrazines. For example: Rosaniline (5grms.) is dissolved in 30cc. of hydrochloric acid and 70cc. of water, and the iced solution is diazotised by adding 3½grms. of $NaNO_2$ in 10cc. of water. On mixing the solution of the diazo-compound with a well cooled solution of 12grms. of tin in 30cc. of hydrochloric acid, the *roshydrazine hydrochloride* separates out in green-shimmering crystals. The body is easily soluble in water, nearly insoluble in hydrochloric acid. Its solution has a bluer shade than rosaniline; it is a strong colouring-matter, and dyes tannined cotton a deep brownish-red. Like other hydrazines it reduces Fehling's solution and forms condensation-products with aldehydes and ketones. The latter compounds are sparingly soluble dyestuffs: thus acetone, aldehyde, pyruvic acid, benzophenone, etc., give reddish to bluish violet colours; acetoacetic ether and benzaldehyde give blues; whilst glucose gives a greyish-blue. Benzaldehyde sulphonic acid yields a blue soluble in water. These condensation-products can also be formed upon the fibre. The reduction of the diazo-compound of acid-magenta gives rise to easily soluble sulphonic acids of roshydrazine, the condensation products of which are soluble colouring matters. Saffranine, when treated in the same way, does not give a hydrazine, but evolves nitrogen.—A. G. G.

Manufacture of α-Naphthylamine. O. N. Witt. Chem. Ind. **10**, 215—220.

ALTHOUGH chemically the preparation of α naphthylamine is quite analogous to that of aniline, the difference in the physical properties necessitates great modifications in the practical details of the process. The purity of the naphthalene used is of great importance. It should melt exactly at 79° C., and boil constantly at 216°—217° C. A small piece exposed to the air on a glass plate should evaporate in a few days without leaving any residue, and remain white to the last. No red colour should be produced by heating 1grm. with pure concentrated H_2SO_4 to 170—200°. If the naphthalene fulfils all these conditions, it is suitable for the preparation of naphthylamine.

The nitration of naphthalene is not an easy operation, for the nitro-derivative is attacked by warm nitric acid almost as easily as naphthalene itself, so that when working in an ordinary manner a mixture is obtained of unaltered naphthalene, nitro-naphthalene, and dinitronaphthalene. To avoid this difficulty as much as possible the operation is performed as follows:—In a cast-iron jacketed shallow cylinder provided with an agitator is put a mixture of 200kilos. of nitric acid (40° B.), 200 kilos. of ordinary sulphuric acid, and 600kilos. of the spent acid from a preceding operation. 250kilos. of naphthalene, ground to a fine meal, is slowly sprinkled in through a sieve keeping the temperature at 45—50° by regulating the stream of cold water flowing through the jacket. At this temperature the nitration takes place steadily, and with the above quantities is completed in the course of a day. The contents of the vessel are now run out into lead-lined troughs, and allowed to cool, when the spent acid can be drawn off from the solid cake of nitro-naphthalene. The latter is freed from acid by boiling with water, and finally granulated by running in cold water whilst stirring. The product should then form light yellow granules and give off no naphthalene on boiling with water. If required for sale it is crystallised; this is best effected by melting on a water-bath and adding one-tenth its weight of xylene or solvent naphtha. The mixture keeps fluid for a long time, and can be filtered and dried over $CaCl_2$; when left to itself it slowly crystallises, and the crystals can be freed from hydrocarbon and impure nitro-naphthalene by hydraulic pressure.

The reduction apparatus is very similar to that employed for aniline, but simpler, as no cohobator or condenser are required.

The reduction is performed with iron and a little HCl in the same way as with nitro-benzene; 800kilos. of iron borings, 40kilos. of hydrochloric acid and some water are put into the still agitated and warmed; 600 kilos. of granulated nitro-naphthalene are slowly added; the reaction is tolerably vigorous, and is so regulated that the temperature of the mixture keeps at about 50°. When all the nitro-naphthalene has been added the temperature is maintained for 6 or 8 hours by blowing in steam. When nitro-naphthalene can no longer be detected, milk of lime (about 50kilos. of CaO) is added, the mixture stirred vigorously and emptied out. Since naphthylamine is only slightly volatile with steam, it cannot be isolated in the same way as aniline, but the mass has to be submitted to dry distillation.

This operation is the weak point of the present naphthylamine process, for, however carefully conducted, there is always an unavoidable loss due to the conversion of some of the naphthylamine into naphthalene and other products by the heated Fe_3O_4; this is less the quicker the naphthylamine can be removed from the retort. The mass is spread out in thin layers upon iron trays, which are placed on shelves within the retort; the latter is heated strongly by direct firing, whilst superheated steam is passed through it. The naphthylamine is condensed in a worm, the surrounding water being kept at 60° C. It is separated from water, dried by heating with dry steam, and distilled in an ordinary wrought-iron retort. It then forms the ordinary commercial product; it is not quite pure, but contains small quantities of naphthalene.

The yield is fairly good, though considerably below the theoretical. The iron residue left in the retorts contains much reduced iron, which renders it strongly pyrophoric.—A. G. G.

Improvements in the Production of Colouring Matters or Dyestuffs. C. D. Abel, London. From C. Roth, Berlin, Germany. Eng. Pat. 43*, Jan. 1, 1886. 6d.

THE emendation consists in the deletion of a misprint. (See this Journal, 1886, 662.)—T. L. B.

A Process for the Manufacture of Anthraquinone. J. Imray, London. From A. F. Poirrier and D. A. Rosenstiehl, Paris, France. Eng. Pat. 8431, June 11, 1887. 4d.

IT is proposed to oxidise anthracene in a solution of ferric sulphate in the following manner:—50 kilos. of pure anthracene are introduced into a close vessel lined with lead containing 2000 to 3000 litres of a solution of ferric sulphate of from 28—45° B. The mixture is heated for about 72 hours at 120—150°, while compressed air is injected to maintain the ferric sulphate at its full degree of oxidation, so that at the end of the operation ferric sulphate remains ready for further use, the anthracene and its associates being thus virtually oxidised by the injected air, the ferric sulphate serving merely as a carrier of oxygen.—D. B.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

The Chemistry of the Cotton Fibre. A paper read before the British Association, Manchester, 1887, by Dr. F. H. Bowman.

THE author proceeds to point out that our investigations in regard to the cotton fibre must embrace its mechanical and chemical structure. The microscope has enabled us to unfold the former, and the science of chemistry to reveal the latter. After speaking of the mechanical structure, he proceeds to point out how cotton, in common with all vegetable substances, has for its base the substance cellulose, to which the formula $C_6H_{10}O_5$ has been assigned. After referring to the results of the analysis of various kinds of commercial cotton, he proceeds to show that there is strong reason to suppose that the fibre, as met with under ordinary circumstances, is really composed of a series of bodies more or less corresponding to this empirical formula, but differing from it in regard to the arrangement of the hydrogen and oxygen atoms within the molecule, and thus constituting a series of celluloses which have a distinct differentiation rather than one single definite composition. He also points out how, having due regard to the atomicity of the constituents of the typical cellulose molecule, it is almost impossible to conceive that the hydrogen and oxygen are arranged in the molecule in the same atomic combination as water, although that body is always associated with the fibre to the extent of from 5 to 7 per cent., and hence concludes that this water of hydration is not an essential constituent of the cellulose molecule. After summing up our knowledge of the general chemical characters of the cotton cellulose, reference is made to the hydration and dehydration changes of which the cellulose molecule is capable, as exhibited in recent researches on this subject, specially with regard to those conducted by M. Witz, and Cross and Bevan, on the formation and reactions of oxy-cellulose. The behaviour of this body, as distinguished from cellulose and the reactions of the latter when treated with acids and alkalis, are then discussed, and the light which these throw on the probable constitution of commercial cotton is pointed out. Considerable stress is laid upon the fact that the cotton fibre always contains mineral matter to the amount of about 1 per cent. as an integral part of its structure, and the importance of this as a factor in the chemical reactions of the cotton fibre is insisted upon, and various researches which give evidence of this are mentioned. Finally, the author points out the invariable presence of oily, fatty, and waxy matter along with commercial cotton, and the necessity for due consideration of this fact in the methods employed in manipulating the fibre for technical purposes.

VI.—DYEING, CALICO PRINTING, PAPER STAINING AND BLEACHING.

Improvements in Bleaching and Apparatus therefor. J. H. Johnson, London. From E. Hermite, Paris. Eng. Pat. 13,929, Oct. 21, 1884 (Amended Specification). 11d.

IN this amended specification the inventor withdraws his claim to the use of chlorides of calcium and aluminium, and confines himself to the employment of magnesium chloride for bleaching purposes, and that *only when used in the particular manner described by him.* He also withdraws the claim for its employment as a bleach for paper pulp. For description of the apparatus employed, see this Journal, 1885, 673—674.—O. H.

An Improved Process of Colouring or Producing Coloured Designs upon Celluloid and Analogous Products. A. M. Clark, London. From La Compagnie Française du Celluloid, Paris, France. Eng. Pat. 9874, July 31, 1886. 6d.

THIS invention relates to a process for producing fast and washable coloured designs upon celluloid and other analogous products. By analogous products are understood plastic substances with a base of nitrocellulose, as, for example, the substances known in commerce under the names of fibrolithoid, lithoxyl, zylonite, ivorine, and pyroxylin. The process depends on the action of the three agents—heat, pressure, and steam. A vehicle or temporary support is used for receiving the coloured design, and transferring the same. Good results have been obtained by using the ordinary printed calicoes of commerce, which readily transfer their colours to celluloid. This process is distinct from those in use for colouring celluloid, where this operation is performed by incorporating colouring matter, or by immersion in an alcoholic solution or dye, or printing or painting by known means giving results destroyed by friction.
—H. A. R.

A New Process for Fixation of the Colouring Matters by Oxidation at High Temperature of the Textile Fibres. C. Collin and L. Benoist, Paris, France. Eng. Pat. 6737, May 7, 1887. 4d.

THE inventors claim "the application of heat for the oxidation or fixation on textile fibres—when taken out from cold or hot vats—of indigo or any other colouring matter, with which the fibres are impregnated." The fibres or tissues are drawn from the vat through squeezing rollers, and put on heated metal rollers, whereby the liquid remaining in them is converted into steam, and "a violent escape of vapour takes place, which, mixed with air, will oxidise or fix the colouring matter on the fibres or tissues."—T. L. B.

Improvements in Dyeing and Scouring Yarns. C. L. Klauder, Philadelphia, U.S.A. Eng. Pat. 8803, June 18, 1887. 8d.

THE invention consists in the use of a wooden or other suitable circular frame or wheel, to which two concentric sets of transverse bars are adapted to support the yarns. The skeins are stretched from one set of bars to the other, and caused to move by the rotation of the bars. On causing the wheel to turn round in a dye-vat the yarns are alternately immersed in the dyebath and exposed to the atmosphere. The claims are fully set forth under eighteen heads. Drawings are given.—T. L. B.

Improvements in the Manufacture of Bleaching Liquid. A. Brin, London, and L. Q. Brin, Paris. Eng. Pat. 11,891, Sept. 18, 1887. 4d.

AN aqueous solution of hydrochloric acid is charged with oxygen under pressure until it becomes saturated. The liquid thus formed exhibits marked bleaching properties, and is retained in closed vessels under pressure until required for use, when it may be employed for bleaching after the same manner as hydrogen peroxide.—S. H.

VII.—ACIDS, ALKALIS AND SALTS.

On the Manufacture of Salt near Middlesborough. Sir I. Lowthian Bell. Proc. Inst. Civ. Eng. 1886–87.

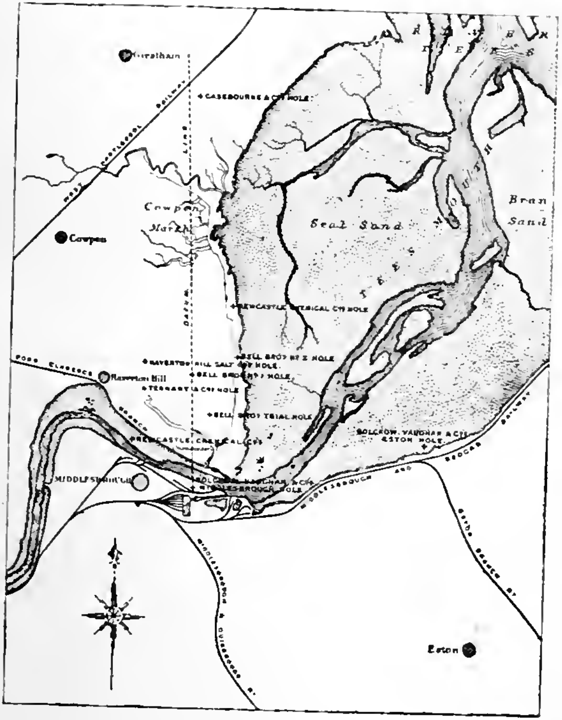
THE existence of salt beds at the mouth of the Tees was first ascertained in 1859, when Messrs. Bolckow, Vaughan & Co., sinking a deep well at Middlesborough in hopes of getting water for steam purposes, came, at a depth of 1200 feet, upon a bed of rock salt 100 feet thick. This point may be regarded as the south-east corner of a parallelogram, having a length of at least 3¼ miles, and a breadth of at least 2 miles, over the whole of which the salt deposits are known to lie, and each square mile of which probably contains 100,000,000 tons. The average thickness of the bed seems to be about 100 feet, and at the most northerly hole it is reached at a distance of 900 feet from the surface, or 300 feet less than in the original hole of Messrs. Bolckow, Vaughan & Co. The inference that the bed sinks as it goes southward is borne out by the depth at which salt has been found in the intermediate holes. The district (see map) belongs geologically to the new red sandstone formation. On the right bank of the river this rock underlies the Lower Lias beds (which here form the Cleveland Hills); on the left bank it gradually rises till it reaches the surface near Hartlepool. Nearly a dozen years after Messrs. Bolckow, Vaughan's discovery, the firm of Bell Bros. put down an exploring hole 1314 yards from that first sunk, in a direction a few degrees east of north. Here they practically demonstrated the possibility of raising the salt in the form of brine by a method which was then working at Nancy, in France, and which will presently be described. The boring was performed by the Diamond Rock Boring Company, and specimens of the strata penetrated were obtained in short lengths of a cylindrical form. The boring was continued for 150 feet below the salt bed, and satisfactory proof obtained of the existence of the magnesian limestone below the red sandstone. Considerable quantities of inflammable gases escaped from this bore-hole, but whether they indicated merely the presence of bituminous shales, or whether they originated in coal measures lying below the magnesian limestone, there was no means of deciding. Besides Messrs. Bolckow, Vaughan, and Bell Bros., the Newcastle Chemical Co., the Haverton Hill Salt Co., Messrs. Tennant & Co., and Messrs. Casebourne & Co., of Hartlepool, have salt wells at work. There are supposed to be altogether 20 holes, of which seven are lying idle from accidents of various kinds. The quantity of salt raised per week is estimated at from 2750 to 3000 tons. Brine when saturated contains 26½ per cent. of its weight of salt, and has a sp. gr. of 1·204. The principle adopted in working the wells is to make the fresh water running in lift the brine as far as the difference in sp. gr. will allow. From the above data it will be seen that a column of water 1200 feet high will support a column of brine 997 feet high—that is, will bring it within 203 feet of the surface. From here it is pumped by ordinary means. In practice the operation is performed as follows:—A hole of, say, 12 inches diameter at the surface is continued a certain distance down. Then a wrought-iron tube is dropped down the hole to support the sides. The boring is continued and new supporting or retaining tubes dropped down, one within the other, till the salt bed is penetrated, and the lowest length of tube fixed by entering a short distance into the limestone. That portion of the tube which passes through the salt is pierced with apertures. Within this tube is lowered a second one, having a diameter from two to four inches less than that of the outer tube, and provided with snore holes in its lower portion, Fresh water is fed down the annular space between the two tubes, the inner of which serves for raising the brine. The pump which completes the elevation is an ordinary one, provided with a bucket and clack, which are placed some feet below the point to which the brine is raised by the fresh water. The pump is provided at the surface with a plunger, which forces the brine into an air vessel for distributing purposes. It is obvious that the amount of salt raised will depend chiefly upon the surface exposed to the fresh water, and increases with the cavity formed by the dissolving action of the latter. This cavity takes the form of an inverted cone, which increases the danger of accidents ensuing from the falling in of the outlying rock. This danger is greater from the fact that in many places the covering bed of sandstone, some 40 feet thick, is interstratified with soft marls, which are affected by the inflowing water. In some places the rock salt contains a good deal of earthy matter, and this may account for the diminution of strong brine sometimes observed. Another cause of this is probably the presence of defects in the screwed joints of the pump, which allow fresh water from the annulus to mingle with the brine. In connection with this system of salt raising another question will probably soon arise—viz., with regard to the right of a man to raise salt produced under the lands demised to his neighbour. The brine as delivered from the wells is run first into settlers (where the earthy matter is deposited) and thence into evaporating pans 60 feet by 20 feet by 2 feet. The heat applied varies according to the purpose for which the salt is intended. Table salt is required of fine grain, and the evaporation is carried on much more rapidly than in the case of fishery salt, where large grains are preferred. For salt for soda works, which is intermediate, the pans are kept at about 196° F. The salt is fished out every other day. Messrs. Bell Bros. and Bolckow, Vaughan perform some of their evaporation with waste heat from the blast furnaces. The other firms use ordinary fires of small coal. The discovery of the South Durham Salt Beds has been a great boon to the soda makers on the Tyne. The old Leblanc process only lives by virtue of its rivals' inability to produce bleaching powder, and this reduction in the price of salt comes as a most welcome and timely aid towards keeping back the shadow on the dial yet a little longer.—A. R. D.

On the Formation of Saltpetre. A. Celli and F. Marino-Zuco. Chem. Zeit. **11**, 151.

THE author finds that traces of saltpetre are formed in pure sand wetted with ammonia salts, even when bacteria germs are carefully excluded; in the presence of bacteria a considerable quantity is produced. It is remarkable that, whereas many kinds of bacteria assist the formation of saltpetre, others—such as *Bacillus saprogenus aquatilus*, *Bacillus fluidificans*, *Micrococcus luteus*—not only form no nitrates, but even possess the power of decomposing them. This at least is the case in gelatine solutions; but when they are cultivated on potato-slices they assist the formation of the nitrate.
—D. E. J.

Deposition of well formed Crystals of Sulphur from a Solution of Calcium Polysulphide. E. Holderman. Chem. Zeit. **11**, 573.

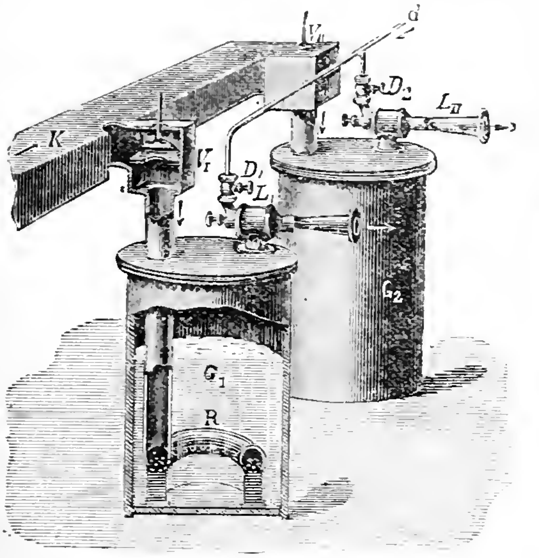
A SOLUTION of calcium polysulphide (obtained by boiling 1 part of CaO, 2 parts of S, and 20 parts of water), which had been kept in a stoppered bottle, occasionally opened, for seven years without apparent change, in the course of a few months deposited an abundant crop of well-formed crystals of sulphur. The solution was then found to contain calcium hyposulphite (CaS_2O_3), but no sulphide. The oxidation must have been produced by the air admitted when the bottle was opened.
—A. G. G.



concentrating a saturated alcoholic solution of [illegible]

Apparatus for Absorption of Sulphuric and Sulphurous Acids, and for the Manufacture of Copper Sulphate (Rossler's system). Chem. Zeit. **11**, 574.

THIS method is suitable for all cases in which, by solution of metals in hot sulphuric acid, gaseous mixtures are evolved containing SO_3 and SO_2 mixed with air. The lead-lined iron cylinder G_1 is half-filled with a saturated solution of $CuSO_4$, and precipitated copper is added. After opening the valve V_1, a stream of the mixed gases is drawn by means of the Körting's injector L_1, from the flue K, into the liquid through the perforated tube R. When all the copper has dissolved, the cylinder G_2 is set at work, whilst G_1 is allowed to cool and deposit the $CuSO_4$. By this treatment the whole of the SO_3 and the greater part of the SO_2 are removed from the gases.—A. G. G.



The Crystallisation of the Alkaline Hydrates from Alcoholic Solution. C. Göttig. J. Prakt. Chem. **35**, 1887, 560—566.

ON heating a fairly concentrated solution of caustic potash in 96·8 per cent. alcohol to 60—80°, very fine microscopic crystals separate on the solution cooling to 50°. Their composition is not constant. When dried they form a fine powder, which loses its water of crystallisation on heating, and absorbs carbonic acid readily from the air. When placed in contact with the water it moves about over the surface until dissolved similarly to the alkali metals. This behaviour is characteristic of most of the hydrates prepared by the author, and has not been observed in the case of the hydrates of the caustic alkalis already known. If a very concentrated solution of caustic potash, in hot 96·8 per cent. alcohol, be allowed to cool, large columnar shaped crystals having the composition $2KHO + 9H_2O$ separate. These melt at 40°, and lose the last traces of moisture only with great difficulty. The hydrate $2KHO + 5H_2O$ is obtained by concentrating a saturated alcoholic solution of potassium hydrate to about half its volume, when the boiling point of the solution rises to 95—116°. On allowing to cool fine needle-shaped crystals separate, which melt below 50°, and which on continued drying over sulphuric acid in vacuo lose $1\frac{1}{2}$ molecules of water—the hydrate $KHO + H_2O$ remaining. If the alcoholic solution be concentrated until the boiling point reaches 100°, only crystals having the approximate composition $2KHO + 3H_2O$ result. All these crystalline hydrates absorb carbonic acid from the air very readily, and the freshly prepared substances always contain varying amounts of CO_2. With the exception of the hydrate $2KHO + 3H_2O$ they all show the characteristic behaviour when placed upon water, as does the crystalline hydrate of sodium, $NaHO + 2H_2O$ (see this Journal, 1887, 508), also prepared by the author.—C. A. K.

Improvements in the Manufacture of Hydrates of Strontia and of Baryta. J. Mactear, London. Eng. Pat. 5170, April 14, 1886. 4d.

STRONTIUM (or barium) sulphate is mixed with a little more than its equivalent of sodium sulphate, and also with carbonaceous matter. The finely-divided mixture is heated in a furnace, until the sulphates are almost completely reduced to sulphides. The resulting mass is dissolved in hot water, when sodium sulphide at once acts on strontium sulphide, forming strontium hydrate and sodium hydrosulphide. The former is obtained by crystallisation, while the latter remains in the mother liquor, which is subsequently boiled down, and the residue used again in reducing another batch of strontium sulphate with carbonaceous matter. If, as in the usual process, solid strontium sulphide be treated with hot water, it is split up into hydrate and hydrosulphide, the hydrate crystallising out, while the hydrosulphide remains in the mother-liquor and forms a by-product of the process. It is now proposed to utilise this by-product by mixing it with a solution of sodium sulphide, obtaining as a result strontium hydrate and sodium hydrosulphide, which are separated by crystallisation.—S. H.

Improvements in Apparatus for effecting the Absorption of Gases by Liquids or Solids. E. Edwards, London. From G. Lunge, Zurich, and L. Rohrmann, Krauschwitz, Silesia. Eng. Pat. 10,037, August 5, 1886. 8d.

THE essential parts of this patent specification are contained in a communication to this Journal (see p. 584); also this Journal, 1887, 538.—S. H.

Improvements in the Manufacture of Sodium Sulphites. J. M. Collett, Gloucester. Eng. Pat. 11,518, Sept. 10, 1886. 4d.

DRY sodium hydrate is treated with sulphur dioxide until it is converted to sulphite or bisulphite.—S. H.

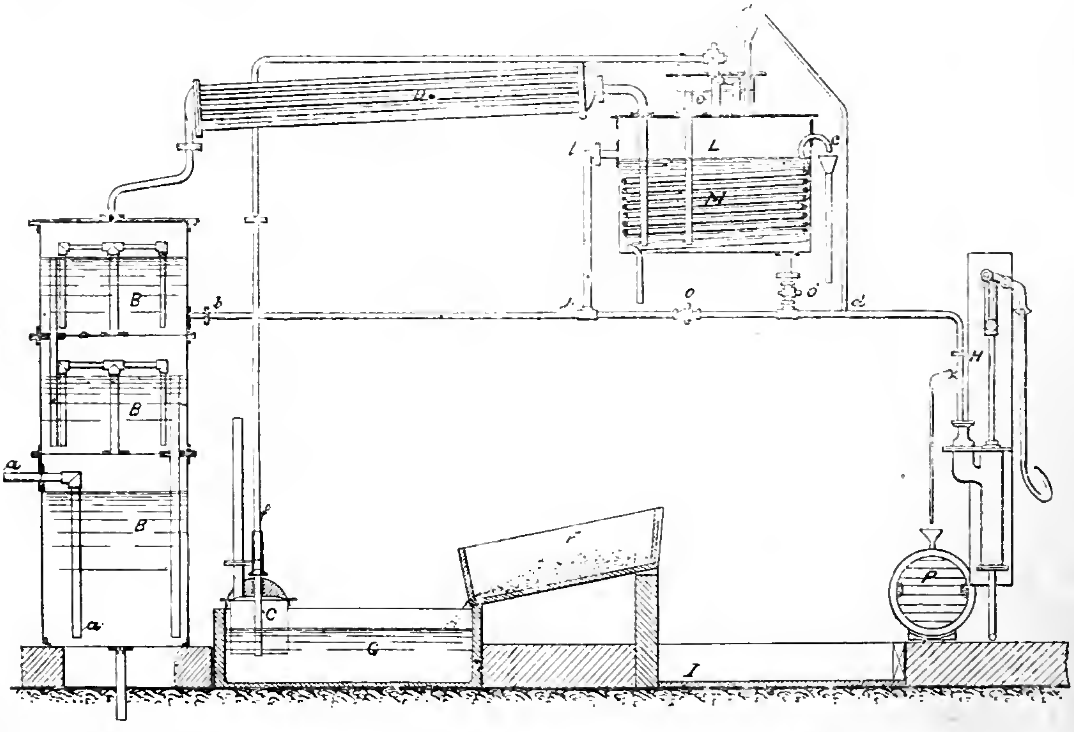
Improvements in the Treatment of Copper and Iron Pyrites for the Manufacture therefrom of Sulphuric Acid and Oxides of Copper and Iron, and in the Treatment of the said Oxides for the Production therefrom of Metallic Copper and the Higher Oxides of Iron. A. Brin, London, and L.Q. Brin, Paris, France. Eng. Pat. 12,070, Sept. 22, 1886. 8d.

THE pyrites is first mixed with fuel and ignited on a suitable hearth until the temperature is sufficient for the unaided combustion of the pyrites; air is then excluded, and a current of oxygen is introduced from beneath. The sulphur dioxide produced is drawn off by a steam jet, by which it is injected into a lead-lined chamber with water-cooled walls, provided with an inlet for a nitric acid spray, an escape pipe leading to condensers above, and a cock for drawing off the liquid products beneath, together with internal revolving beaters for the more complete mixture of the gases. The residue on the hearth in the case of copper pyrites is an oxide of copper which may be smelted for the metal; in the case of iron pyrites it is an oxide which may be submitted to the further action of oxygen for the production of pigments or other similar substances.—W. G. M.

Improvement in Apparatus for Distilling and Purifying Ammoniacal Liquids. L. A. Chevalet, Paris. Eng. Pat. 8819, July 6, 1886. 8d.

THE object of this invention is the production of a highly concentrated ammoniacal liquor, and this end is attained by condensing ammoniacal vapours freed from steam in ammoniacal liquor. The apparatus employed in this

process consists of a distilling chamber B, heated by steam and divided into three or four compartments, an air-cooler D and a condenser L. The ammoniacal liquid is pumped into the top of the distilling chamber B, and as it descends successively from one compartment to another it loses the volatile ammoniacal compounds until it reaches the last compartment of the still B, where it comes in contact with milk of lime, and is thus freed from the fixed ammoniacal salts. The vapours passing into the air-cooler become more concentrated inasmuch as the steam becomes partially condensed and returns to the still, while the ammonia proceeds to the closed reservoir L, which contains a cooling worm M. The reservoir L is two-thirds full of cold ammoniacal liquor, which absorbs the ammoniacal vapours bubbling through it: the worm A keeps the solution at a low temperature. The gases arising from L are first washed with ammoniacal liquor in the tank Q, and finally with sulphuric acid in the saturator G. If it be desired to manufacture ammonium sulphate, the liquor in L is allowed to become heated, when most of the ammonia will proceed to the tanks Q and G, which must be filled with sulphuric acid. By another modification this apparatus can produce solid ammonium carbonate. A tank is placed above L and connected with it by a wide pipe. A jet of cold water is directed against this upper tank, and the lower one L is allowed to heat slightly so as to distil ammonium carbonate. The latter condenses on the cold sides of the upper tank and forms a continually increasing crust. If the liquor obtained in the tank L is heated for a short time it gives off carbonic acid and sulphuretted hydrogen, while most of the ammonia remains in solution. Such a liquor is particularly suitable when cold for washing coal-gas and removing its carbonic acid and sulphuretted hydrogen.
—S. H.



Improvements in the Manufacture of Meta-stannic Acid, and in the Purification of Meta-stannic Acid. J. J. Hood and A.G. Salamon, London. Eng. Pat. 12,110, Sept. 23, 1886. 6d.

Metallic tin is treated with sulphuric acid, and the resulting mass, containing more or less stannous salt, oxidised with sodium nitrate. A large quantity of water is then added, to precipitate the meta-stannic acid, which, after being washed free from acid, and subsequently neutralised or rendered alkaline, is ready for use in the elimination of iron from aluminium sulphate or otherwise. The oxidation of the stannous salt may also be performed by ferric sulphate or manganese dioxide (Weldon mud). When industrially applied, the meta stannic acid gradually becomes so charged with iron as to interfere with the efficacy of its action, and the removal of the iron becomes imperative. To this end the stannic mud is boiled with sulphuric acid for a few minutes, a solution of stannous chloride added, in sufficient quantity to reduce ferric oxide to the ferrous state, and the latter is removed by washing. Any stannous chloride in excess is oxidised by bleaching powder solution. Organic matters are removed from the stannic mud by the combined action of sulphuric acid and an oxidising agent.—S. H.

Improvements in, or relating to, the Manufacture of Chlorate of Potash. J. W. Kynaston, Liverpool. Eng. Pat. 14,344, Nov. 6, 1886. 6d.

This invention has for its object the recovery of potassium chlorate and chloride from the mother-liquors, which are obtained as a waste product in the manufacture of potassium chlorate. For this purpose it is proposed to remove a large portion of the calcium chloride, which forms the principal constituent of the chlorate mother-liquors, by the addition of caustic lime. On heating, the latter combines with calcium chloride, forming calcium oxychloride, which crystallises out on cooling, and is a very stable compound when suspended in a solution of calcium chloride. Half of the latter is therefore only converted into oxychloride, while the other half remains in the mother liquors along with all the potassium chlorate and chloride. On evaporation these liquors yield crystals containing both potassium salts, which are separated in a well-known manner. The liquor drained off from these crystals is mixed with an equal bulk of fresh mother-liquor, and the treatment with lime repeated, as previously mentioned. The calcium oxychloride crystals are treated with boiling water, when the oxychloride is decomposed into calcium chloride and hydrate, which latter settles out. The superaatant liqnor is run away; the calcium hydrate washed with water is used again for the treatment of fresh mother-liquor.—S. H.

Improvements in the Production of Liquid or Compressed Chlorine. C. T. J. Vautin, St. Kilda, Victoria. Eng Pat. 8820, June 18, 1887. 4d.

CHLORINE GAS is collected in a receiver lined with a suitable material, which resists the action of the gas. When the receiver is full, it is connected with an air compressor, and air is forced in until the gas is compressed to any required degree or entirely liquefied. The liquefied gas may be distributed in suitably lined vessels for transport.—S. H.

Process and Apparatus for Automatically Mixing Liquids with Carbonic Acid. A. Brünler, Berlin, and C. G. Rommenhöller, Rotterdam. Eng. Pat. 9046, June 25, 1887. 6d.

THE object is attained by the utilisation of the power which is stored up in the compressed gas. The latter passes under great pressure through a jet injector, which aspirates the liquid to be impregnated with the gas, and both liquid and gas travel into a mixing tank, where a set of arms keeps up a continuous agitation. —S. H.

An Improved Process and Apparatus for the Production of Sulphuric Anhydride. E. Hänisch and M. Schröder, Neumühl-Hamborn, Germany. Eng. Pat. 9188, June 28, 1887. 6d.

THE object of this invention is to facilitate the combination of sulphurous acid and oxygen to form sulphuric anhydride. A mixture of the two gases in a certain fixed proportion is passed at a low, red heat, and under pressure, over asbestos, coated with spongy platinum, whereby a large surface and a lengthened duration of contact is ensured to the gases. The pressure also promotes chemical reaction by bringing nearer together the active gas molecules. A gas mixture consisting of 25% sulphurous and 75% air is most suitable for the process, and the mixing of the gases simultaneously with their compression is effected by a double cylinder compressor, the two cylinders of which have a cross sectional area in the proportion of 1 to 3. By these means the gas mixture will always have the most suitable composition, one cylinder pumping three times as much air as the other pumps sulphurous acid. The compressed gases mix in the conducting tube, whence they pass to the compressing vessel, and subsequently to the combining furnace. The latter is furnished with two wrought-iron pipes, heated to redness, and charged with platinised contact substance through which the mixed gases pass. Here the greater portion of the gases is converted into anhydride, whereas that which escapes passes into a tube beyond the furnace, through a valve and into a bent tube leading to condensing jars. To prevent deposition in these pipes they are surrounded with a steam-heated lead worm. Thus all this latter SO_3 is carried forward and condensed in the jars.—S. H.

IX.—BUILDING MATERIALS, CLAYS, MORTARS AND CEMENTS.

Improvements in the Manufacture of Artificial Elaterite or Elastic Bitumen to be employed in Road Making, Roof Surfacing, and other like Purposes and Uses. W. Brierley, Halifax. From F. Wallbrecht and H. Russe, Hanover, Germany. Eng. Pat. 7492, June 4, 1886. 6d.

"THE Elaterite is found in its natural state principally in regions of volcanic origin, and forms a soft and elastic bitumen (mineral caoutchouc), formed under the influence of a high or volcanic temperature from the liquid bitumen or naphtha." It is proposed to manufacture this substance artificially by mixing the liquid bitumens or naphthas with vegetable oils or fatty or sebacic acids of vegetable origin, and heating this mixture under pressure with sulphur, compounds of sulphur, nitric acid, or other oxidising agent. The elaterite prepared in this manner may then be mixed with asphaltic substances and powdered limestone, and the mixture heated and ground. This powder can be pressed and stamped very easily. It resists friction and atmospheric influences, and compares favourably with the best native asphalte.—D. B.

X.—METALLURGY, Etc.

Improvements in the Manufacture of German Silver. E. Cottam, Sutton. Eng. Pat. 8989, July 9, 1886. 6d.

THE patentee claims the use of siliceous copper, made by heating shot copper for from three to six hours to a temperature just short of fusion, with a mixture of equal parts of sand and charcoal. An alloy of equal quantities of copper and nickel and a similar alloy of copper and zinc (brass) are also prepared. The siliceous copper and the copper nickel, with copper, iron, cobalt oxide, and charcoal, are melted together, and then before pouring, brass and tin are added. The following percentage proportions are recommended :—Siliceous copper 18, copper-nickel 28½, copper 4¼, iron 2¾, brass 46, cobalt oxide ¼, tin ¼.—W. G. M.

An Improved Process and Apparatus for obtaining Spelter and Caustic Soda, Chloride of Lime, Chloride of Calcium, or other Products. P. Higgs, London. Eng. Pat. 9158, July 14, 1886. 8d.

THE zinc ore, rendered conducting by admixture with graphitic coke, serves as the anode, while plates of some conducting material form the cathode, and receive a deposit of metallic zinc. The electrolyte consists of a solution of chloride of magnesium or sodium chloride ; in the latter case the products consist of zinc, sodic hydrate, and chlorine. The chlorine enters at the bottom of a tower, from the top of which lime is falling in a state of fine powder ; by this means oxychloride of lime is formed, and from it chloride of calcium can be obtained by the application of heat.—B. T.

Improvements in Apparatus used for Coating Sheets of Iron and Steel and Articles of Iron and Steel with Zinc or Alloys of Zinc, or other Coating Metal or Alloy. R. Heathfield, Birmingham. Eng. Pat. 10,089, Aug 6, 1886. 6d.

As the plate leaves the bath of zinc it is passed between one or more pairs of flat or slightly curved brushes, pressed with an even pressure against it, and having, if desired, a reciprocating motion.—W. G. M.

Improvements in Furnaces for Chlorinating Ores and in the Process connected therewith. J. E. Baugh and C. Hinksman, London. Eng. Pat. 11,776, Sept. 16, 1886. 8d.

THE furnace is of a kiln form, and made of such a size that 20 to 100 tons may be treated at a time. After preparing a simple foundation and rearing the outside walls for any required internal size in length, width, or height, a number of small arches is built across, leaving sufficient space beneath for firing ; these arches are crossed every 30in. by 2in. openings. Pyrites in lumps is laid over the 2in. openings, forming a column of about 10in. in width and 1ft. in height the whole length of the furnace, which, for operating on 20 tons, is about 12ft. square within and 14ft. high. Pulverised calcined ore mixed with salt in the ordinary manner is now placed between the rock pyrites on the arches. The columns of rock pyrites, first broken to any required lump size, are again reared a foot higher, when more prepared fine ore for chlorination is added as before, and this repeated until the furnace is charged. After the use of a little fuel to kindle the sulphur in the raw pyrites, the furnace may be left undisturbed, without cost of material or labour of any kind, until the charge is calcined and has cooled down ready to be withdrawn. "The rock pyrites is then passed to the crusher for pulverisation, to be afterwards mixed with salt or any other chlorinising agent, when the already chlorinised ore will be found completely prepared for any of the humid process." A chimney, 8–10ft. in height, built on the top of the kiln or furnace, will be sufficient where no objection is made to noxious vapours. When gold is contained in the ore in the form of arsenide or sulphide, it is found to be converted into chloride, along with the silver and copper present. A large percentage of the metallic gold, if not the whole of it, is also converted into chloride. When, however, it is found by assay that metallic gold is still present, chlorine generated in the ordinary manner is passed through the ore after the latter has been leached by the aid of boiling brine. The gold, silver, and copper are precipitated together by means of metallic iron.—J. T.

Improvements in obtaining Gold, Silver, and other Noble Metals from Ores or other Compounds. J. S. MacArthur, Pollokshields; and R. W. Forrest, W. Forrest, and G. Morton, Glasgow. Eng. Pat. 11,817, Sept. 17, 1886. 6d.

The crushed ore is submitted, in suitable tanks, to the action of a solution, saturated with chlorine, bromine, or iodine, of a substance which, unacted upon by halogens, is itself incapable of precipitating gold from solution, but which will prevent the solution of base metals. Borax, sodium hypochlorite, and many other bodies are specified as suitable for the purpose. The gold and silver are precipitated from the decanted liquors, into which they have dissolved as haloid salts, and the halogen is recovered for further use.—W. G. M.

Purification of Iron Ore and Fluid Iron Metal, and Apparatus therefor. B. H. Thwaite, Liverpool. Eng. Pat. 11,972, Sept. 21, 1886. 8d.

Molten pig iron in a falling stream is subjected to the action of one or more jets of air, by which it is partially oxidised, and so purified. Several more or less elaborate pieces of apparatus are shown with this object in view. Iron ores are purified by being passed through a "calcining revolving cylinder," having its axis somewhat inclined to the horizontal. In this cylinder the ore is subjected to reducing gases, and drops out of the lower end "in the form of reduced spongy metal into a fine B.W.G. riddle, by which the metal and its impurities are properly shaken, and the finer particles of the metal and earthy and other impurities fall into a trough in which there revolves a magnetised Archimedean screw, to which the finer metal particles become attached by magnetic attraction; the earthy particles fall through the perforations." The present invention principally consists in improvements on a prior invention (Eng. Pat. 11,402, Sept. 25, 1885; this Journal, 1885, 615; 1886, 461).

Improvements in Producing Silicous Copper and utilising the same for Metallurgical Purposes. C. Heusler, Bonn, Prussia. Eng. Pat. 12,720, Oct. 6, 1886. 6d.

The inventor fuses copper with siliceous pig iron, removes the two upper layers which form on allowing the molten mass to stand, and utilises the copper silicide left at the bottom of the vessel for refining purposes or for producing silicon alloys.—O. H.

Improvements in obtaining Zinc from its Blende or Sulphide. R. Hannan and M. Milburn, Glasgow. Eng. Pat. 5029, April 5, 1887. 6d.

An upright retort, with bell and cone hopper above, with tap holes beneath, and condensing arrangement suitably placed, is used in preference. The charge consists of zinc sulphides, mixed with an equivalent quantity of metallic (malleable) iron scrap, or with iron oxide and carbon, and with the necessary fluxes. This is fed in through the hopper, the liberated zinc is collected in the condenser, and the resulting iron sulphide and slag are tapped off at intervals. The arrangement is thus continuous. Copper, if present, forms a regulus, and may be extracted by wet processes; lead, silver, and gold sink to the bottom in the metallic condition.

—W. G. M.

Process and Apparatus for Extracting the Tin from Tinned Iron Cuttings or Scrap, and from Metal covered with Tin. S. T. Montagne, Nantes, France. Eng. Pat. 6370, May 2, 1887. 6d.

This is an improvement on Eng. Pat. 2865, of 1886 (this Journal, 1887, 294). The scrap is packed loosely in a number of chambers arranged in series, so that a current of hydrochloric acid gas introduced into any one flows successively through each of the others, the waste gases escaping finally into a flue. When the scrap in the first chamber is sufficiently treated, it is washed with water spray and afterwards steam; the tin liquors are then drawn off into a reservoir, the charge withdrawn, and a fresh quantity introduced. This chamber is then made the last of the series, that which was formerly second now receiving the fresh acid gas, and so on.—W. G. M.

A Process of obtaining Aluminium from its Ores or from Aluminiferous Earths, or Earths containing Alumina, and of combining Aluminium with other Metals. W. A. Baldwin, Chicago, U.S.A. Eng. Pat. 7198, May 17, 1887. 6d.

A mixture of 4 parts of clay, 1 part of charcoal, and 3 parts of sodium chloride fused in a suitable pot yields a light alloy of aluminium and sodium, to be skimmed off and remelted in a fresh crucible under a cover of sodium or sodium chloride; when melted, the contents of the second vessel are poured into a heated mould, wherein the heavier aluminium subsides. Or by introducing other metals, useful alloys are formed without fusion, by the simple permeation of the alloying metal by the aluminium.—W. G. M.

Improvements in Treatment of Ores. J. Belon, Paris, France. Eng. Pat. 7519, May 25, 1887. 8d.

It is proposed to treat ores in general, and more especially pyritous, auriferous, and argentiferous ores, with pure hydrogen or gaseous hydrocarbons, for the purpose of extracting their metals, instead of employing carbon and the oxygen of the air. In some cases, retorts may be employed, which are heated externally and are charged with the ore and reducing gas or gases. In other cases, blast furnaces may be employed, into which the reducing gases are blown, and also the necessary amount of atmospheric air or of pure oxygen to heat the charge. No claim is made to any of the apparatus described.—J. T.

An Improved Method of and Apparatus for Reducing Zinc Ores and Collecting the Metallic Zinc therefrom. E. Walsh, St. Louis, U.S.A. Eng. Pat. 8599, June 15, 1887. 8d.

Zinc oxide reduces at 1300° F., and the metal volatilises at about 100° F. lower than that temperature. At 1300° F., carbon is unaffected by the action of carbonic acid, and the carbonic acid generated from the reduction of the zinc oxide is carried off with the zinc vapour at that temperature. Carbonic acid at a temperature below 1300° F., when mixed with zinc vapour, oxidises the latter; but when zinc vapour and carbonic acid, both at a temperature of 1400–1500° F., are allowed to pass through carbonaceous matter at the same temperature, the carbonic acid is immediately converted into carbonic oxide, and the zinc vapour remains unoxidised. Applying these principles, it is proposed to reduce zinc oxide in a closed top cupola. The cupola is charged with a mixture of fuel and zinc oxide, by means of a hopper which descends below the level at which the surface of the fuel is maintained by means of two more hoppers, through which fuel alone is charged. Care is taken that the ore hopper descends to a point in the furnace at which the temperature is 1500° F., or slightly higher. The hoppers have each a movable cover and a conical valve to prevent escape of gases during charging. The zinc vapour and products of combustion are taken off above the fuel to a condenser, consisting of two horizontal iron pipes placed parallel to each other and connected together by a series of U-shaped pipes placed vertically above them; the whole being heated to a temperature of 780—1200° F., so that the zinc is collected and maintained in a liquid state. The waste furnace gases are either passed into heating flues surrounding the condenser, or are otherwise utilised. In a modified form of the cupola, one charging hopper only is used, which does not pass below the level of the fuel, through which both ore and fuel are charged; and the reduced zinc, together with the products of combustion, are drawn off to the condenser from a point below the surface of the fuel at which the temperature exceeds 1400° F.—J. T.

XII.—PAINTS, VARNISHES AND RESINS.

Improvements in the Manufacture of White Pigment. F. M. Lyte, Putney. Eng. Pat. 10,298, Aug. 11, 1886. 6d.

The covering power of insoluble or sparingly soluble lead-salts (*e.g.*, carbonate, sulphate, chloride and phosphate) depends in part on the degree of their basicity. The patentee prepares these basic salts by digesting insoluble or difficultly soluble normal or partly basic lead-salts with solutions of soluble basic lead-salts, such as basic lead-acetate.—F. W. T. K.

Improvements in the Preparation of Colours for Artistic Purposes. Alexander M'Lean, Brockley, and Robert Smith, London. Eng. Pat. 11,493, Sept. 9, 1886. 6d.

According to the patentees, the bleaching of aniline colours is due to oxidation. By the employment, however, of materials containing little or no oxygen (*e.g.*, fusel oil, benzene, pitch, resins, etc.), they prepare coloured varnishes with aniline colours, in which the latter remain perfectly unaffected by the strongest light. They have obtained good results with the following mixture, to which the requisite quantity of "aniline crystals" is added: Fusel oil, 37·02; alcohol, 24·68; Swedish pitch, asphaltum or tar, 10·00; resin or gum (gum Dammar), 28·30.—F. W. T. K.

Improvements in Preservative Coatings for Ships' Bottoms. J. B. Hannay, Loch Long. Eng. Pat. 12,499, Oct. 2, 1886. 6d.

The coating consists of a mixture of powdered zinc, mercuric and other metallic oxides and a suitable coating medium. According to the patentee, the use of mercuric oxide increases the efficiency of the coating as a preservative against shellfish, on account of the formation of metallic mercury through the reduction of the oxide by the zinc; and also the anti-corrosive action is due to the zinc in the coating placing the metal of the ships' bottoms in an electro-negative state.—F. W. T. K.

A Process of and Apparatus for obtaining Purified Carbon from Soot and other similar Carbonaceous Products of Combustion. R. Pringle, Blackheath. Eng. Pat. 11,684, Sept. 14, 1886. 8d.

The soot, etc., is worked into a thin paste, strained to remove coarser particles, and then passed down a tube into a vessel almost full of water. The mixture enters the lower vessel (under a pressure due to a head of ten feet) by a nozzle or rose fixed at the bottom of the vessel and directed upwards. Four inches above the nozzle is fixed a horizontal plate, against which the jet of mixed soot and water strikes. As soon as the current is thus arrested, the carbonaceous matter separates from the accompanying impurities, the latter sinking to the bottom, the former rising to the surface of the liquid in the vessel, where it is skimmed off. To prevent the carbon being carried away by the overflow water, a dip curtain is placed in front of the outlet at the top, and the carbon is held back whilst the water flows off. The process can thus be worked continuously.

—F. W. T. K.

XIII.—TANNING, LEATHER, GLUE AND SIZE.

An Improved Method of making Leather and other Materials Flexible to any Degree, and of Waterproofing the same. T. Laycock, Northampton. Eng. Pat. 9613, July 26, 1886. 4d.

The patentee employs wax of various kinds, such as paraffin, bees', common, or earth wax alone or mixed with "petroleum jelly," and drying oils. The ingredients are heated in a suitable vessel to about 200° F. and the leather is soaked in the melted wax. The leather when impregnated is placed in a drying chamber. If flexibility is not required, paraffin wax alone, or 9 parts of paraffin wax with 1 part of common earth wax, are used. If greater flexibility is required, 4 parts of paraffin to 1 part of common earth wax, or 1 part of petroleum jelly are used.—B. H.

A Process for clearing Hides, Skins, Hair, Wool, or Fur from Lime. E. P. Nesbit, Wandsworth. Eng. Pat. 12,681, Oct. 5, 1886. 4d.

In the inventor's specification, No. 7744, of 1886 (this Journal, 1887, 513), was described a method of removing lime from hides or skins, preparatory to tanning, by subjecting them, while in water, to the action of carbonic acid gas. The present invention consists in the application of this method to the removal of lime from hides, or scraps of these, such as are used for the manufacture of size or glue, and also from hair, wool, or fur which has undergone lime treatment.—B. H.

XIV.—AGRICULTURE, MANURES, Etc.

On the Probable Part played by Magnesia and other Elements in resisting Phylloxera in French and American Vines. A. C. Dejardin. Compt. Rend. **104**, 1249.

The author draws the following conclusions from his investigations:—(1) That in places where French vines offer the greatest resistance to phylloxera, and American vines flourish the best, magnesia plays an important part as a constituent of the soil. (2) The percentage of magnesia in the ash of American vines is somewhat greater than in that of the Vinifera. (3) In rare cases where the resistance of French vines against phylloxera has been increased, a greater amount of magnesia has always been taken up by the plants. Nitrogen, iron, manganese, and especially phosphoric acid, also increase the resistance offered to phylloxera; and the author suggests the addition of ammonium magnesium phosphate to manure, and the use of manures containing nitrogen, iron, manganese, phosphoric acid, and magnesia, as a preventive against this vine pest.—C. A. K.

Are Nitrates formed in the Organism of Higher Plants? E. Schulze. Ber. **20**, 1500—1504.

Kreusler (*Ber.* **20**, 999) has shown that young potato plants, sown in sawdust and watered with a tertiliser free from nitrogen, contain no nitrates. On the other hand the author had previously found (*J. Prakt. Chem.* [2], **32**, 451) that the young shoots of lupines and pumpkins grown in pure sand, and watered with distilled water only, contain considerable quantities of nitrates. This at first sight seems to be evidence in favour of the occurrence of nitrate-formation within the organism as assumed by Berthelot and André. When, however, the seeds are sown upon paraffined gauze lying on the surface of distilled water, no nitrates could be detected. Upon further investigation the author came to the conclusion that the nitrates contained in the shoots when grown in sand are absorbed from the sand, where they are produced, by oxidation of nitrogenous matter given off by the plants.—A. G. G.

The Origin of Methyl Alcohol in Plants. H. Gutzeit.

Chem. Zeit. **11**, 663.

According to Thoms (*Pharm. Centralhalle*, 28, 231) the presence of methyl alcohol in plants is due to the decomposition of a salt of methylamine by means of alkali. This, the author disputes, since in the first place amines cannot be thus decomposed by alkalis, and further, were such a decomposition possible in plants, then one would, in all probability, be able to detect methylamine wherever methyl alcohol is found, and this is contrary to the experiments of Moslinger Maquenne and the author, ammonia being present in quantity, but only traces of the compound ammonias. Thoms found the reverse the case with *Acorus calamus*, the chloride of the volatile base contained in the root consisting essentially of methylamine hydrochloride, and containing only traces of ammonium chloride. Since, however, the former was dissolved out by means of a mixture of absolute alcohol and absolute ether, in which ammonium chloride is not altogether insoluble, and further, because the chlorine determination was effected by igniting the dried chloride with calcium carbonate, and then precipitating with silver solution after exhausting the ignited mass with nitric acid, the author considers the results, which are contrary to his own, to be incorrect.—C. A. K.

XV.—SUGAR, GUMS, STARCHES, Etc.

A New Galactan and some Properties of Galactose.

E. O. von Lippmann. Ber. **20**, 1001—1008.

The author has succeeded in isolating a new substance, which he calls γ-*Galactan*, from the liquors from the lime mud forming the end product in the purification of sugar. It closely resembles dextran and levulan in appearance, and when pure consists of a white amorphous substance, which, in the hydrated state, is easily soluble in hot and cold water; in the anhydrous state it is soluble in hot, but only very slowly in cold water: the hot solution does not gelatinise on cooling, resembling, in this respect, dextran, and differing from levulan. The substance is insoluble in alcohol. It has the composition $C_6H_{10}O_5$, and has $\alpha_D = +238°$, a number more than three times as high as that for cane sugar; it does not reduce Fehling's solution, and gives mucic acid on oxidation with nitric acid. When inverted with dilute sulphuric acid, it is completely converted into galactose. The substance appears to belong to the series of bodies lately found in the vegetable kingdom by the author and others, which yield galactose on invertion. The galactose from the above γ-galactan was obtained in crystalline masses, which melted at 166—168°; the optical activity was $\alpha_D = +81{\cdot}5$; when oxidised, it yielded 77 per cent. of mucic acid; it also combined with phenylhydrazine.

In conclusion the author discusses the fermentability or otherwise of galactose, and considers that further experiments are necessary, in order to explain the present discordant views.—G. H. M.

On Progress in the Manufacture of Starch, Dextrose and Glucose. Prof. L. V. Wagner. Dingl. Polyt. J. **264**, 174—179.

Leon Cuisinier, in Paris, has patented a process for the saccharification of starchy substances by means of a malt which has been allowed to germinate for from 7 to 10 days. The raw materials must be made perfectly neutral (acid free) by treatment with a 1 per cent. soda, or ½ per cent. sulphuric acid solution, as the case may be. The grain after two or three days' soaking in tepid water, should contain not more than 40—45 per cent. water, and is then to be ground. The moist materials are made into a paste with an equal weight of water, and from 2½ to 5 per cent. of malt is well kneaded into it, during an hour. The liquefaction of this paste takes place in an upright cylinder, surrounded by a water-bath which is maintained at 75° C., and provided with powerful stirring gear. The mash thus obtained is then heated in a steam jacket, under a pressure of one atmosphere for about an hour, then cooled to 70° and treated with 1 to 2 per cent. of malt infusion. After two hours the solution is put through a filter-press, cooled to 50°, and treated with 15 to 20 per cent. of malt infusion, which is added in 5 per cent. lots every two hours. When thoroughly saccharified, the solution is heated again, filtered and evaporated to 40° Bé., and sold as concentrated beer wort.

Joseph Franklin Gent, of Columbus, Ind., U.S.A., frees maize from the germs and husks by steaming at 160° in a special apparatus, for not longer than 1 minute, and subsequently crushing and sifting the grain. The product thus obtained is then again steamed, pressed into thin cakes, and brought into the market under the name of "Cercaline."

Messrs. Vierneisel, K. Trobach, and Alfred Cards recommend the following treatment of potatoes for the purpose of dextrose manufacture, avoiding thereby the necessity for the separation of the starch from the pulp, which always retains a considerable percentage, and utilising the roots at the period when they contain most starch—viz., at their harvest time; thus avoiding also the loss of starch which stored potatoes always undergo. The potatoes are washed and ground, the paste put through a filter-press, in which the cakes are well washed with a solution of calcium bisulphite, to prevent any fermentation, and then either dried for storing or worked up forthwith. The cakes made into a suitable paste with water, are saccharified under pressure, by acid; the acid sugar solution is thereupon neutralised with calcic sulphite and chalk, put through a filter-press, evaporated to 30° B., again filter-pressed, and finally concentrated at 100° down to 35° B., for crystallisation. The resulting sugar when separated from the molasses is ready for the usual processes of recrystallisation. Thadeus v. Korvins-Sákovicz and David Rosenblum, of Warsaw, produce crystallised grape sugar, from all sorts of starch, by boiling 10 per cent. solutions of starch with certain quantities of sulphuric anhydride, which quantities vary from 4·9 per cent. with 11 hours' boiling when working in open vessels, to 0·15 per cent. when the operation is conducted in a closed vessel, and under a pressure of four atmospheres. The boiling in the first case lasts eleven hours, in the latter only four hours. Instead of using charcoal to decolourise the neutral sugar solution, it is cooled to 45° and about 0·2 per cent. (on the weight of starch) of permanganate of potash added, whereby a brown precipitate is formed, the solution after passing through the filter-press being perfectly colourless. The crystallisation is performed under vacuum, but the crystals cannot be readily freed from the mother-liquor.

Alf. Seyberlich, of Riga, and Alex. Trampedach, of Mitau, transform starch into sugar by the action of dilute nitric acid. The starch is made into a milk with water, and run into a dilute boiling solution of nitric acid, and boiled until 10 drops of the solution added to 200cc. 96 per cent. alcohol no longer produce any turbidity. The proportions used are 1000 starch, 5 nitric acid, and 2000 to 3000 water. They then recommend that the solution be made distinctly alkaline by the addition of sodium or potassium carbonate, thereupon evaporated in the vacuum apparatus to 35—36° Bé., and allowed to crystallise. The crystals thus obtained are well developed, and easily separated from the mother-liquor.—T. L. B.

Manufacture of Carbonic Acid in Sugar Works.

Dingl. Polyt. J. **264**, 191—192.

Nearly half the Russian sugar-works obtain their carbonic acid from the flue gases, which, however, usually contain only 8 to 12 per cent. Jelinck obtains a richer gas by utilising the gases of only one boiler, the damper being kept as closely shut down as possible, and the gases removed by a pump the supply pipe to which is adapted in *front* of the damper. Under most favourable conditions 18 per cent. of carbonic acid in the gas are obtained, sufficient to work up from 160,000 to 170,000 kilos. roots.

P. Ehrhardt describes in *Deutschen Zuckerindustrie*, 1887, 78, a continuous apparatus, consisting of a blast furnace, as is used in French factories, into which limestone and fuel are together thrown, in the proportion of 7 parts limestone to 1 of coke. The heat is very thoroughly used up, and the gases are drawn off at a lower temperature, and contain on an average 30 per cent. CO_2. Another apparatus consists of a so-called step-kiln, in which the warming, burning, and cooling chambers are kept distinct, but owing to the fact that the material has to pass through two elbow-shaped and one level channel, it will probably be found difficult to keep in regular work.—T. L. B.

The Sweetness of Grape Sugar. Chem. Zeit. **11**, 139.

According to numerous experiments made with different persons, Herzfeld concludes that 153 parts of glucose are equivalent to 100 parts of cane sugar—*i.e.*, that the relative sweetness of these two kinds of sugar is approximately in the proportion of $\frac{2}{3}$: 1.—D. E. J.

Errata.—On p. 553, second column, line 2 from bottom, for "Madgeburg," *read* "Magdeburg." On same page and column, line 25 from bottom, *for* "acetic acid," *read* "acetic and lactic acids."

XVI.—BREWING, WINES, SPIRITS, Etc.

The Influence of the Mineral Constituents of Water upon the Composition of Worts. E. R. Moritz. Dingl. Polyt. J. **264**, 338—339.

The author's results are given in the following table, from which it will be seen that common salt added to the mash liquor increased the yield of maltose and dextrose by 9 per cent. He therefore recommends the addition of 20 to 35grms. of salt per hectolitre of water before mashing:—

Mash Water.	Maltose per cent.	Dextrose per cent.	Total per cent.	Colour of the Wort.
1. Distilled water	18·96	18·01	66·97	Pale.
2. New river water..........	48·96	18·01	66·97	,,
Distilled water containing				
3. 50·37 salt per hectolitre ..	50·18	25·77	75·97	Extremely pale.
4. 34·70 calcium chloride	46·68	15·10	61·78	Very pale.
5. 10·10 gypsum	47·79	17·34	65·13	,,
6. 36·34 magnesium sulphate	47·79	17·31	65·13	,,
7. 16·07 sodium sulphate	48·96	18·01	66·97	Rather darker,
8. 11·80 sodium nitrate	48·96	18·01	66·97	,,
9. 11·27 sodium carbonate ..	42·71	20·45	63·16	Dark.
10. Burtonised water	49·57	15·66	65·23	Very pale.

—T. L. B.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(*A*) CHEMISTRY OF FOODS.

The Relation of the Yield of Butter to the Acidity of the Cream. J. Sebelien. Chem. Zeit. **11**, 133.

From a series of experiments made, the greater the acidity of the cream used, the greater the yield of butter appears to be. The amount of fat contained in butter milk decreases, as the degree of acidity of the cream increases up to an acidity equal to 40cc. decinormal soda, when the decrease ceases. In some experiments the fat seemed to increase above this limit. The author determines the degree of acidity of the cream by titrating 50cc. with decinormal caustic soda solution until a drop of an alcoholic solution of phenolphthaleïn acquires a red tint as it spreads over the surface of the cream. The time necessary for churning increases regularly with an increase in the acidity of the cream.—C. A. K.

Examination of Butter with the Margarimeter. F. Benecke. Zeits. f. Nahrungsmittel-Untersuch. u. Hygiene, 1887, 87.

The application of the margarimeter rests on the supposition that butter has a higher specific gravity at 100 than all other animal and vegetable fats (this Journal, 1887, 447). A specific gravity of 0·8650—0·8670 at 100° is taken as a sign of the purity of butter, but the author has found that the specific gravity of ground-nut oil is 0·8630, that of sesame oil 0·8675, and that of poppy seed oil 0·8710, all taken at 100°. Still the margarimeter is of use as a preliminary test, the specific gravity of four adulterated samples of butter examined being from 0·8610 to 0·8625.—C. A. K.

Variations in the Amount of Phosphoric Acid contained in Milk. A. Andouard. Compt. Rend. **104**, 1298.

The author draws the following conclusions from his results:—1. The phosphoric acid in milk decreases from the beginning to the end of lactation, while the amount of butter, and especially of sugar, is also decreased during the same period. 2. With two of four cows experimented on the quantity of caseïn increased: with the other two it decreased. 3. The increase of solids in milk during lactation is not constant. 4. The age of cows appears to influence the quantity of milk given, the youngest giving the least. The nutritive power of the food affects both the quality and the quantity of the milk. 6. In opposition to Kröner's conclusion, the author states that green fodder is better for cows than dry fodder. Cabbages and leguminous plants are the best green fodder, and then in order of merit potatoes, beetroot and maize. 7. Individuality appears the chief factor in modifying the quantity and composition of the milk.—C. A. K.

(*B*) SANITARY CHEMISTRY.

Examination of Effluent Water. H. Schreib. Rep. Anal. Chem. **7**, 271—275.

The author has endeavoured to account for the remarkable fact that effluent water often contains more organic matter in solution after than previous to being purified. To a certain extent this may be traced to the lime which has been added, and which renders soluble certain bodies previously suspended in the water. But this cannot be the only cause. Attention is particularly drawn to the fact that waste water which has not been purified decomposes very rapidly, which entails loss of organic matter, whereas lime, etc., preserves the water by stopping the fermentation. Effluent water containing large quantities of carbo-hydrates is particularly liable to decomposition.—A. R.

Composition of the Water of the River Bode as Influenced by Drainage from the Potash Works, "Douglashall." H. Focke. Rep. Anal. Chem. **7**, 287.

COMPOSITION.

	Previous to entrance of Drainage.		After entrance of Drainage.
Dry residue (120°)	0·390	....	0·752
Organic substances (by ignition)	0·027	....	0·152
Chlorine	0·049	....	0·161
Sulphuric anhydride	0·042	....	0·132
Silica	0·019	....	0·014
Ferric oxide and alumina	0·004	....	0·002
Lime	0·092	....	0·130
Magnesia	0·017	....	0·058
Potassium oxide	0·007	....	0·015
Sodium oxide	0·043	....	0·106

—A. R.

On Ptomaines from Pure Cultures of Vibrio Proteus. O. Boeklisch. Ber. **20**, 1441—1446.

It has been repeatedly observed that animals injected with the vibrio proteus of Finkler and Prior (which occurs normally in the intestinal canal), often exhibit pathological symptoms which sometimes end in death. In order to determine whether this microbe produces a specific poison by its action upon proteids, the author has submitted sterilised beef broth to the action of pure cultivations, at a temperature of 37° to 38° for several weeks. The only bases produced were ammonia and the non-poisonous cadaverine (pentamethylenediamine), together with traces of indole. As it appeared likely that the pathological appearances observed in animals might have been due to the impure cultivations of the vibrio, the experiments were repeated with the addition of certain putrefactive bacteria. It was now found that the action of the vibrio was entirely altered, the products containing, in place of the innocuous cadaverine, the highly poisonous methylguanidine.—A. G. G.

XVIII.—ELECTRO-CHEMISTRY.

Note on a New Class of Voltaic Combinations in which Oxidisable Metals are replaced by alterable Solutions. C. R. Alder Wright and C. Thompson. J. Chem. Soc., 1887, 672—676.

The authors find that voltaic combinations can be obtained by substituting for oxidisable metals plates of platinum or other incorrodible material immersed in liquids capable of taking up oxygen or chlorine, and opposed to similar plates immersed in fluids capable of yielding up oxygen or chlorine, the two plates being connected by a siphon or a wick, or arranged as in a gravity cell. As an illustration, a solution of sodium sulphite is opposed to potassium permanganate, the former being oxidised to sulphate while the latter is reduced.—O. H.

Improvements in the Construction of Secondary Batteries. J. S. Sellon, London. Eng. Pat. 5631, Dec. 23, 1881. 4d. (Third Edition.)

Plates or supports, composed of materials such as carbon or platinum, not readily subject to oxidation or other destructive action, are made use of, and may be made of a cellular, corrugated or fluted shape: or a compound plate composed of two outer non-metallic plates, with an intervening plate of platinum, may be utilised. —B. T.

New or Improved Treatment or Manufacture of Materials for Use as the Incandescing Medium or Luminant of Electric Lamps, or for other Purposes. T. Mace, New York, U.S.A. From the Vitrite and Luminoid Co., New York, U.S.A. Eng. Pat. 9696, July 27, 1886. 6d.

This treatment, as applied to carbon filaments, for example, is as follows:—The filament is dipped in a solution of an organic salt of aluminium (such as the methylate or ethylate), after which an electric current is passed through it in the absence of oxygen. The decomposition of the salt thus effected causes a deposit of carbon and alumina to form upon the filament, which confers upon it a high degree of strength and elasticity, and enables it subsequently to resist disintegration by the electric current.—A. R. D.

Improvements in Secondary Batteries. T. J. Jones and W. H. Tasker, London. Eng. Pat. 11,101, Aug. 31, 1886. 8d.

A thin sheet of lead is perforated with oblong holes, surrounded by two thin sheets of celluloid and corrugated or crimped by suitable means, the bends being parallel to the intervening strips of lead. The lead strips are thus separated by distances equal to the double thickness of celluloid, and these spaces are filled with a paste formed of lead monoxide and ammonium sulphate solution. Several modifications of this method are described.—B. T.

An Improved Arrangement of Electric Battery with means for regulating the amount of Submersion or Withdrawal of the Positive Plates. H. Carter, London. Eng. Pat. 11,239, Sept. 3, 1886. 8d.

The carbons are attached to the sides of very elongated cells, but do not extend to the bottom. The zincs are carried on a suitable platform with sliding bars, which can be adjusted by a set screw until the required surface of the positive plates is immersed in the solution. A combined binding screw and switch is described.—B. T.

Improved Means for effecting the Electro-chemical Generation of Chlorine in Metallurgical Operations for the Extraction of Gold from its Ores, and for other Purposes. D. G. Fitzgerald, London. Eng. Pat. 11,242, Sept. 4, 1886. 8d.

The inventor makes use of peroxide of lead as the anode, and builds up this anode with slabs or plates of the peroxide, cemented together with a paste of litharge and dilute sulphuric acid. The anodes hitherto used have been unable to withstand the action of nascent chlorine. —B. T.

Improvements in and Apparatus or Means for Electroplating. R. K. Boyle, London. Eng. Pat. 11,291, Sept. 4, 1886. 8d.

This is a dry process of electro-plating, and by its means plating of iridium can be effected, and plating of aluminium facilitated. The article to be plated and the metal to form the plating are included in an electric circuit, and a rapid make and break is produced between the article and metal, the article being gradually moved along to expose new surface for deposition.—B. T.

Improvements in the Manufacture of Positive Pole-plates for Secondary Batteries or Accumulators. S. Farbaky and S. Schenek, Schemnitz, Hungary. Eng. Pat. 11,487, Sept. 9, 1886. 8d.

The active material is packed in polygonal divisions of a leaden grating, having unoccupied spaces between these divisions, so as to allow of the expansion of the active material without alteration to the form of the plate. —B. T.

An Improved Primary Battery. C. E. O'Keenan, Paris, France. Eng. Pat. 11,834, Sept. 17, 1886. 11d.

A distributing canal, in connection with the cells and also with vessels containing crystals of the salts used, is adopted to maintain the solutions at their proper level; while by means of an automatic arrangement desaturating solutions are supplied to the cells. An apparatus for measuring the number of ampère-hours given out is attached.—B. T.

A Method of Producing Carbon Fibres or Filaments. W. Maxwell, London. Eng. Pat. 11,997, Sept. 21, 1886. 6d.

WITHIN a closed vessel kept constantly full of a gaseous hydrocarbon, under a pressure preferably below that of the atmosphere, a refractory conductor (such as a bar of dense hard carbon) is maintained at a white heat by an electric current. Hair-like fibres or filaments gradually appear, attached to the conductor. These may be removed for use as the apparatus cools.—A. R. D.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Phenyl-piperidine. E. Lellmann. Ber. **20**, 680—681.

PHENYL-PIPERIDINE $C_5H_{10}NC_6H_5$ is produced in considerable quantity when piperidine (3 mols.) is heated at 250—270° with bromo- or iodo-benzene (1 mol.). It forms a strongly alkaline colourless oil of slight scatol-like odour. Its platino-chloride crystallises in long needles. The aromatic nitro-halogen derivatives react with piperidine more readily.—A. G. G.

Synthesis of Pyridine Bases. J. Plöchl. Ber. **20**, 722 and 723.

THE action of aldehydes upon a concentrated solution of ammonium chloride at a high temperature, appears to be a general reaction for the preparation of bases of the pyridine series. In this way paraldehyde gives collidine, and propionic aldehyde gives parvoline. The yields are rather small.—A. G. G.

Strychnine. C. Stoehr. Ber. **20**, 810—814; and 1108—1111.

BY the dry distillation of strychnine hydrochloride with lime (10 parts) there is formed in addition to ethylene and NH_3, picoline (β or γ?), a reduced pyridine base, skatole, and probably a collidine or lutidine. From this it appears that the strychnine molecule does not contain a quinoline residue (as assumed by Hanssen, *Ber.* 20, 460), but a pyridine and possibly also an indole residue.

The two oxygen atoms in strychnine are not present as hydroxyl, for they are not removed by heating with a large excess of PCl_5, the product of the reaction being *trichlorostrychnine.* This body forms very stable colourless crystalline salts, and is different from the trichlorostrychnine obtained by chlorination.—A. G. G.

Aesculetin and some Derivatives of Hydroxyquinol. W. Will and W. Pukall. Ber. **20**, 1119—1136.

AESCULETIN, found in the horse-chestnut, has been shown to be a di-hydroxy-derivative of cumarin, but endeavours made by various chemists to prepare it by the condensation of the ethereal salts of different acids with phloroglucinol have been unsuccessful; other experiments also showed that the only possible constitution of aesculetin was that of an ethereal derivative of hydroxyquinol. To settle this question, the authors have prepared these derivatives and compared them with aesculetin. After preparing the tri-ethoxyquinol $C_6H_3(OC_2H_5)_3$ [1 : 3 : 4], and a comparison of its properties, the author concludes that there can be no doubt that aesculetin is derived from the phenol corresponding to this substance, and future experiments must be made to show the position of the acrylic acid in the benzene ring.—G. H. M.

Ecgonine. E. Einhorn. Ber. **20**, 1221—1229. (Compare this Journal, 1886, 40, and 1887, 225.)

ECGONINE is a decomposition product of cocaïne. Merck has stated that when ecgonine hydrochloride is heated with phosphorus pentachloride and chloroform a new base is formed. The author, however, had previously to this prepared the substance in a much simpler manner, and since it appears to be formed from ecgonine by the simple abstraction of water, he proposes to call it *anhydroecgonine.* The following gives the preparation and properties of its chief compounds:—

Anhydro-ecgonine $C_9H_{13}NO_2$ is best prepared by boiling ecgonine hydrochloride with phosphorus oxychloride with an inverted condenser: the product is poured into water and a solution of iodine in hydriodic acid added. The periodide of anhydro-ecgonine is completely precipitated; this is washed with water and distilled in steam to rid it of free iodine; the colourless aqueous solution thus obtained is evaporated, and the iodide allowed to crystallise. It forms fine crystals of the composition $C_9H_{13}NO_2HI$. These are treated with moist silver oxide, the silver removed by sulphuretted hydrogen, and the free base crystallised from methyl alcohol. It forms colourless crystals melting at 235° with decomposition; it is easily soluble in water and alcohol, quite insoluble in ether, chloroform and benzene. It gives good crystalline salts with the haloid acids; the *hydrochloride* melts at 240—241°: the *platinum* double salt crystallises in yellow prisms, melting at 223°.

The *periodide* of anhydro-ecgonine $C_9H_{13}NO_2HI.I_2$, crystallises in violet plates, melting at 185—186°. The aqueous solution loses the excess of iodine on boiling. The *perbromide* forms orange crystals, melting at 154—155° with decomposition; the *bromide* melts at 122°. The substance admits of easy etherification. The *ethylanhydro-ecgonine* is an oil which forms crystallisable salts with haloid acids. The *hydrochloride*, $C_9H_{12}NO_2.C_2H_5.HCl$, forms white needles, melting at 243—244°. The *platinum* double salt $(C_9H_{12}NO_2.C_2H_5.HCl)_2,PtCl_4$, crystallises in yellow prisms, melting at 211°.

When anhydroecgonine hydrochloride is heated in a sealed tube with bromine, a substance crystallising in white crystals and melting at 183—184° is obtained. It appears to have the composition $C_8H_{12}NBr_2COOH.HCl$, and does not lose its bromine to a solvent; it also differs in behaviour from the perbromide of anhydro-ecgonine.

The author regards anhydro-ecgonine as *methylated tetrahydropyridylacrylic acid*: ecgonine as *methyl-tetrahydropyridyl-β-oxypropionic acid*: and cocaine as *methylic methyltetrahydropyridyl-β benzoyloxypropionate*, with the following formulæ:—Anhydro-ecgonine, $C_5H_4N(CH_3)H_3.CH:CH.COOH$.: ecgonine, $C_5H_4N(CH_3).H_3.CHOH.CH_2.COOH$: cocaine, $C_5H_4N(CH_3)H_3.CHO(OCC_6H_5).CH_2.COOCH_3$. Anhydro-ecgonine oxidised with potassium permanganate yields a crystalline substance.—G. H. M.

Eucalyptus and Eucalyptus Oils. Adrian. Nouv. Remed. 1887, 195.

THE eucalyptus oil of commerce is obtained from more than 150 species of eucalyptus, but *E. globulus* is the only one that yields the hydrocarbon eucalyptol discovered by Cloëz. In the south of France a yield of 0·4 to 0·7 per cent. is obtained by distilling the leaves of *E. globulus*, and 1kilo. of oil gives on the average 600grms. eucalyptol. The oil is fractionated, and the portion boiling between 170° and 175° separated. It is then treated with caustic potash and warmed, separated from the alkaline solution and fractionated repeatedly till a distillate having the constant boiling point 175° is obtained. A little below 170° 6 per cent. of a liquid with a pleasant smell, resembling that of valeraldehyde, passes over. The author considers Cloëz' formula for eucalyptol ($C_{24}H_{20}O_2$) unfounded, and regards it as a hydrocarbon consisting of a mixture of varying amounts of terebene and cymene.—C. A. K.

Lactic Acid Fermentation. M. Hayduck. Chem. Zeit. **11**, 151.

THE author has investigated the effect which lactic acid itself has upon the development of lactic acid bacteria. He finds that an addition of 0·1 per cent. of lactic acid distinctly retards the fermentation, whereas if 0·15 per cent. is added it stops completely. Now in practice about ten times as much lactic acid as this is produced. The apparent contradiction is explained by the fact that the liquids examined by the author only contained very small quantities of the lactic acid ferment: the presence of 0·15 per cent. of lactic acid does not check the fermenting power of the bacteria, but only prevents their rapid development. This explanation is supported by a set of microscopic observations made concurrently with determinations of acidity (no lactic acid having previously been added). It was found that at first the amount of acid produced was very small, because of the small quantity of ferment present; as the ferment developed the rate of production increased, until the very presence of the acid reacted prejudicially upon the development of the ferment, and so ultimately upon the further formation of the acid itself. The presence of 4 per cent. of alcohol hinders the lactic acid fermentation, and 6 per cent. stops it entirely. It acts even more prejudicially upon the butyric acid ferment: whereas acetic acid, on the other hand, is more readily formed in the presence of alcohol.—D. E. J.

On Ethyl Bromide. M. C. Traub. Chem. Zeit. **11**, 151.

As this is now used as an anæsthetic, it is important that it should be free from sulphur compounds, which have an injurious effect. Commercial ethyl bromide is prepared from phosphorus containing sulphur, which accounts for the presence of ethyl sulphide in it. For this reason the phosphorus method should not be employed; a much better preparation can be obtained by the method given in the French Pharmacopœia. A good preparation should be quite colourless, of a pleasant ethereal smell, and of sp. gr. 1·385—1·390. It should undergo no change when shaken up with pure sulphuric acid for three or four days; if the acid is coloured yellow, sulphur compounds are present. If it is shaken up with an equal volume of water, the water should neither colour litmus paper nor react upon silver nitrate.

—D. E. J.

Cali Nuts. Chem. Zeit. **11**, 633—634.

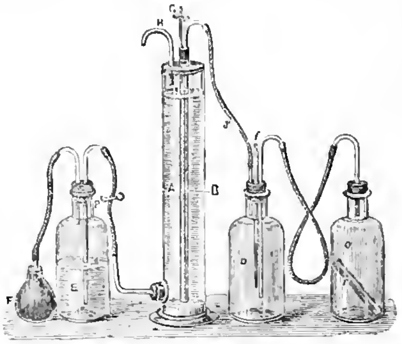
Calabar beans, by fraudulent intention, accident, or carelessness, are occasionally mixed with the seeds of other West African plants, such as those of the palm oil tree (*Elæis guineensis*) and of *Entada scandens*. The seeds of various species of *Mucuna*, more especially those of *M. cylindrosperma* (Cali nuts), often get into commerce as wild Calabar beans. Since they are said to possess similar properties to the true Calabar beans, and are somewhat similar in physical characters, botanists are divided in opinion as to whether Cali nuts are not a species of physostigma rather than of *Mucuna*. The seeds of *M. cylindrosperma* may be distinguished from the true Calabar beans by the former being cylindrical, of a reddish-brown colour, finely corrugated, and the hilum does not extend quite to the extremity of the bean at the end where the microphyle is visible, but forms there a slight projection. Both are used by the natives of West Africa as ordeal poisons.—W. E.

Erratum.—In heading of second abstract in second column, p. 561, *for* "Neucki" *read* "Nencki."

XXII.—ANALYTICAL CHEMISTRY.

Apparatus for Determining Carbonic Acid Volumetrically in Carbonates. D. Sidersky. Zeits. Anal. Chem. **26**, 336—338.

The apparatus, which is shown in Fig. 1, is of simple construction, and requires no stands or supports; the graduated tube B, which is used for measuring the carbonic acid, is placed in the glass cylinder A, and held in position by the cork above. The cylinder A is filled with water, and thus protects the gas from changes of temperature. The carbonate, or other substance to be analysed, is placed in the bottle C; the small india-rubber test-tube *r*, filled with HCl, is next introduced carefully, and the bottle closed by means of the stopper, in which is fixed the delivery-tube. The clips G and P are now opened, and the ball F is squeezed so as to force water from the reservoir E into A and B, until it reaches the zero of the graduation on the measuring-tube B. The clips are now closed, and the bottle C is tipped over so as to bring the acid in contact with the substance; by opening the clip P the water can be brought to the same level in A and B. The temperature of the evolved gas in D is noted, and the volume of the air in B read off at the same time.—D. E. J.



Some New Laboratory Appliances. E. Pollack. Rep. Anal. Chem. **7**, 287—288.

Fig. 1 represents a dropping funnel which allows of a constant outflow of the fluid. This is effected by a hollow stop-cock, to which a small tube is fused in such a manner that the interior of the stop-cock can communicate with the air when in a certain position. Another advantage of this arrangement is that it is possible to dry the air or to free it from CO_2 before allowing it to enter the funnel, by attaching to the side tube apparatus for absorbing this gas or the aqueous vapour. Fig. 2 is a flat funnel used instead of glazed paper in collecting precipitates previous to weighing them. Fig. 3 is a new reflux condenser with interior cooling action.—A. R.

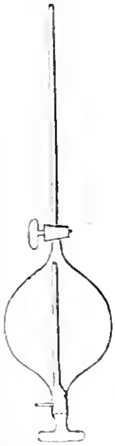


Fig. 1.

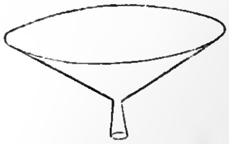


Fig. 2.


Fig. 3.

Simple Apparatus for Distilling Mercury in Vacuo. B. Nebel. Repert. Physik, 1887, **23**, 236.

An inverted bottle connected by a glass tube with a glass cylinder fitted into a movable wooden frame serves to supply the mercury to the distilling bulb, which is placed at the average barometric height above the cylinder, and which is connected to it by a tube fused into the bulb. The exit tube of the bulb is bent twice, and finally connected with a narrow vertical tube, the end of which is bent in a semi-circle and fused into a small trumpet-shaped vessel, from which a short side tube leads to the receiver. In order to start the distillation, the supply bottle is charged, and then the bulb exhausted by attaching a pump to a glass tube which fits inside the trumpet-shaped vessel connected with the receiver. The mercury is thus drawn into the distilling flask, where it is heated by a Bunsen burner. As soon as the distilled mercury fills the trumpet-shaped vessel to the height of the exit tube connected with the receiver the pumping is stopped, for now the mercury falling down the narrow tube connected with the distilling bulb acts like a Sprengel pump. The total vertical length of the tube is 850mm. The apparatus works continuously, and distils 500—600grms. of mercury per hour.—C. A. K.

Qualitative Method for the Detection of Sulphites in presence of Hyposulphates (Thiosulphates) and Sulphates. A. Villiers. Compt. Rend. **104**, 1177.

When an alkaline sulphite is precipitated with barium chloride the previous alkaline solution becomes neutral to test paper, while with alkaline bisulphites an acid solution results according to the equation :—

$$2KHSO_3 + BaCl_2 = BaSO_3 + 2KCl + H_2SO_3.$$

Thiosulphates behave like bisulphites, and can be detected in presence of sulphites by carefully neutralising the solution if previously alkaline with hydrochloric acid, and then treating with barium chloride. The acid solution is distilled, and the sulphurous acid tested for in the distillate.—C. A. K.

Solubility of Magnesium in Water containing CO_2. Kappel. Chem. Zeit. **11**, 137.

If a stream of carbonic acid is led for some time through distilled water in which magnesium wire is placed, the magnesium gradually dissolves, forming magnesium bicarbonate, and hydrogen is evolved. In the opinion of the author, this indicates the existence of the compound H_2CO_3.—D. E. J.

On a New Reagent for Copper Salts. Aliamet. Bull. Soc. Chim. **47**, 754.

This reagent produces in aqueous solution of copper salts a blood-red coloration like that of sulphocyanate of iron. The reagent itself is colourless, and is prepared by adding pyrogallic acid to neutral sodium sulphite. The reaction is very delicate; *e.g.*, a solution containing only $\frac{1}{3000000}$grm. of $CuSO_4$ per cc. gives a distinct orange-red coloration. Pyrogallic acid itself gives with copper salts a red colour; but the reaction is not nearly so delicate as when sodium sulphite is present.—D. E. J.

On the Determination of Ammonia in Soils by the Azotometric Method. Dr. Anton Baumann. Zeits. Anal. Chem. **26**, 302—312.

Of the three methods for estimating ammonia in soils—Boussingault's, Schlösing's, and the azotometric method—the first alone is capable of giving good results. It depends upon driving off the ammonia by means of magnesia at the boiling-point. Schlösing's plan of driving off the ammonia with caustic soda in the cold can only be applied to soils which contain little humus, for soda decomposes other nitrogenous constituents of humus soils, with evolution of ammonia. Knop-Wolf's azometric method, which is recommended in the text-books as being the best, is shown by the author to be quite unreliable, inasmuch as it is subject to three important sources of error. The method, as originally described, consisted in treating 200—300grms. of the soil with borax-solution and 50 cc. of bromine-water, shaking up well, and measuring in the azotometer the nitrogen evolved. The solution of borax was added with the object of preventing that contraction of the air in the evolution-flask which would otherwise occur on shaking up of soils with alkaline fluids. It is just this contraction which forms the first defect of Knop's method, for the author has shown that when humus soils are shaken up with alkalis in closed vessels, they absorb oxygen from the air; a contraction therefore occurs which diminishes the apparent amount of nitrogen evolved. When the soil under examination is very rich in humus, this contraction may even overpower the increase in volume due to the evolution of nitrogen, so that the reading of the azotometer becomes negative. Again, the addition of borax does not correct this error, for borax-solution is itself alkaline—as is shown by its behaviour towards indicators and ammonium salts—and it produces the same contraction as alkalis; it therefore increases the error, instead of diminishing it. Lastly, bromine-water not only sets free nitrogen from ammonia, but also from other nitrogenous substances, such as amido-compounds and albuminous substances. The error from this source is very serious, and may increase the apparent amount of ammonia by 400—4000 per cent. The author further criticises the modification of the method proposed by Knop (*Zeits.* 26, 1), and shows that it is subject to the same errors.—D. E. J.

Determination of Sodium and Potassium Chloride in Crude Potash. H. Focke. Rep. Anal. Chem. **7**, 285—286.

Most chemists have hitherto assumed, on the authority of Fresenius, that the chlorine contained in potash must be regarded as combined with potassium rather than with sodium. Dr. Ziurek, however, held that the chlorine is chiefly present as sodium chloride, and with a view to testing the accuracy of this idea, he undertook some experiments, which were not quite concluded before his death, and the author of this paper is publishing the results obtained by Ziurek. The method employed was as follows:—The residue obtained by evaporation of a crude potash solution, previously exactly neutralised with sulphuric acid, was extracted with alcohol of 85 per cent. strength. Determination of chlorine and potash were then made in this alcoholic extract, and the quantities obtained compared with those originally found in the crude potash. It appears that all the chlorine in the latter is found in the alcoholic extract. The following is the result of a few analyses :—

Chlorine in Potash, directly determined.	In Alcoholic Solution.		The latter corresponds to Chlorine.
	$Cl.$	$K_2O.$	
5·30%	5·23%	0·44%	0·33%
4·76	4·49	1·45	1·09
2·45	2·45	2·70	2·02
2·15	2·37	2·71	
2·62	2·54	1·50	1·13
1·68	1·68	1·94	1·49

—A. R.

Estimation of Sulphur by Weil's Method. C. Friedheim. Ber. **20**, 1483—1485.

The method proposed by Weil for the estimation of sulphur in sulphides decomposable by acids consists in absorbing the H_2S in ammoniacal $CuSO_4$, or Fehling's solution, and titrating the copper remaining in the filtrate with $SnCl_2$. The author has already shown (*Ber.* **20**, 59) that with employment of ammoniacal $CuSO_4$ the process gives incorrect results. He now publishes a series of analyses which show that the method is equally inexact if Fehling's solution is used; in this case the numbers are too high, probably from formation of oxysulphide.—A. G. G.

On a Reaction which can be employed for the Colorimetric Estimation of Phosphorus in Iron, Steel, etc. F. Osmond. Bull. Soc. Chim. **47**, 745.

When phospho-molybdic acid is dissolved in an acid solution of chloride of tin, a beautiful blue coloration is produced, the intensity of which is proportional to the amount of phospho-molybdic acid present. The author employs this reaction for the rapid determination of phosphorus in iron and steel. The solution of tin is prepared by dissolving 12grms. of the crystallised chloride in 80cc. of pure hydrochloric acid, and diluting with water to 1 litre. The precipitate of ammonium phospho-molybdate obtained in the usual way is filtered through asbestos (not through paper, because this absorbs the colouring matter), and after washing upon the filter is dissolved in a sufficient quantity of the tin solution; the filtrate is then made up, by means of the same solution, to a constant volume of 100cc. for every gramme of the metal used, and the depth of the coloration is determined. A series of solutions made up so as to contain known quantities of ammonia phospho-molybdate can be used for this purpose; these solutions keep well for several days. Crova's spectro-photometer can also be employed for estimating the intensity of the colour.—D. E. J.

Detection of Alcohol in Oil of Lemons. Dingl. Polyt. J. **264**, 520.

The oil to be tested is placed in a dry test tube, and a little powdered fuchsin is dusted over the inside of the test tube, above the oil, which is now heated to boiling. If it is free from alcohol, the fuchsin remains unchanged; but if the oil contains even 0·1 per cent. of alcohol, the solvent action of the latter produces a red edge round each particle of fuchsin.—D. E. J.

Determination by Titration of the Free Acid in Tannin Liquor. R. Koch. Dingl. Polyt. J. **265**, 33—41.

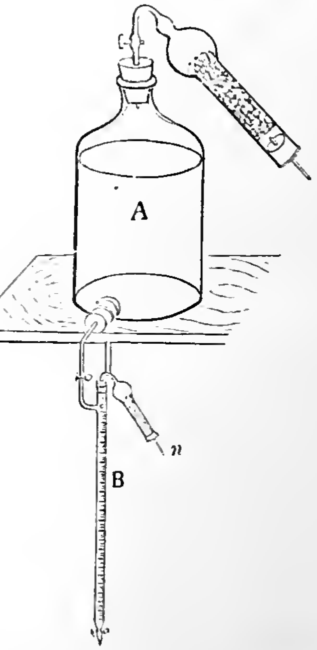
In a previous communication (*Ibid.* **264**, 395) the author recommended the use of albumen for the precipitation of tannin and the decolorisation of tannin liquor. He now finds the application of a gelatin solution more preferable. It is necessary, however, to adjust the concentration of the solution to the percentage of tannin in the liquor, otherwise difficulties in connection with the filtration of the precipitate may arise. A solution containing 2grms. of gelatin in a litre is applicable to most cases. The method is based on the fact that on treating tannin liquor with gelatin and nearly neutralising the mixture with standard alkali, a light-coloured filtrate is obtained which assumes a dark colour as soon as the point of alkalinity is reached. The mode of procedure is described in detail in the original paper, and the results of several test analyses are given. In conclusion, it is shown that powdered skin cannot be employed instead of gelatin, owing to the fact that it absorbs acid from tannin liquor.—D. B.

Estimation of Small Quantities of Paratoluidine in Orthotoluidine. C. Häussermann. Dingl. Polyt. J. **265**, 42—43.

Of the methods recommended for the estimation of para- and orthotoluidine (compare Lewy and Lunge, this Journal, 1883, 242; and 1885, 339), the process based on the titration of the para compound with oxalic acid in an ethereal solution (Rosenstiehl, *Ibid.* **204**, 326) has been mostly adopted. It is not, however, wholly free from error, owing to the fact that the amount of ether to be used is frequently insufficient to completely dissolve the "ortho-oxalate" produced by the reaction. The author suggests the following method:—A solution containing 88grms. of crystallised oxalic acid in 750cc. of water and 43cc. of hydrochloric acid of 22° Bé. is heated in a porcelain basin to from 70—75° and treated with 10grms. of the toluidine under examination. When the precipitate which separates has been entirely redissolved, the mixture is allowed to cool gradually to 30—35° until the oxalate shows signs of crystallisation on the surface of the solution. It is then filtered through cotton, and the residue washed with a few drops of water. The precipitate forms small colourless scales having a dull appearance. The filtrate on standing deposits a further portion of crystals which are collected on a separate filter and washed. This operation is repeated until crystals are obtained having a lustrous appearance. These consist of the pure "ortho-oxalate," and are readily distinguished from the crystals of the para compound. The crystalline fractions are then treated with a solution of sodium carbonate and subjected separately to distillation. The solidifying point of the distilled bases is determined by cooling a fraction of each distillate with ice. If the oil solidifies by merely agitating it, the crystals are collected on a tared filter, and after drying over caustic soda, weighed as paratoluidine. If, however, the addition of a few crystals of pure paratoluidine is required to induce solidification, only one-half of the mass is calculated as paratoluidine. If, on the other hand, it is impossible to solidify the base obtained from the distillation of the first crystalline fraction, orthotoluidine only is present in the sample under examination. With good toluidines, it generally suffices to collect and distil two fractions, in which case the base from the second crystallisation mostly constitutes a perfectly liquid oil. This method being inapplicable to mixtures containing more than 10 per cent. of paratoluidine, it is suggested to dilute such mixtures by the addition of pure orthotoluidine.—D. B.

New Method for the Quantitative Determination of Starch. A. V. Asbóth. Rep. Anal. Chem. **7**, 299—302.

The author maintains that unsatisfactory results are obtained in determinations of starch, when the method employed is based upon the inversion of sugar, formed as an intermediate product, since maltose, dextrose, and levulose are partly decomposed by boiling with dilute acids. He proposes to replace the methods hitherto employed by one which depends upon the formation of a barium salt of starch, to which he assigns the formula $BaO.C_{24}H_{40}O_{20}$. This salt is sparingly soluble in water and insoluble in dilute alcohol. In making a determination a weighed quantity of starch is saccharified with water, then mixed with an excess of normal baryta solution, dilute alcohol added to make up to a certain volume and, after the precipitate has settled the excess of baryta is titrated back with acid.



The author also describes the apparatus he employs for storing and titrating with baryta solution. The latter is contained in the bottle A, and the drying tube attached to the neck of the same is filled with quicklime. The burette B, which is in direct connection with the bottle, may be filled with the solution by opening the stop-cock, and the small drying tube *n* is filled with dry KOH, thus preventing the entrance of any CO_2. Numbers are appended which seem to testify to the excellence of the method employed. The author finally gives a detailed account of the entire analysis of various cereals.—A. R.

The "Helfenberger" Method of Estimating Morphia.

Eugen Dieterich. Chem. Zeit. **11**, 144.

Further study of the best conditions for carrying out this analysis has led the author to the following improved methods:—

I. *Opium.*—Rub up 6grms. of finely-powdered opium with 6grms. of water, transfer to a weighed flask, and make up with water to 54grms.. Allow the maceration to proceed (with frequent stirring) for one hour, and filter through a quick filter of 10cm. diameter. To 42grms. of the filtrate add 2cc. of normal ammonia, mix well, and filter as before. Place 36grms. of the filtrate (=4grms. of opium) in a tared Erlenmeyer's flask, add 10grms. of ether and 4cc. of normal ammonia, shake gently until the liquid becomes clear, then cork up the flask and leave it. After standing for 5 hours, transfer the ethereal layer as completely as possible on to an ordinary filter of 8cm. diameter, add another 10grms. of ether to the solution in the flask, shake gently, and again transfer this to the filter. After this has run through, pour the aqueous solution on the filter: the morphine crystals will now be found attached to the walls of the flask. Wash the flask twice with 5cc. of water saturated with ether, dry the flask and filter at 100°, transfer the small quantity of morphia on the filter to the flask, and again dry until the weight becomes constant.

II. *Opium-extracts.*—Dissolve 3grms. of the extract in 40grms. of water, mix with 2cc. of normal ammonia, and filter at once through a quick filter of 10cm. diameter. 30grms. of the filtrate (=2grms. of the opium-extract) are then treated as above.

The method depends on the peculiar behaviour of the salts of morphia, which, when decomposed by ammonia, remain clear at first, and only deposit the morphia (in crystals) slowly.—D. E. J.

Estimation of Emetine in Ipecacuanha and its Extracts.

M. Lignon. Chem. Zeit. **11**, 148.

Analysis of the Root.—Grind up 25grms. of the root in a mortar with 25cc. of water, mix with 20grms. of slaked lime, and after this has been well rubbed up, add 30grms. more of slaked lime. Extract for 3 hours in a suitable extraction-apparatus with 300cc. of ether, filter the ethereal solution (about 200cc.) if it contains any solid matter, and make it up to 200 or 250cc. Place 50cc. of the solution in a 100cc. flask; to this add 10cc. of seminormal sulphuric acid and 4 to 5 drops of freshly-prepared concentrated extract of campeachy wood. After thorough shaking the mixture divides into a colourless ethereal layer and a yellow aqueous layer. The acids contained in the solution are neutralised by adding seminormal ammonia drop by drop until the aqueous layer is coloured red.

Analysis of the Extract.—Mix 5grms. of the extract with 5grms. of water, and add gradually 25grms. of slaked lime, rubbing it up thoroughly with the mixture. A powdery mass is thus obtained which can easily be extracted: it is to be treated with 200cc. of ether as above. According to the experiments of the author, good ipecacuanha ought to contain about 1·45 per cent. of emetine, or 1·663 per cent. of the hydrochloride.

—D. E. J.

A New Method of Estimating Glycerol.

R. Diez. Chem. Zeit. **11**, 148.

0·1grm. of glycerol is dissolved in from 10 to 20cc. of water, and shaken up in a flask with 5cc. of benzoyl chloride and 35cc. of 10 per cent. caustic soda solution. During the reaction the flask should be cooled, and after the benzoyl compound has separated out it is collected upon a dried filter, washed with water, and dried on the filter at 100° for 2 or 3 hours. 0·1grm. of glycerol corresponds to 0·385grm. of the ether. If it is proposed to estimate the amount present in wines or beer, the glycerol should first be isolated in the usual way, and then examined as above and under the conditions there described (*i.e.*, not more than 0·2grm., and in a 0·5 per cent. to 1 per cent. solution). All carbohydrates should be carefully removed, because they also yield, when treated with benzoyl chloride and soda, ethereal salts which are insoluble in water and alkalis. The following directions are to be observed in the several cases described: *A. Fermented wines poor in sugar.*—Take 20cc. of the wine, and after driving off the alcohol, evaporate it nearly to dryness with an excess of lime: extract the residue while still warm with 20cc. of 96 per cent. alcohol. After cooling add 30cc. of dry ether, filter, and wash with a mixture of alcohol and ether (2 : 3). After evaporating off the solvent, dissolve the glycerol in water, and proceed as above. *B. Sweet wines.*—A larger amount of lime should be used, and 1grm. of sand added to it. Twice the quantity of alcohol and ether should be taken. *C. Beer.*—Evaporate 50cc. with lime and sand nearly to dryness. Allow the residue to cool, grind it to a fine powder, and treat it with 50cc. of 96 per cent. alcohol; then add 75cc. of dry ether and allow it to stand. The glycerol obtained from the filtered solution is dissolved in from 5 to 10cc. of water and treated as above with soda and 2 to 3cc. of benzoyl chloride.—D. E. J.

Adulteration of Rape Oil with Mineral Oil.

H. Focke. Rep. Anal. Chem. **7**, 286—287.

Rape oil is occasionally found to be mixed with mineral oil. A specimen examined by the author contained 20 per cent. of oil which could not be saponified. The specific gravity of the admixture was the same as normal rape oil, viz., 0·9144, and its reactions appear to show that it is a mixture of a mineral and resinous oil. For lubricating purposes this adulteration causes a serious deterioration in the value of the rape oil, and in some countries where rape oil is also used for cooking purposes, several cases of poisoning occurred which were traced to the presence of mineral oil in the rape oil employed.—A. R.

New Books.

Coal-tar and Ammonia. The Second and Enlarged Edition of "A Treatise on the Distillation of Coal-tar and Ammoniacal Liquor." By George Lunge, Ph.D., Professor of Technical Chemistry in the Federal Polytechnic School, Zurich. London: Gurney & Jackson, 1, Paternoster Row. 1887.

In its second edition this important, and indeed unique work, has grown to double the size of the first edition. It now takes the form of a somewhat thick 8vo volume, bound in cloth, and containing Preface, Table of Contents, and 727 pages of subject matter, including an introductory chapter, and at the end of the book a chapter of Addenda and an Appendix. An Alphabetical Index concludes the work. With the text are interspersed 191 excellent woodcuts. The plan of the work may be roughly sketched as follows:—Chap. I. Introductory. Chap. II. Processes for Obtaining Coal-tar; (A) the Production of Coal-tar at the Gas-works; (B) Tar and Ammonia obtained as By-products in Coke Making; (C) Tar and Ammonia from Gas Producers; (D) Tar and Ammonia from Blast-furnace Gases; (E) Preparation of Mixtures similar to Coal-tar, by the Decomposition of certain vapours at a high temperature. Chap. III. The Properties of Coal-tar and its Constituents. Chap. IV. The Applications of Coal-tar without Distillation. Chap. V. The First Distillation of Coal-tar. Chap. VI. Pitch. Chap. VII. Anthracene Oil. Chap. VIII. Creosote Oil. Chap. IX. Carbolic Acid and Naphthalene. Chap. X. Light Oil and Crude Naphtha. Chap. XI. Rectification by Steam. Final Products. Chap. XII. Sources from which Ammonia is obtained. Chap. XIII. The Composition and Analysis of Ammoniacal Liquor and Properties of its Constituents. Chap. XIV. The Working up of Ammoniacal Liquor.

Die Chemische Technologie der Brennstoffe. Von Dr. Ferdinand Fischer. (Bolley's Handbuch der Chemischen Technologie). 45, Bd.I. 3.2. *Zweite Lieferung.* Braunschweig: Druck und Verlag von Friedrich Vieweg und Sohn. 1887. London: H. Grevel & Co., 33, King Street, Covent Garden, London.

The second part of this important work has now made its appearance, and takes the form of an 8vo volume, bound in paper cover. The first part was issued in 1880. The price of this second part is 8s. The work as a whole is illustrated with 281 woodcuts, the text covering 105 pages. A concise Table of Contents, in lieu of alphabetical index, is given at the end. The work opens with some chapters on the MEASUREMENT OF HEAT, followed by others on the MEASUREMENT OF LIGHT. The subject of the INVESTIGATION OF FUEL is next taken up, various solid and gaseous fuels being treated of, and also all the principal varieties of calorimeters. The INVESTIGATION OF ATMOSPHERIC AIR then follows, and is very fully dealt with. The subject of the EXAMINATION OF FIRE-GASES is then considered in detail, and the methods of Bunsen, Winkler, Bunte, Liebig, Regnault, Frankland, and Kempel, etc., for measuring and otherwise testing gases, are given. The INVESTIGATION OF ILLUMINATING GAS forms the closing subject of the treatise, and it is very completely treated.

MELTING AND BOILING POINT TABLES. PHYSICO-CHEMICAL CONSTANTS. BY THOMAS CARNELLEY, D.Sc., F.C.S., F.I.C., Professor of Chemistry in University College, Dundee. Vol. II. London: Harrison & Sons, 69, Pall Mall. 1887.

PROF. CARNELLEY, with this second volume, completes a really great work, the preparation of which, as he states in the Preface, has been extending over 10 years. Vol. II. contains more than 32,000 melting and boiling point data, which, with those given in the first volume, make a total of over 51,000. The book presents the form of a quarto volume, strongly bound in cloth, with short Preface, Table of Contents, and matter covering 709 pages, dealing with Organic Compounds of from 4 to 708 elements, also special elements. This brings the reader to Part III., which is devoted to:—1. Vapour tension and boiling point tables of simple substances. 2. Ditto of mixed substances, such as mixed liquids and saline solutions. 3. Freezing and melting points of mixtures, including cryohydrates. 4. Miscellaneous melting and boiling point data, such as melting and boiling points of fats, oils, etc. 5. Volumes and corresponding years of issue of the more important chemical and physical periodicals. 6. Alphabetical index of root carbon compounds. The work is of such a kind that any compound can be speedily looked up, and being once found, a glance serves to inform the reader as to its constitution, formula, boiling and melting point, authority, original works of reference, and references to "Watts' Dictionary" and the *Journal of the Chemical Society.* In point of fact, it is a kind of condensed Dictionary of Chemistry that would, uncondensed, occupy eight or nine volumes, and cost four times the amount of this work. Being exceedingly handy for immediate reference, it combines economy in every form. The price of the work is for each of the two vols. £2 2s., net cash £1 12s. each.

Trade Report.

(From the Board of Trade Journal.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

FRANCE.

Classification of Bromides and Iodides of Ammonia.

A circular, dated 20th July last, has been issued by the French *Direction General des Douanes,* from which it appears that the Committee of Arts and Manufactures has given the opinion that bromides and iodides of ammonia should be assimilated in the tariff to salts having potassium for their base, and, consequently, pay duties of 100 and 350 francs per 100 kilogrammes, respectively; also, that this decision has been ratified by the Departments of Finance and Commerce.

SPAIN.

Classification of Articles in Customs Tariff.

(*Note.*—Quintal = 220·4lb. avoirdupois. Kilogramme = 2·2011b. avoirdupois. Peseta = 9$\frac{5}{8}$d.)

The following decision has recently been given by the Spanish Customs authorities:—

Ground colours for painting, composed of two elements, organic and inorganic, and easily soluble in alcohol and ether. —Category 72. Duty 75 cents. per kilog.

SWITZERLAND.

Classification of Articles in Customs Tariff.

(*Note.*—Quintal = 220·4lb. avoirdupois. Franc = 9$\frac{5}{8}$d.)

The following decisions affecting the classification of articles in the Swiss Customs Tariff have been given by the Swiss Customs authorities during the month of July last:—

Pepsine wine.—Categories 11 and 12. Duties from 30 to 100 francs per quintal.

Hartshorn oil, raw.—Category 16. Duty, 30 francs per quintal. (Formerly included in Category 17.)

Camphor oil.—Category 18. Duty, 2 francs per quintal.

Chrome ochre.—Category 36. Duty, 3 francs 50 centimes per quintal.

NEW CUSTOMS TARIFF OF BRAZIL.

(Continued from page 16[illegible] of the last Number of the Board of Trade Journal.)

(*Note.*—Kilogramme = 2·2011b. avoirdupois. Litre = 0·22 Imp. gallon. Milreis = 2s. 3d.—nominal value.)

No. in Tariff.	Articles, etc.	Rates of Duty.	
	XI.—CHEMICAL PRODUCTS, PHARMACEUTICAL COMPOSITIONS AND MEDICAMENTS IN GENERAL—*contd.*		Reis.
211	Borates:		
	Of manganese	Kilog.	800
	,, silver	Grammo	50
	,, soda (sub or bi), or tinkal, melted or crystallised	Kilog.	160
	,, any metal, not otherwise mentioned	,,	3,000
	,, alkaloids or organic bases	Gramme	100
212	Bromine, hydrated	Kilog.	20,000
213	Bromates of any description	,,	11,000
214	Bromoformium or perbromure of formyle	,,	30,000
215	Bromides, hydrobromates or bromhydrates:		
	Of ammonia	,,	1,500
	,, iron	,,	3,000
	,, lithia	,,	11,000
	,, gold	Gramme	300
	,, potash	Kilog.	2,400
	,, silver	Gramme	60
	,, soda	Kilog.	2,100
	,, metal, metalloids, not otherwise mentioned	,,	6,000
	,, alkaloids or organic bases	Gramme	100
216	Brucine and its salts	,,	60
217	Chemical re-agents (boxes of) for use in laboratories	15 % *ad val.*	
218	Caffeine, theine, and their salts	Gramme	30
219	Cantharides	Kilog.	4,000
220	Capsules and medicinal confections of any kind	,,	2,000
221	Carbonates:		
	Of ammonia, concrete, volatile, alkali, or sesquicarbonate of ammonia	,,	240
	,, baryta	,,	640
	,, bismuth	,,	4,000
	,, cadmium	,,	9,600
	,, lead, or white lead	,,	70
	,, copper	,,	1,200
	,, iron (proto, sub, or sesqui)	,,	320
	,, lithia	,,	10,000
	,, magnesia or white magnesia	,,	320
	,, potassium:		
	Impure, Dantzic, pearlash, or commercial	,,	16
	Purified, salt of tartar, or vegetable alkali	,,	200
	Bicarbonates:		
	Of potassium	,,	250
	,, silver	Gramme	50
	,, soda, or barilla or mineral alkali:		
	Common, black and raw	Kilog.	16
	White, refined or purified, in crystals	,,	80
	,, soda	,,	160
	,, zinc, pure or precipitate	,,	1,000
	Do. impure, natural, or calamine stone prepared	,,	240
	,, any metal, not otherwise specified	,,	2,000
	,, alkaloids or organic bases	Gramme	100
222	Vegetable charcoal, pure or medicinal of any kind	Kilog.	1,000
223	Castoreum, in powder or whole	,,	12,000
224	Beer, medicinal, of any kind	,,	500
225	Chloral of any kind	,,	3,000
226	Chlorates:		
	Of potash or soda	,,	320
	,, any metal, not otherwise distinguished	,,	1,200
	,, alkaloids or organic bases	Gramme	100
227	Chloroform	Kilog.	2,400
228	Chlorodine	,,	5,200
229	Chloro-iodure of mercury (Boutigny salt)	,,	10,000
230	Chloride, hydrochlorate, or muriate:		
	Of ammonia	,,	240
	,, ammonia and mercury, or of ammonia and iron, of flowers of sal ammoniac	,,	

No. in Tariff.	Articles, etc.	Rates of Duty.	
	XI.—CHEMICAL PRODUCTS, PHARMACEUTICAL COMPOSITIONS AND MEDICAMENTS IN GENERAL.—*contd.*		
	Chlorides—*contd.*		Reis.
	Of antimony or butter of antimony, liquid	Kilog.	800
	,, antimony or butter of antimony, solid or concrete	,,	1,200
	,, arsenic	,,	10,000
	,, baryta	,,	500
	,, bismuth (sub)	,,	4,000
	,, cadmium	,,	16,000
	,, chalk or hypochloride of chalk, solidified or liquid	,,	50
	,, calcium, dissolved or crystallised	,,	800
	,, cerium	,,	8,000
	,, chromium	Gramme	20
	,, cobalt	Kilog.	10,000
	,, tin (proto, bi, or deuto), salts of tin, oxymuriate of tin	,,	500
	,, iron, solid or liquid	,,	800
	Do. sublimate	,,	3,200
	,, iodium	Gramme	20
	,, lithia	Kilog.	14,000
	,, magnesia	,,	1,000
	,, mercury (proto, bi, or deuto), sweet mercury or white precipitate, calomel, and corrosive sublimate	,,	1,600
	,, gold, pure, or of gold and other metals	Gramme	300
	,, palladium	,,	60
	,, platinum, pure, or of platinum and other metals	,,	100
	,, potash, liquid, or hypochloride of potash, Javelle water	Kilog.	210
	,, silver	Gramme	50
	,, soda or hypochloride of soda (Labarraque water)	Kilog.	240
	,, sodium, common or cooking salt, coarse or impure	Litre	10
	Do., refined or purified	Kilog.	80
	,, strontium or strontian	,,	600
	,, metals or metalloids, not otherwise mentioned	,,	1,600
	,, alkaloids or organic bases	Gramme	100
231	Chocolate, medicinal of any kind	Kilog.	1,000
232	Chromates:		
	Of bismuth	,,	10,000
	,, lead, yellow or chrome yellow	,,	210
	Do., red or vermilion	,,	450
	,, potash	,,	150
	,, silver	Gramme	50
	,, metals, not elsewhere distinguished	Kilog.	2,000
	,, alkaloids or organic bases	Gramme	100
233	Medicinal cigars and cigarettes of every kind	Kilog.	2,000
234	Cinchona	Gramme	20
235	Citrates:		
	Of bismuth and ammonia	Kilog.	12,000
	,, iron, pure, or of iron and ammonia, or of iron and any other metal	,,	2,000
	,, iron and quinine	Gramme	10
	,, lithia	Kilog.	10,000
	,, silver	Gramme	50
	,, metals not otherwise mentioned	Kilog.	1,500
	,, alkaloids or organic bases	Gramme	100
236	Saponaceous coal tar	Kilog.	1,600
237	Codeine and its salts	Gramme	200
238	Collodion of every kind	Kilog.	2,000
239	Preserves, electuaries, and medicinal opiates of any kind	,,	1,000
240	Creosote	,,	1,200
241	Cyanides, hydrocyanates, cyanhydrates, hydro-ferrocyanates or prussiates:		
	Of iron (Prussian blue)	,,	600
	,, gold	Gramme	600
	,, potash white	Kilog.	2,500
	Do., yellow or vermilion	,,	600
	,, silver	Gramme	30
	,, metals or metalloids, not otherwise mentioned	Kilog.	3,000
	,, alkaloids or organic bases	Gramme	100
242	Delphinite	,,	300
243	Dextrin	Kilog.	250
244	Disinfectants of any kind, not otherwise mentioned	,,	350
245	Digitaline	Gramme	250
246	Elaterine pure	,,	300
247	Elaterium	,,	150
	XI.—CHEMICAL PRODUCTS, PHARMACEUTICAL COMPOSITIONS AND MEDICAMENTS IN GENERAL.—*contd.*		
			Reis.
248	Elixirs or medicinal liquors of any kind	Kilog.	1,000
249	Emetin:		
	Pure	Gramme	500
	Impure or of Codex	,,	100
250	Ointments:		
	In paste or in magdaleons, of cantharides, or vesicatories	Kilog.	1,000
	Do., not otherwise mentioned	,,	2,000
	Spread (plasters) or cerecloths, vesicatories of any kind	,,	4,000
	Do., waxed, oiled or pharmaceutical taffetas	,,	8,000
	Do., adhesive, and those not otherwise mentioned	,,	2,500
251	Ergotine	,,	11,000
252	Bechic plants (the Swiss), etc.	,,	1,000
253	Medicinal spirits and alcohols of any kind, not otherwise specified	,,	1,000
254	Sponges:		
	Calcined	,,	1,600
	Prepared or compressed	,,	14,000
255	Ether:		
	Sulphuric, vitriolic	,,	600
	Not otherwise mentioned	,,	1,000
256	Extracts:		
	Of Spanish or Asiatic saffron	,,	36,000
	,, liquorice, dry or soft	,,	650
	,, Calabar beans	,,	30,000
	,, ipecacuanha	,,	26,000
	,, opium	,,	20,000
	Not otherwise mentioned	,,	5,000
257	Iron and steel:		
	Pure or pulverised	,,	900
	Iron reduced by hydrogen or by electricity	,,	3,000
258	Fluorides, fluates and hydrofluates:		
	Of calcium or fluate of lime	,,	160
	Not otherwise mentioned	,,	4,800
259	Fluosilicates of any description	,,	4,000
260	Formiates:		
	Metallic, of any kind	,,	4,000
	Of alkaloids	Gramme	100
261	Medicinal jellies of any description	Kilog.	1,000
262	Medicinal gin of every kind	,,	1,000
263	Homœopathic globules, prepared or not, of any kind	,,	2,000
264	Glutin or vegetable fibrine	,,	1,000
265	Glycerine	,,	500
266	Glyceroles, glycerades, and glycerates	,,	2,500
267	Medicinal drops of any kind	,,	1,800
268	Guaranine	Gramme	240
269	Helicine	Kilog.	8,000
270	Hydrate of sulphur, milk of sulphur, or magisterium of sulphur	,,	800
271	Medicinal injections of kind	,,	1,000
272	Iodates:		
	Metallic, of any kind	,,	16,000
	Of alkaloids or organic bases	Gramme	100
273	Iodo (? iodine)	Kilog.	20,000
274	Iodates, hydriodates, and iodhydrargyrates	,,	5,000
	Of lead	,,	5,000
	,, iron:		
	Pure or with manganese	,,	9,600
	Of quinine, or of other alkaloids	Gramme	100
	,, formyle or iodoform	Kilog.	24,000
	,, lithia	,,	16,000
	,, mercury:		
	Pure	,,	7,000
	Of morphia or other alkaloids	Gramme	100
	,, gold	,,	500
	,, potassium or potash	Kilog.	4,000
	,, silver	Gramme	40
	,, platina		160
	,, sodium or soda	Kilog.	4,00
	,, zinc, and of strychnine, or of other alkaloids	Gramme	100
	,, metals or metalloids, not otherwise mentioned	Kilog.	12,000
	,, alkaloids or organic bases	Gramme	100
275	Iridine	,,	40
276	Kairine	,,	50
277	Lactophosphate of lime	Kilog.	3,600
278	Lactates:		
	Of lime	,,	2,000

No. in Tariff.	Articles, etc.	Rates of Duty.	
	XI.—CHEMICAL PRODUCTS, PHARMACEUTICAL COMPOSITIONS AND MEDICAMENTS IN GENERAL.—*contd.*		
	Lactates.—*contd.*		Reis.
	Of iron, pure or combined with other salts	Kilog.	2,000
	,, metals, not otherwise distinguished	,,	5,000
	,, alkaloids or organic bases	Gramme	100
279	Laudanum (Rousseau or Sydenham)	Kilog.	4,000
280	"Le Roy" (purgative)	,,	2,000
281	Lemonades (gaseous), of all kinds	,,	800
282	Liniments and fomentations, not otherwise mentioned	,,	2,000
283	Lupulin	,,	1,800
284	Lycopodium	,,	1,300
285	Magnesia, fluid (Murray and other descriptions)	,,	800
286	Manganates and permanganates of every description	,,	2,000
287	Manna sugar, crystallised	,,	3,000
288	Cocoa butter	,,	1,000
289	Honey:		
	Unprepared, or bees'	,,	250
	Prepared	,,	1,000
290	Molybdates of any kind	Gramme	15
291	Naphthaline and naphtol	Kilog.	3,000
292	Narcotine or Derosne salt	Gramme	30
293	Nitrates or azotates:		
	Of ammonia	Kilog.	500
	,, baryta	,,	200
	,, bismuth (sub) in powder, or in troches	,,	4,000
	,, lime, pure	,,	1,200
	,, cadmium	,,	10,000
	,, lead:		
	Common or unprepared	,,	200
	Pure	,,	600
	,, cerium	,,	8,000
	,, cobalt, solid, or liquid	,,	8,000
	,, copper, crystallised	,,	1,000
	,, lithia	,,	20,000
	,, magnesia	,,	1,200
	,, mercury:		
	Proto or deuto	,,	2,500
	Soluble Hahnemann mercury	,,	5,000
	,, nickel, solid or liquid	,,	6,000
	,, potash:		
	Impure, nitre salts of nitro	,,	30
	Pure	,,	200
	,, silver, crystallised or smelted	Gramme	30
	,, soda, refined or unrefined	Kilog.	100
	,, strontian	,,	250
	,, uranium	,,	15,000
	,, metals, not otherwise mentioned	,,	1,300
	,, alkaloids or organic bases	Gramme	100
294	Nitrites or azotites of all kinds	Kilog.	3,200
295	Nitrobenzine or essence of Myrbane	,,	1,200
296	Nitroprussiates of any kind	,,	3,200
297	Oleine, pure or common	,,	400
298	Opodeldoc	,,	2,000
299	Oxalates:		
	Of bismuth	,,	4,000
	,, cerium	,,	5,000
	,, nickel	,,	6,000
	,, lithia or lithium	,,	20,000
	,, potash, neutral or acid	,,	350
	,, silver	,,	30,000
	,, metals, not otherwise mentioned	,,	2,000
	,, alkaloids or organic bases	Gramme	100
300	Oxychlorides:		
	Of bismuth	,,	4,000
	,, any other metal	,,	2,000
301	Oxides:		
	Of barium or baryta (proto or bi)	,,	3,500
	,, bismuth	,,	4,000
	,, cadmium	,,	10,000
	,, cerium	,,	16,000
	,, lead:		
	Yellow or massicot and vermilion, blue and vitreous, litharge or gold litharge	,,	50
	White siccative	,,	160
	,, cobalt	,,	12,000
	,, iron:		
	Black, and red or colcothar	,,	250
	(Per) or peroxide of iron, hydrated, gelatinous	,,	500
	,, lithium or lithia	,,	16,000
	,, magnesia:		
	Calcined, common	,,	1,000
	XI.—CHEMICAL PRODUCTS, PHARMACEUTICAL COMPOSITIONS AND MEDICAMENTS IN GENERAL.—*contd.*		
	Oxides—*contd.*		Reis.
	Of magnesia:		
	Calcined, "Henry"	Kilog.	4,000
	,, manganese (per or bi)	,,	40
	,, mercury (proto, bi, or deuto), mercurious oxide, oxide, mercuric salt	,,	2,000
	,, nickel	,,	3,000
	,, gold	Gramme	500
	,, platinum	,,	300
	,, potassium or potash:		
	Pure or alcoholic potash	Kilog.	3,000
	Impure, caustic potash	,,	120
	,, silver	Gramme	50
	,, sodium or soda:		
	Pure or alcoholic soda	Kilog.	3,000
	Impure or caustic soda	,,	120
	Liquid	,,	30
	,, uranium	,,	16,000
	,, zinc:		
	Impure (white) or ceruse of zinc	,,	70
	Impure dust	,,	500
	Pure, sublimate, flowers of zinc	,,	800
	,, any metal, not otherwise mentioned	,,	800
302	Pancreatine, pure	Gramme	30
303	"*Papaina*"	,,	60
304	Chemical or medicinal papers of any kind	Kilog.	2,000
305	Pectoral or medicinal lozenges of any kind	,,	1,000
306	Medicinal pastilles or tablets of any kind	,,	1,000
	Pepsine	,,	4,000
	Phenates:		
307	Of soda (phenol of soda) and other mineral bases	,,	2,500
308	,, alkaloids or organic bases	Gramme	100
309	Medicinal pearls of any kind	Kilog.	3,200
310	Phosphates, pyrophosphates, and metaphosphates:		
	Of alumina	,,	4,000
	,, lime	,,	800
	,, cobalt	,,	11,000
	,, iron:		
	Simple (proto or deuto)	,,	1,500
	Of manganese and of other metals, and (pyro) simple, citro-ammoniacal, and of soda, liquid or solid	,,	3,000
	Pyrophosphates of iron and of quinine	Gramme	50
	,, lithium or lithia	Kilog.	16,000
	,, silver	,,	30,000
	,, nickel	,,	8,000
	,, soda:		
	Phosphate	,,	500
	Pyrophosphate or metaphosphate, and of ammonia	,,	1,500
	,, any metal, not otherwise mentioned	,,	2,400
	,, alkaloids or organic bases	Gramme	100
311	Phosphites and hypophosphites:		
	Of any metal	Kilog.	6,000
	,, alkaloids or organic bases	Gramme	100
312	Phosphurets of all kinds	Kilog.	5,000
313	Medicinal pills, balls and grains of every kind	,,	4,800
314	Piperine	Gramme	40
215	Podophylin	,,	15
316	Stag-horn, raw, or in powder or calcined	Kilog.	600
317	Medicinal powders, compounded:		
	Dover or ipecacuanha	,,	5,000
	James or antimonial powders	,,	4,000
	Of pepsine, of any kind	,,	20,000
	,, pancreatine, of any kind	,,	12,000
	Seidlitz of any kind not otherwise specified	,,	2,400
318	Pyridine	,,	6,000
319	Quinates of any kind	,,	10,000
320	Quinine and quinidine, and salts of the same, not otherwise mentioned	Gramme	50
321	Quinium of any kind	,,	16
322	Medicinal soap of any kind	Kilog.	1,000
323	Saccharates, saccharoles, and saccharides	,,	1,800
324	Salts:		
	For the manufacture of ice	,,	160

No. in Tariff.		Rates of Duty.	
	XI.—Chemical Products, Pharmaceutical Compositions and Medicaments in contd.		
	Salts—*contd.*		Reis.
	Vichy, for bathing and drinking, and Carlshad	Kilog.	1,300
	Of any other description	,,	2,400
325	Salicine	Gramme	10
326	Sarsaparilla (Sands, Bristol, Ayer, and other fluid extracts)	Kilog.	2,000
327	Santonine	,,	10,000
328	Silicates:		
	Pure, for medicinal use	,,	1,200
	Impure, for the arts, liquid or solid	,,	80
329	Stearates:		
	Of any metal	,,	2,000
	,, alkaloids or organic bases	Gramme	100
330	Strychnine	,,	50
331	Succinates of any kind	,,	16

Note.—The translation of the Brazilian Customs Tariff will be continued in the next number of the *Journal*.

New Customs Tariff of Portugal.

With reference to the notification which appeared on page 390 of the May number of the *Board of Trade Journal*, a despatch, dated the 18th August last, has been received from Mr. M. de Bunsen, Her Majesty's Chargé d'Affaires at Lisbon, enclosing translation of the new Portuguese Customs Tariff, which will come into operation on the 1st of October next.

Tariff Proper.

(Note.—The column headed "Total Duty" refers to the duties leviable under the Portuguese General Tariff as modified by treaties between Portugal and other Powers. The additional duties for Custom House fees and Harbour Works, in the case of articles not governed by any of the treaties, are stated to be included in the rates specified in the final column.)

(*Note.*—Kilogramme = 2·204lb. avoirdupois. Decalitre = 2·2 Imp. Gallons. Milreis = 4s. 6d.)

No.	Articles.	Conventional Duty.	Three per Cent. for Custom House Fees.	Tax for Harbour Works.	Total Duty.
	Class VII.—Mineral Substances, Glass, Crystal and Ceramic Products.	Reis.	Reis.	Reis.	Reis.
111	Sulphuric and chlorhydric acids	Kilog. —	—	—	1
112	Azotic or nitric acid	,, —	—	—	30
113	Saltpetre	,, —	—	—	35
114	Sulphate of soda, potash, copper, or iron	,, —	—	—	5
115	Carbonate of potash, raw	,, —	—	—	7
116	Do. refined	,, —	—	—	55
117	Carbonate of soda, refined, dry, or crystallised	,, —	—	—	15
118	Chlorate of sodium, caustic alkali, solid or liquid	,, —	—	—	10
119	Chemical products, not otherwise distinguished	,, —	—	—	12 % *ad val.*
120	Earths for colouring, and ochres	,, —	—	—	6
121	Explosives, not otherwise distinguished, including tares	,, —	—	—	300
122	Dynamite and powder without cartridges, including tares	,, —	—	—	250
123	Gunpowder in cartridges, including shot and tares	,, —	—	—	350
124	Gypsum, calcined, and cements	,, —	—	—	3
125	Hydraulic lime and pozzolana clay	,, —	—	—	1
126	Marbles	1 % *ad val.*	—	2 % *ad val.*	3 % *ad val.*
127	Mineral oils for lighting purposes, pure or refined, and other residues	Kilog. —	—	—	62
128	Coal and coke	Ton —	—	—	325
129	Combustible fossils and their products, not otherwise distinguished	Kilog. —	—	—	2
130	Mineral waters, including tares	,, —	—	—	25
131	Minerals, manufactured	1 % *ad val.*	—	2 % *ad val.*	3 % *ad val.*
132	Glass vessels, common, of any colour	Kilog. —	—	—	20
133	Glass and crystal, in polished sheets, with or without frames	25 % *ad val.*	—	2 % *ad val.*	27 % *ad val.*
134	Glass and crystal, manufactured, not otherwise classified	Kilog. 100	3	7	110
135	Earthenware	,, —	—	—	100
136	Porcelain	,, 200	6	14	220
137	Ceramic products, not distinguished	,, —	—	—	2
	Class XI.—Miscellaneous Articles.				
260	Cotton seed oil	,, —	—	—	800
261	Fixed oils, vegetable, not otherwise mentioned	,, —	—	—	50
262	Volatile oils, not solid and not elsewhere specified	,, —	—	—	700
263	Camphor, refined	,, —	—	—	100
264	Oleaginous cotton seeds, cleaned	,, —	—	—	30
267	Fruits and seeds, for distilling, not otherwise mentioned	,, —	—	—	15
268	Barley, germinated, and yeast	,, —	—	—	5
269	Vegetable juices and materials, not otherwise mentioned	—	—	—	7 % *ad val.*
270	Soap	Kilog. —	—	—	50
271	Gelatine, glue, and fish gum	,, —	—	—	60
272	Glues, not otherwise mentioned	,, —	—	—	10
273	Wax, raw, cleaned, or its residues (gross weight)	,, —	—	—	20
274	Candles of any description	,, —	—	—	80
275	Ink (including the tare)	,, —	—	—	50
276	Varnishes, colours, and inks, not solid, not otherwise mentioned (gross weight)	,, —	—	—	30
277	Blacking (including the tare)	,, —	—	—	80
278	Acids, fatty, and margarine	,, —	—	—	60
279	Medicinal substances and perfumery, not elsewhere specified	—	—	—	7 % *ad val.*
280	Medicines, not otherwise mentioned (including the tare)	Kilog. —	—	—	300
281	Perfumery of every description (including bottles, but excepting the boxes of paper or wood)	,, 200	6	14	220
282	Matches of all descriptions	,, —	—	—	80

Free List. (B.)

(Articles free of Import Duty, but subject to a tax of 2 per cent. ad valorem, for works in Harbours and Bars.)

No.	Articles.
17	Mineral ore.
18	Sulphur, refined or unrefined.
32	Metallic antimony, pure or sulphurated.
33	Quicksilver or mercury.
39	Resins, gums, and resinous gums.
40	Concrete fixed oils.
41	Volatile turpentine oils.
42	India-rubber and gutta-percha.
43	Oleaginous seeds, not otherwise mentioned.
44	Dry materials for the arts.
45	Vegetable materials not classified.
46	Colouring materials and products.
47	Bromide, iodine, and phosphorus.
48	Arsenical acid.
49	Pyroligneous acid, marking 6° in the Beaumé areometer.
50	Azotate of soda.
51	Azotate of silver.
52	Carbonate of soda, natural.
53	Borate of soda.
54	Chloride of calcium
55	Boxes of chemical preparations and copies for study.
56	Miners' fuses.
57	Shreds and rubbish for paper paste, and paste in any shape for paper manufacture.
58	Ice.
59	Manures for agriculture.

ITALY.

Classification of Articles in Customs Tariff.

(*Note.*—Quintal = 220·4lb. avoirdupois. Kilogramme = 2·201lb. avoirdupois. Lira = $9\frac{6}{10}$d.)

The following decisions affecting the classification of articles in the Italian Customs Tariff have recently been given by the Italian Customs authorities:—

Phenic acid, containing 60 per cent. of light oil.—Category I., No. 8*a*. Duty, 38 lire per quintal.

Chlorhydrate of quinine.—Category III., No. 32*b*. Duty, 5 lire per kilog.

Carbonate of magnesia, natural.—Category III., No. 15. Duty, 5 lire per quintal.

NEW SOUTH WALES.

Modification of Customs Duties.

With reference to the notification that appeared on page 267 of the December number of the *Board of Trade Journal*, a communication, dated the 20th July last, has been received from the New South Wales Government statistician, enclosing copy of an Act modifying the Customs duties on certain articles imported into that colony. The following statement shows the new duties imposed by this Act which, up to the 30th of September next, is to be read with the previous Act of 1886, notice of which appeared in the December number of the *Journal*—that is, the old duties are leviable except in regard to the articles specified in the following Schedule (on which the new duties came into force on the 30th March last, and were to remain in force until the 30th September next, after which date the new tariff alone comes into operation):—

Classification of Articles.	Rates of Duty.
Cement ....per barrel	£0 2 0
Essences, flavouring and fruit, containing not more than 25% of proof spirit ....per gallon	0 4 0
Containing more than 25% of proof spirit, per gallon	0 11 0
Glucose, liquid and syrup ....per cwt.	0 3 4
„ solid .... „	0 5 0
Naphtha or gasoline ....per gallon	0 0 6

EXTRACTS FROM CONSULAR AND DIPLOMATIC REPORTS.

GERMAN LAW RESPECTING THE EMPLOYMENT OF COLOURS IN ARTICLES OF FOOD.

(See *Board of Trade Journal* for September, page 275, *seq.*)

THE WINE TRADE OF LA ROCHELLE.

Ib., page 279, *seq.*

BRITISH AND GERMAN TRADE IN BRAZIL.

Ib., page 280, *seq.*—"Unless it be in chemicals and drugs—and in earthenware—it is absurd to suppose that Great Britain enjoys the supremacy in any single article imported into this province."

ITALIAN TRADE DURING THE FIRST SIX MONTHS OF 1887.

Ib., page 282.

ASSOCIATIONS FOR THE DEVELOPMENT OF THE EXPORT TRADE IN GERMANY.

A despatch, dated the 23rd August last, has been received from Mr. R. Milbanke, her Majesty's Secretary of Legation at Coburg, respecting the forming of an association at Gotha for the development of the export trade. The following is an extract from the despatch in question:—

"It is intended, according to the local press, to found at Gotha an association for the development of the export trade of the manufactures of this part of Germany. Similar associations *(export-vereine)* have been established in various parts of the Empire with the object of facilitating the export of German goods to foreign countries by enabling the individual manufacturers to obtain, with little trouble, and but small cost, information as to the best markets for their goods, the kind of articles which will find most ready sale, etc.

"These associations intend, moreover, it is stated, to appoint representatives in the great commercial centres, as well as travelling agents, whose business it will be to furnish reliable information respecting the goods to be exported, and the state of the market as affecting the manufactures of the district to which they belong.

"It appears now to be considered advisable, in the interests of Thuringian trade, to establish such an association at Gotha."

EGYPT.

Drug Trade of Alexandria.

The exports of drugs from Alexandria during the last two years were as under. The effects of the Soudan war are traceable in the enormous reduction in the quantity of gum arabic exported:—

	1886.	1885.
Drugs proper	£37,131	£29,287
Chemicals, medicines, and perfumery	11,699	9,513
Gum Arabic....................	11,717	100,112
Wax	9,879	11,867

while among the imports the following are enumerated:—

	1886.	1885.
Indigo	£181,665	£251,822
Other dyes	36,791	43,698
Soap	131,608	112,618
Chemicals and perfumery	112,335	107,785
Olive oil	80,110	93,031
Spices	49,828	67,111

FRENCH COLONIES.

Vanilla-growing in Réunion.

The quantity of vanilla exported from the island of Réunion in 1885 was 111,229lb. (value £51,831), while in 1886, 110,308lb. (value £53,752) were shipped. The high prices lately realised by vanilla on the European markets have been a great temptation to many persons in Réunion to convert what little land they possess into vanilla plantations; but this happy state of things is not destined to a long life, vanilla being an article for which the demand is restricted, and its over-production must necessarily be attended by a great fall in value.

Essential Oils.

The industry of perfume manufacture is assuming considerable proportions in Reunion. At present the industry is mainly confined to the manufacture of essence of geranium, great tracts of land having been devoted to the cultivation of this plant. Other perfumes are as yet made on an insignificant scale only; but this industry may assume large proportions.

JAPAN.

Nagasaki Drug Trade.

The value of the imports into Nagasaki of Western (European ?) drugs, medicines, and chemicals in 1886 was £5037, against £3551 in 1885. Of dyes and paints £3982 worth was received in 1886, and £1876 the year before.

The exports include:—

	1886.		1885.	
	lb.	£	lb.	£
Camphor	5,096,674	76,194	4,288,918	80,300
Cuttlefish..........	2,017,472	39,822	2,166,091	38,444
Drugs (sundry)	—	2,200	—	3,290
Sulphur	1,061,356	1,716	1,053,604	2,241
Vegetable wax....	151,641	2,615	385,538	6,850

Sulphur Exports.

In 1886 4117 tons of sulphur were exported from Hakodate, of a value of £7960 6s. 8d., against 6260 tons 15cwt., valued at £11,529 7s. 6d., in 1885, being a decrease of 2190 tons and £6569 0s. 10d. The production was about the same as in 1885, and the prices did not vary. Of the quantity shipped, about 950 tons went to San Francisco and the remainder to New York. At the end of the year there were some 2500 tons of sulphur on hand, owing to difficulty in obtaining suitable vessels to take it away. It is anticipated that the production of sulphur during 1887 will be greatly in excess of former years, as a company has been formed to work the sulphur mines at Atosanobori, near Kushiro, and a line of rails will be laid from the works to Shibecha, a distance of nearly twenty-five miles; thence the sulphur will be conveyed by river to Kushiro, a distance of about forty-four miles. Hitherto great difficulty has been experienced in conveying the refined sulphur from the works to the river.

PERSIA.

Bushire Exports.

The following articles figure among the exports of the port of Bushire :—

	1886.	1885.
	Value	Value
Drugs and medicines	£2,216	£4,010
Dyeing and colouring materials	4,387	4,126
Gum	4,978	5,328
Opium	303,071	340,240
Perfumery	9,025	6,974

TRADE BETWEEN SPAIN AND THE UNITED KINGDOM.

(1.) *Imports into the United Kingdom from Spain.*

Principal Articles.		July, 1886.	July, 1887.
Chemical products unenumerated	Value	£3,792	£4,895
Copper ore and regulus	Tons	4,075	7,098
	Value	£59,712	£110,366
Manganese ore	Tons	1,150	2
	Value	£2,013	£8
Pyrites of iron or copper...	Tons	35,742	41,466
	Value	£65,511	£77,256
Quicksilver	lb.	285,567	289,125
	Value	£26,177	£25,250
Rags, Esparto	Tons	3,116	4,047
	Value	£18,476	£23,260

Total Value	1886.	1887.
July	£495,364	£681,501
August	£548,550	£660,821

(2.) *Exports of British and Irish Produce from the United Kingdom to Spain.*

Principal Articles.		July, 1886.	July, 1887.
Alkali	Cwt.	26,102	25,137
	Value	£9,624	£8,782
Caoutchouc manufactures	Value	£824	£930
Cement	Tons	2,030	502
	Value	£3,415	£970
Chemical products, including dyestuffs	Value	£2,603	£5,521
Coal products, including naphtha, etc.	Value	£231	£221
Manure	Value	£5,350	£4,808
Painters' colours and materials	Value	£1,503	£2,290
Paper of all sorts	Cwt.	481	349
	Value	£1,184	£760
Soap	Cwt.	196	186
	Value	£190	£207

Total Value	1886.	1887.
July	£221,722	£264,521
August	£233,447	£313,297

STATISTICS.

TRADE STATISTICS FOR AUGUST.

The Board of Trade Returns for August show the following figures :—

Imports.

	Aug., 1886.		Aug., 1887.
Total value....................	£27,321,351	....	£29,690,020

Exports.

	Aug., 1886.		Aug., 1887.
British and Irish Produce	£18,741,859	....	£19,788,299
Foreign and Colonial Produce (partly estimated)	4,640,586	....	4,162,080

Below are the details affecting drugs and chemicals :—

Imports.

		Aug. 1885.	Aug. 1886.	Aug. 1887.
Drugs, unenumerated..	value £	61,224	42,889	51,470
Chemical manufactures and Products, unenumerated—	value £	111,543	102,901	110,340
Dyestuffs, tanning material and crude chemicals, unenumerated—	value £	115,836	99,791	124,516
Alkali	cwt.	8,497	9,637	7,591
,, ...	value £	7,427	7,686	5,574
Brimstone	cwt.	74,694	20,987	36,842
,, ...	value £	20,316	7,429	7,862
Nitre (nitrate of soda)	cwt.	95,262	85,600	168,257
,, ,,	value £	53,755	43,705	73,445
,, (nitrate of potash)	cwt.	31,651	27,568	23,489
,, ,,	value £	24,033	26,088	19,658
Quicksilver	lb.	120,577	96,670	90,000
,, ...	value £	9,519	8,120	7,530
Bark (Cinchona)	cwt.	7,963	11,009	10,305
,, ...	value £	56,307	57,213	46,619
Gum Arabic	cwt.	3,388	1,796	3,840
,, ...	value £	12,582	7,600	18,392
Lac, seed, shell, stick, and dye	cwt.	9,927	7,092	11,929
Lac, seed, shell, stick, and dye	value £	31,149	18,733	30,216
Dyes and tanning materials—				
Bark (for tanners' or dyers' use)	cwt.	76,765	43,531	29,580
Bark (for tanners' or dyers' use)	value £	38,717	17,981	10,033
Aniline dyes	value £	20,815	23,409	21,978
Alizarin	value £	15,709	23,404	22,461
Other coal-tar dyes....	value £	400	550	418
Cochineal	cwt.	1,007	555	881
,, ...	value £	6,107	3,474	5,474
Cutch and gambier..	tons	2,179	3,220	2,757
,,	value £	45,416	75,679	65,363
Indigo	cwt.	1,756	700	778
,, ...	value £	28,557	12,356	12,616
Madder, madder root, garancine, and munjeet....................	cwt.	1,837	1,901	899
Madder, madder root, garancine, and munjeet....................	value £	2,745	2,430	1,110
Valonia	tons	3,268	2,361	2,806
,, ...	value £	50,564	31,033	36,162
Oils—				
Cocoa-nut	cwt.	10,469	11,793	6,989
,, ...	value £	15,828	15,965	9,556
Olive..................	tuns	2,180	1,814	2,280
,, ...	value £	85,525	68,292	77,307
Palm	cwt.	97,241	71,431	115,057
,, ...	value £	129,832	73,096	106,678
Petroleum	gals.	4,922,962	4,827,462	5,097,811
,, ...	value £	154,077	155,569	136,251
Seed, of all kinds	tuns	1,016	1,416	897
,, ...	value £	28,696	34,284	22,802
Train, blubber, and sperm	tuns	2,519	2,330	2,598
Train, blubber, and sperm	value £	68,626	55,302	50,362
Turpentine	cwt.	35,829	23,260	64,091
,, ...	value £	46,274	30,974	81,216
Rosin	cwt.	103,557	120,987	96,995
,, ...	value £	30,031	38,884	22,478
Tallow and Stearine	cwt.	104,181	97,462	94,990
,, ...	value £	157,247	122,722	107,951

Exports.

		Aug., 1885.	Aug., 1886.	Aug., 1887.
British and Irish produce:—				
Alkali	cwt.	426,076	453,343	476,903
,,	value £	127,900	126,783	135,223
Bleaching materials	cwt.	110,498	129,387	119,893
,, ,,	value £	36,386	39,366	45,439
Drugs and medicinal preparations (unenumerated)	value £	74,062	61,130	74,176
Other chemicals and medicinal preparations	value £	159,836	161,126	186,303
Chemical manure	value £	141,413	128,507	151,138
Oil (seed)	tons	5,004	3,794	4,910
,,	value £	117,534	85,055	106,758
Soap	cwt.	28,411	35,544	33,675
,,	value £	31,879	35,127	31,459
Painters' colours and materials (unenumerated)	value £	99,681	96,991	125,694
Foreign and Colonial merchandise:—				
Bark, Cinchona	cwt.	8,425	7,960	9,395
,, ,,	value £	43,521	36,580	30,042
Chemicals (unenumerated)	,,	16,309	11,132	18,637
Cochineal	cwt.	1,038	870	498
,,	value £	6,350	5,793	3,251
Cutch and gambier	tons	925	1,077	678
,, ,,	value £	18,252	27,740	18,034
Gum Arabic	cwt.	4,984	4,388	5,077
,,	value £	17,123	18,005	22,086
Indigo	cwt.	3,228	3,248	2,081
,,	value £	67,915	59,183	42,519
Lac, various kinds	cwt.	4,455	4,569	6,307
,, ,, ,,	value £	13,905	10,545	15,810
Lard	cwt.	2,505	2,216	2,257
,,	value £	4,954	4,188	3,196
Oils, cocoa-nut	cwt.	9,919	8,628	3,058
,, ,,	value £	15,178	12,614	3,931
,, olive	tuns	168	216	221
,, ,,	value £	8,515	9,115	7,592
,, palm	cwt.	21,340	21,989	27,863
,, ,,	value £	28,820	25,863	24,800
,, petroleum	gals.	59,876	35,509	27,772
,, ,,	value £	3,848	1,356	1,216
Quicksilver	lb.	486,678	296,411	468,300
,,	value £	36,709	26,699	42,936
Nitre (nitrate of potash)	cwt.	7,064	1,768	3,345
,, ,,	value £	5,929	1,454	2,768
Tallow and stearine	cwt.	5,384	16,257	35,060
,, ,,	value £	8,012	18,452	38,130

ANNUAL PRODUCTION OF ALKALI, ETC., IN UNITED KINGDOM.

By the kind assistance of Mr. E. K. Muspratt, hon. sec. to the Alkali Manufacturers' Association, I am enabled to append a tabular statement of the amount of the various products of the soda industry, annually produced from the year 1877 to 1886.

Year.	Salt decomposed.	Alkali 48 %.		Soda Crystals.	Caustic Soda.	Bleaching Powder*	Bi-carbonate of Soda.	Total.
		Lebl'nc Process	Ammonia pr'cess					
1877	578,201	217,556	6,220	169,769	74,663	105,529	12,109	1,164,017
1878	568,542	196,876	11,116	170,872	81,612	105,044	11,756	1,118,818
1879	615,287	230,683	15,526	185,319	86,511	115,290	13,083	1,126,699
1880	700,016	266,093	18,800	192,926	106,384	131,606	13,539	1,429,361
1881	675,099	238,687	20,400	203,773	108,310	135,826	12,853	1,394,948
1882	679,935	233,213	39,000	180,816	116,861	135,170	14,115	1,399,143
1883	705,732	227,281	52,750	188,678	119,929	141,868	12,609	1,452,188
1881	690,502	204,072	61,480	182,567	111,639	128,651	11,576	1,423,487
1885	722,472	181,597	77,530	202,705	111,954	132,761	15,179	1,180,198
1886	713,112	165,782	85,000	182,379	153,884	136,234	15,083	1,454,465

* This includes chlorate of potash, taking 5 tons of bleaching powder for 1 ton of chlorate. The amount of chlorate now made is 7000 tons per annum.

STATISTICS OF THE GERMAN SODA INDUSTRY.

(From a lecture delivered before the British Association at Manchester, by Mr. A. E. Fletcher, H.M. Chief Inspector under Alkali, etc. Works Regulation Act.)

By the kindness of Mr. Hasenclever, of Aachen, I am enabled to give the following statistics of the German soda industry. There has been a great development of it since the year 1879, when a change was made in the excise regulations which affect the trade. At that time, and for some years previously, soda, equal to about 27,000 pure carbonate, had been imported from abroad, this being about 40 per cent. of the quantity consumed in the country. Since that period the production has increased so as to stop importation, and to leave a small balance for export. At the same time the price has fallen from 20s. to 8s. per kilo—48 per cent. soda ash.

There are in Germany twenty-four alkali works, from which the yearly output is a quantity equivalent to 150,000 tons pure carbonate. This is against an output in 1878 of 42,000 tons. This rapid growth is shown in the following tabular statement:—

Import and Export of Foreign Soda to or from Germany. Amount given in tons.

Year.	Soda Ash.	Caustic.	Crystals.	Bi-carbonate.	Total Calculated as Pure Carbonate
1872	7,513	1,331	10,977	238	12,211
1873	10,101	1,858	12,306	472	16,093
1871	15,413	3,751	11,040	401	22,638
1875	16,064	5,980	11,381	517	26,101
1876	14,412	7,831	13,253	503	27,500
1877	14,530	7,915	10,679	510	26,787
1878	14,111	9,275	9,219	452	27,474
1879	15,911	6,887	10,686	366	26,475
1880	6,061	9,373	10,053	263	20,512
1881	6,310	5,266	10,833	327	16,132
1882	5,598	6,131	7,332	297	15,251
1883	887	4,748	2,076	206	7,917
1884	*7,318*	1,973	2,037	250	*3,305*
1885	*8,962*	2,299	282	112	*6,270*
1886	*9,150*	676	*1,759*	120	*10,204*

* The figures printed in italics indicate exports, the plain figures imports.

Mr. Hasenclever adds that it is, in his opinion, impossible for Germany to carry on permanently an export trade in soda products, since in England all the raw materials for that industry are cheaper, and the alkali works are better situated in relation to the seaports.

MISCELLANEOUS.

CHILIAN BORAX.

From some analyses made by Senor Emil Eisele, of Valparaiso, and by Mr. J. Clark, of London, of several samples of crude Chilian borax, it would appear that Chili is capable of producing at least as good borax as California, the quality being equal to a good deal of that which comes from Italy. The attempts which are being made to open up a borax industry in Chili would, therefore, seem likely to prove successful.

TRADE IN NEW PERFUMES.

The Danish *Archiv for Pharmaci of teknisk Chemi* for July of this year describes two new vegetable perfumes which have lately become articles of commerce. One of these is a kind of *xylopia* from the province of Chirigui in Costa Rica. The odour closely resembles that of *canaga odorata*, and the flowers are now used, like those of that plant, in the manufacture of ylang-ylang. The other is named *ouco*, and is the extremely odorous blossom of a kind of acacia-tree which is found in Central Africa, and which Serpa Pinto was the first to describe. The *ouco* flowers are brought down the Cubangin river for sale; they cover the trees on which they grow with such profusion that they fill the atmosphere with the overpowering richness of their scent.

PRODUCTION OF MALVA FIBRE IN BRAZIL.

The Belgian *Bulletin du Musée Commercial* for the 13th August last, quotes from the *Journal Commercial et Maritime* an article on the growth of *malva* in the province of Céara in Brazil. Until lately this plant, the *orena lubata*, was looked upon as a weed; it now proves to be a considerable source of wealth. The fibre of the *malva* forms an excellent material for the manufacture of sacks, and is found to take the place of jute. It is beginning to be largely exported for manufacturing purposes to Europe. The preparation of the *malva* fibre is easy and cheap, and if machinery of a suitable kind were introduced from Europe it might be produced on a large scale. The journals of Céara assert that their province contains in abundance other textile plants, which need only to be prepared to become a source of revenue.

Imports of Medicines.

The following table shows the amount of duty collected by the Customs on the importation of the articles named for the years ending March 31, 1886 and 1887, respectively :—

——	1887.	1886.
	£.	£.
Chloroform	2	6
Chloral hydrate	979	1015
Collodion	16	6
Ether, sulphuric	15	5
Ethyl. iodide of	—	—
Naphtha, purified	—	—
Soap, transparent, in the manufacture of which spirit has been used	180	224
Varnish containing alcohol	112	91

As the duty on chloroform is 3s. per lb., it appears that the total quantity of that article imported from abroad last year was under 14lb. The duty on chloral hydrate is 1s. 3d. per lb. The total import of the chemical for home consumption was therefore 15,664lb.—*C. and D.* 10. 9. 87.

Recent Trade Blue Books.

Mining and Mineral Statistics of the United Kingdom of Great Britain and Ireland, including Lists of Mines and Mineral Works for the year 1886, and a list of plans of abandoned mines. (C—5132) Price 3s. 7d.

Special Report from the Select Committee on Merchandise Marks Act (1862) Amendment Bill, together with the Proceedings of the Committee Minutes of Evidence and Appendix. 203. Price 4s. 4d.

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS AND MACHINERY.

APPLICATIONS.

11412 B. H. Thwaite, Liverpool. Improvements in methods of calcining and heating argillaceous, calcareous, and metalliferous substances and any mixture thereof, and in apparatus therefor. August 22

11456 W. S. Squire, London. Improvements in machinery for the separation of solid matters from liquids, and for washing out and exhausting the solid matters so separated. August 23.

11473 C. Kasefang, London. Taps or cocks specially adapted for the delivery of fluids under pressure. August 23

11519 P. Hodkinson, London. Apparatus for consuming smoke in steam-boiler and other furnaces. August 24

11549 G. Large, Wolverhampton. A water tuyere with a false nose or nozzle for use in hearths, cupolas, furnaces, etc. August 25.

11609 J. E. Warren, London. Means and apparatus for filtering water and other fluids. Complete specification. August 26

11622 N. Petersen, London. Improvements in furnaces. August 26

11628 C. Howe, B. Beckwith, and J. H. Beckwith, London. Apparatus for generating secondary steam ; specially applicable for distilling water. August 27

11636 R. Robson, Leeds. Atmospheric injector, for improving draught and consuming smoke in furnaces. August 27

11780 R. Cahn, London. Cooling apparatus. , August 30

11811 J. H. Hayes, London. Improved means for regulating the supply of gas and other fluids or liquids. August 31

11865 R. Gough, London. New or improved filter. September 1

11876 F. W. Cannon, G. P. Addison, and F. R. Burnett, London. Method and apparatus for generating steam. September 1

11877 J. Nicholas and H. H. Fanshaw, London. Construction of water or liquid gauges. September 1

11887 W. Fairweather—From the Babcock and Wilcox Company, United States. Drumheads and manifolds for sectional steam generators. Complete specification. September 2

11894 B. D. Healey, Bamber Bridge. Making and working furnace rocking bars. September 2

11929 B. Willcox—From M. Perret, France. Firebars or grates for furnaces. September 2

11981 W. Leigh, London. Amalgamating apparatus. September 3

11984 H. F. Green, London. Processes and apparatus for producing currents of air, spray, and gas, and for purifying, disinfecting, and chemically treating the same. September 3

12003 J. R. Alsing, London. Method of and apparatus for reducing sawdust, straw, and other vegetable substances to an impalpable powder or to a pulp, the apparatus being also applicable for pulverising hard substances. Complete specification. September 5

12038 J. S. Doran—From J. Reilly, United States. Heating apparatus. September 6

12071 J. von Ehrenwerth, London. Improved regenerative gas furnace with periodical action. Complete specification. September 6

12088 R. H. Brownhill, Manchester. Rotary pumps for raising and forcing liquids. Complete specification. September 7

12153 F. H. Danchell, London. Filter-presses. September 8

12169 P. Altieri, Naples. Preventing and removing the incrustations in steam boilers—known as "Vegetable Disincrustant." Complete specification. September 8

12180 G. Seagrave, London. Apparatus for heating or cooling air, gas, or other fluids. September 8

12216 H. L. Currier, London. Method and apparatus for removing the scale and other deposits from steam boiler and other tubes. Complete specification. September 9

12249 W. McElroy and H. Connett, London. Machines and apparatus for carbonating liquids. September 9

12293 W. P. Thompson—From W. Jäger (W. Pataky), Prussia. Centrifugal machine filters. Complete specification. September 10

12352 T. L. G. Bell, London. Means and apparatus for distilling sulphur, tar, rosin, arsenic, sal-ammoniac, and the like. September 12

12357 R. M. Bryant, London. Anti-incrustation preparation for steam boilers. September 12

12455 H. W. Lewis, London. An improved press for compressing cotton, jute, sewage, clay, china clay, small coal, artificial fuel, tar, yeast or barm, etc., into partly solid blocks. September 14

12594 J. H. Hayes, London. Means for regulating the supply of gas and other fluids or liquids. September 16

12627 G. F. Deacon, Liverpool. Apparatus for disintegrating the flow of liquids. September 17

12631 O. Imray—From La Compagnie Industrielle des Procédes Raoul Pictet, France. An improvement in refrigerating apparatus. September 17

12685 D. Mellor, London. Furnaces and furnace bars. September 19

*COMPLETE SPECIFICATIONS ACCEPTED.**

1886.

12475 J. Y. Johnson—From L. Labeyrie. Automatic valve for steam and other pipes or conduits conveying fluids under pressure. August 31

12907 A. Brin and L. Q. Brin. Apparatus for combustion of liquid, gaseous, or pulverulent fuel, for generating steam, etc. September 14

13605 J. Cooke. Composition for preventing and removing incrustation and corrosion in boilers. September 3

13789 F. Siemens. A combined evaporating and calcining furnace. August 27

13861 J. Bernhardi. Apparatus for distilling, condensing, heating, cooling, and extracting operations. August 31

13959 J. Howie and T. Groves. Open kilns. September 3

14141 R. Cunliffe and J. Lund. Apparatus for calcining, drying or roasting materials, and extracting gases or acid therefrom. September 10

14349 G. Dietrich. Apparatus for promoting consumption of smoke by means of air and steam jets. September 14

14415 E. A. Cowper. Filter-presses. September 21

14535 C. A. Sahlströhm. Apparatus for burning oil, tar, and similar substances. September 17

14643 T. Gilmour. Feed-heating apparatus. September 17

14873 H. H. Lake—From M. Hanford and C. C. Hanford. See Class XVI.

14967 E. O. Cooper and W. T. Cooper. Preventing and removing calcareous incrustations. September 21

15006 T. Routledge—From A. Abadie, France. Apparatus for crushing, grinding, triturating, disintegrating, reducing or preparing fibrous materials, or mineral, chemical, oleaginous, or other substances. August 31

1887.

3848 C. J. Buhring. Filtering apparatus. September 21

8260 M. Lachman—From J. J. Rauer. Apparatus for automatically supplying gas to closed vessels at a regulated pressure. August 31

10393 E. W. Tucker. Hot air bridge walls for furnaces. August 27

10451 O. D. Orvis. Means for consuming smoke and gases in furnaces. August 31

10535 H. Davey. Air-compressing pumps. August 31

10723 R. Cunliffe and J. Lund. Apparatus for calcining, drying, roasting or carbonising materials, and extracting gases, spirits, or acids therefrom.

11035 R. Clayton. Construction of filters.

II.—FUEL, GAS AND LIGHT.

APPLICATIONS.

11367 G. Thew, J. Stansfield, and G. Long, Farnworth. Making illuminant gas and other chemical products from human excreta. August 20

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* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

11439 W. C. P. Asselbergs, London. Improvements in hydraulic mains for gas works. Complete specification. August 22

11440 W. C. P. Asselbergs. Improvements in apparatus for purifying or washing gas. August 22

11450 A. Eichelbrenner, London. Improvements in the manufacture of illuminating gas. August 22

11537 O. Bowen and A. S. Tomkins, London. Improvements in the manufacture of charcoal. August 24

11627 J. A. Walker, Farnham. An improved means of obtaining greater heat and generating steam more rapidly in boilers by the agency of liquid fuel. August 26

11783 J. Hall, London. Improvements in machinery for the manufacture of artificial fuel. August 30

12129 J. McEwen, London An improved double purifier or gas washer. Complete specification. September 7

12229 A. Kitson, Philadelphia. Improvements in carbureting gas lamps. Complete specification. September 9

12451 J. T. Williams, London. Improvements in treating anthracite coal, and in machinery or apparatus therefor. September 14

12481 W. H. Nevill, London. Improvements in artificial fuel for heating and gas producing purposes. September 14

12519 J. Orchard and H. Lane, London. Improvements in means and apparatus for producing and utilising heat and energy arising from the combustion of gases. September 15

12,560 A. Hill, Birmingham. Improvements in incandescent gas fires. September 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

8163 R. Stone. Manufacture of fuel, and apparatus therefor. August 24

12340 A. G. Meeze. Apparatus for the manufacture of gas from fluid hydrocarbons. September 21

13578 H. H. Lake—From G. Godeffroy. Preparation of fuel. August 27

13637 R. Combret. Manufacture of blocks of artificial fuel. August 27

13752 W. M. Chinnery and H. Hill. Apparatus for inducing complete combustion of mineral oil, gases or smoke, to be used for heating or lighting. August 27

13922 W. H. Lindsay. Apparatus for moulding coal dust or small coal into solid blocks. August 24

13985 W. H. Lindsay. Manufacture of artificial fuel. Aug. 27

15007 C. S. Court, H. Veevers, and M. Schwab. Continuous process for the purification of coal gas from sulphur compounds, by which the sulphur is recovered. September 21

15621 B. H. Thwaite. Method of generating gaseous fuel, and apparatus therefor. September 21

1887.

8953 R. B. Avery. Method and apparatus for generating gas for illuminating, heating, and metallurgical purposes from liquid hydrocarbons. September 21

10102 A. J. Boult—From W. C. Shaffer. Application of the expansive power of heat, and apparatus therefor. September 14

11201 J. Tennent. Heating air and other fluids. September 21

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATIONS.

11689 A. H. Allen and R. Angus, Sheffield. Improvements in the treatment of the oil or tar obtained by condensation from the gases of blast furnaces, gas producers and coke ovens, or by the distillation of bituminous shale, and in the utilisation of the products therefrom. August 29

11716 M. L. Honnay, London. A new or improved process for enriching pitch obtained by the evaporation of tars produced from coal. August 29

11805 S. Banner, Liverpool. Improvements in treating resins, oleo resins, gums, pitches, varnishes, bitumens, and other like substances. August 31

12090 Watson Smith, Manchester. The employment of the phenoloid bodies obtained from the tar or oil condensed from blast furnaces, coke ovens, or similar gases, or from the distillation of bituminous shale, in the manufacture of waterproofed indiarubber goods. September 7

COMPLETE SPECIFICATION ACCEPTED.

1887.

13929 H. Ellison and G. E. Davis. Method for distillation of coal tar, the oils from coke ovens, and other similar fluids. September 11

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

11879 C. D. Abel—From C. Wachendorff (of R. Koepp and Co.), Germany. Production of compounds of antimonic fluoride with alkaline fluorides and alkaline chlorides, and the application thereof and of known combinations of these substances to dyeing and printing. September 1

11880 C. D. Abel—From the Actiengesellschaft fur Anilin-Fabrikation, Germany. Process for the production of azo colouring matters. September 1

11976 J. Imray—From La Societé Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Poirrier and D. A. Rosenstiehl, France. Production of azoic colouring matters. September 3

11988 J. Dawson, Kirkheaton, and R. Hirsch, Huddersfield. The manufacture of rosaniline sulpho acid. September 5

11989 J. Dawson, Kirkheaton, and R. Hirsch, Huddersfield. The manufacture of a new alpha-naphtylamine-disulpho acid. September 5

12020 J. Imray—From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Poirrier, and D. A. Rosenstiehl, France. Production of new azoic colouring matters. September 5

12285 E. Bentz, Manchester. Improvements in the manufacture and composition of oil compounds for dyeing and calico printing, and such like purposes. September 10

12355 J. Imray—From La Societe Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Poirrier and D. A. Rosenstiehl, France. Production of new tetrazoic colouring matters. September 12

12549 H. H. Lake—From Wirth and Co., agents for K. Oehler, Germany. Improvements in the manufacture of colouring matters. September 15

12667 C. S. Bedford, Liverpool. New or improved colouring matters, and process of manufacturing the same.

12692 J. Imray—From La Societe Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, France, A. F. Poirrier and Z. Roussin. Production of colouring matters by combination of nitro-diazobenzoles and their analogues with isomers of naphthionic acid. September 19

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

14283 J. Anraheim. Methods of treating oxynaphthol and aniline or its homologues, obtaining certain products, and utilising the same in the manufacture of dyes. September 7

14625 J. H. Johnson—From the Badische Anilin and Soda Fabrik. Preparation of red colouring matters. September 17

15363 D. Stewart. Preparing grey and black colouring matters, to be applied to textile fabrics. September 21

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

11141 W. S. Archer, London. Improvements in machines for opening or separating and cleaning cotton or other fibrous material. August 22

11570 S. S. Bromhead—From U. C. Allen, United States. An apparatus for separating wool, silk, or other animal fibre, from vegetable fibre or other vegetable matter. Complete specification. August 25

11612 H. Martinz, London. Improvements in machinery for preparing or dressing textile fibres. Complete specification. August 26

11665 W. Nelson and E. Bowen, London. An improved machine for drying wool. Complete specification. Aug. 27

12365 J. Nasmith, Manchester. Improvements in and apparatus for combining fur or fur waste with fabrics made from cotton, wool, or other fibrous substances. September 13

12506 J. Fitton, J. Fitton, jun., and E. Fitton, Bradford. An improved method of and apparatus for carbonising or destroying vegetable matter contained in or mixed with woollen, silk, or other animal fibre or fabric. September 15

12709 W. Nelson and E. Bowen, London. An improvement in machinery or apparatus for drying wool. Complete specification. September 19

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

11610 A. C. Henderson—From La Société Charles, Vignet, Sons & Co. Method and apparatus for dressing or sizing textile fabrics. August 31

1887.

9274 E. W. Serrell, jun. Process and machinery for reeling silk from the cocoon. September 21

VI.—DYEING, CALICO PRINTING, PAPER STAINING AND BLEACHING.

APPLICATIONS.

11355 W. J. S. Grawitz, London. The preparation of cotton fibres for dyeing. August 19

11391 J. H. Gartside and J. Barnes, Manchester. Improvements in dyeing cotton and other vegetable fibres and yarns, and fibres composed thereof. August 20

11497 A. Graemiger, London. Processes of and apparatus for dyeing, scouring, bleaching, and otherwise treating yarn in cops. Complete specification. August 23

11525 J. Farran, Manchester. Improvements in bleaching certain materials. August 24

11812 J. Smith and P. W. Nicolle, Jersey. Improvements in bleaching cotton, flax, jute, rhea, esparto, and similar fibres and fibrous substances. August 31

11879 C. D. Abel—From C. Wachendorff (of R. Koepp and Co.), Germany. See Class IV.

12004 A. C. Henderson—From U. A. G. Herisson and G. Lefort, France. Improvements in bleaching vegetable fibres of all kinds, whether raw or manufactured. September 5

12075 B. Willcox—From the Farbenfabriken Vormals, F. Bayer and Co., Germany. A new process or means for producing azo colour upon animal or vegetable fibres or fabrics in printing or dyeing. September 6

12144 T. F. Naylor, Kidderminster. Improvements in dyeing yarns. September 8

12283 M. Ashworth and R. Wild, Rochdale. Improvements in apparatus or machinery for washing, scouring, or bleaching fibres, fibrous materials, and textile fabrics. September 10

12358 T. Sampson and F. H. Jealous, London. Improvements in the dyeing of yarn and other fibrous materials, and in means or apparatus employed therein. Complete specification. September 13

12502 J. Birtwistle, Manchester. Improvements in the printing of textile fabrics. September 15

12522 T. Skene and L. Devallee. Improvements in machines for dyeing wool and other textile materials. September 15

12602 C. T. Clegg, H. A. Clegg, and F. Lee, Manchester. Improvements in apparatus for dyeing wool, cotton, silk, or other similar fibrous material. September 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

11981 A. Hodgkinson. Cleansing composition for use in bleaching cotton and linen fabrics or yarns, etc. August 31

13814 A. Aykroyd, W. E. Aykroyd, and J. Smith. Aniline black dyeing or printing processes for obtaining a fast aniline black in textile fibres and fabrics. September 14

1887.

4953 A. Brin and L. Q. Brin. Bleaching fibrous substances for paper making. September 10

VII.—ALKALIS, ACIDS AND SALTS.

APPLICATIONS.

11449 J. Clark, London. Improvements in obtaining chloride of aluminium, etc. August 22

11456 W. S. Squire, London. See Class I.

11492 H. H. Lake—From A. Kayser, H. Williams, and A. B. Young, United States. Improvements relating to the production of caustic alkali carbonates of the alkaline metals, muriatic acid, and other substances. Complete specification. August 23

11493 H. H. Lake—From A. Kayser, H. Williams, and A. B. Young. An improved method or process of producing silicate of sodium or of potassium. Complete specification. Aug. 23

11494 H. H. Lake—From A. Kayser, H. Williams, and A. B. Young. An improved method or process of producing muriatic acid. Complete specification. August 23

11500 C. J. E. de Haën, Liverpool. Improvements in the manufacture and application of the compounds of fluoride of antimony with the combinations of the chlorides of sodium, potassium, and ammonium, and phosphates of soda, potash, and ammonia. Complete specification. August 23

11653 F. P. E. de Lalande, London. Improvements in the manufacture of caustic soda and potash. August 27

11799 R. Wyllie, Liverpool. Improvements in and connected with apparatus for distilling ammoniacal liquors. August 31

11821 T. Schloesing, Paris. Extraction of chlorine from solutions of chloride of magnesium. August 31

11846 G. E. Davis, Manchester. An improved method of manufacturing alkalis. September 1

12219 W. McElroy and H. Connett. See Class I.

12674 W. L. Wise—From G. M. Tauber, Saxony. Process for the manufacture of sodium-ammonium-sulphite and converting the same into sodium sulphite and sodic hydrate. September 19

12700 S. Pitt—From V. Ragosine and P. Dvorkovitch, Russia. Method of producing anhydrous sulphuric acid and its monohydrate, and of utilising for this purpose the acid residues of petroleum production and other, as also sulphates of all metals. September 19

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

10868 J. Lea and H. R. Hammond. See Class X.

12480 F. H. Gossage, T. T. Mathieson, and J. Hawliczek. Treatment of sulphate of sodium for manufacture of sulphide of sodium therefrom, and apparatus therefor. September 7

13286 A. Frank. Treatment of spent lyes used in manufacture of cellulose, by means of sulphites, for recovery of sulphurous acid therefrom, and utilisation of said lyes after such treatment. September 17

13389 E. Solvay. Continuous furnace for the production of chlorine. August 31

13762 W. Bramley and W. P. Cochrane. Manufacture of hydrate carbonate of magnesia and other products produced herein. September 3

14217 J. B. Hannay. Manufacture of sulphuric acid. September 10

14441 W. Burns. Manufacture of sulphuric acid under high pressure with agitation, and apparatus therefor. August 31

14673 E. Hermite, E. J. Patterson, and C. F. Cooper. Apparatus for preparation of bleaching solutions by electrolysis. September 17

14711 J. Simpson and E. W. Parnell. Apparatus for treatment of sulphuretted hydrogen for the separation of sulphur or the production of sulphurous acid. September 21

15182 E. P. Alexander—From E. J. L. Delsol. Obtaining mother-liquors free from magnesium salts in the manufacture of carbonate of potash by means of the double carbonate of potash and magnesia. September 21

15352 W. Burns. Manufacture of bichromate and carbonate of soda by the ammonia process, and apparatus therefor. September 14

VIII.—GLASS, POTTERY AND EARTHENWARE.

APPLICATIONS.

11495 A. J. Boult—From F. Czech, Austria. Improvements in decorating ceramic ware. Complete specification. Aug. 23

11513 J. S. Williams, Brierley Hill Glass Works. Improvements in frosting the surfaces of flint and coloured glass ware. August 24

11906 J. Budd, London. Improvements in the crystallisation of glass. September 2

12001 J. Miller and The Sowerby's Ellison Glass Works, Limited, London. Improvements in polishing cut glass of every description. September 5

12546 A. D. Brogan, J. French, and J. Craig, London. Improvements in and connected with glass annealing kilns. September 15

12566 C. G. Warne, Weston-super-Mare. Improvements in pottery kilns for the purpose of economising fuel and equalising the burning of the goods. September 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

12496 W. Horn and R. Bell. Shears used in the manufacture of glass bottles. September 17

14216 A. M. Clark—From E. Weis. Process for cutting very thin parts on glass articles. September 14

14288 G. F. Chance. Machinery employed in manufacture of sheets of rolled glass. August 31

14380 A. D. Brogan and A. M. Malloch. Manufacture of chequered glass, and apparatus therefor. September 7

14727 H. M. Ashley. Manufacture of bottles, etc. September 14

16613 J. Northwood. Treating the glass cullet known as blacks. September 21

1887.

87 W. H. Hales. Machinery for making pottery ware. August 21

10874 A. J. Boult—From P. Sivert. Glass furnaces. Sept. 10

IX.—BUILDING MATERIALS, CLAYS, MORTARS AND CEMENTS.

APPLICATIONS.

11509 H. Warrington and W. W. Howlett, Hanley. Improvements in bricks and other blocks for building purposes. August 24

11937 J. Homan, London. Improvements in the construction of fireproof floors. September 2

11996 S. G. Rhodes, Leeds. Making bricks. September 5

12271 J Davies, Manchester. Improvements in the construction of brick kilns. September 10

12503 E. Winsor, F. Winsor, and J. Winsor, Manchester. Improved method of treating clay or gypsum, and apparatus therefor. September 15

12524 G. J. Snelus, W. Whamood, and T. Gibb, London. An improved preparation or manufacture of cements. September 15

12525 G. J. Snelus, W. Whamond, and T. Gibb, London. Improvements in the preparation or manufacture of cements. September 15

12526 G. J. Snelus, W. Whamond, and T. Gibb, London. Improvements in the manufacture of cements. September 15

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

11303 E. Larsen. See Class X.

13981 W. H. Lindsay. Apparatus for moulding bricks or blocks. September 14

14674 W. Scott, J. C. Swan and H. Smith. Manufacture or treatment of Portland and other hydraulic cements. September 14

15012 H. Macevoy, H. Holt, L. White, and W. Wilders. Manufacture and burning of Portland cement. September 14

1887.

10898 E. Keirby. Compound or cement for making and renovating asphalte walks, protecting masonry, and analogous purposes. September 17

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

11432 G. French, London. An improved method of blasting in coal mines and in other places, and in materials to be used therein. August 22

11449 J. C. Clark. See Class VII.

11474 P. C. Gilchrist, London. Improvements in the manufacture of steel and ingot iron by the basic process. Complete specification. August 23

11478 L. L. Lefevre, jun.—From C. Payen, United States. Improvements in the manufacture of crystallised metal, and in articles made thereof. August 23

11510 F. Fenton and R. J. Partridge—From J. Woolford, France. Improvements in plant, apparatus, furnaces, or retorts for extracting auriferous and other metallic ores, slags, cinders, or wastes. August 24

11516 E. Cope and A. Hollings, Liverpool. Improvements in hollow steel shafting, and in the manufacture of the same. August 24

11532 G. Gatheral, London. Improvements in the treatment of ores for the extraction of copper therefrom, or of ore residues and the like, for the elimination of copper or other impurities. August 24

11556 J. McCann, Millom. The improvement of blocks and tuyeres connected with blast furnaces. August 25

11571 R. E. Shill and A. Martin, London. Improvements in hardening or chilling the face of armour and other plates and projectiles. August 25

11613 F. A. Herbertz, London. Improvements in cupola smelting furnaces. Complete specification. August 26

11672 M. M. Bair, London. Improvement relating to the volatilisation of lead, antimony, and other substances, and to the condensation of the resulting vapours. August 27

11733 J. E. Bennett, Manchester. Improvements in the treatment of metallic chlorides for the extraction of metals therefrom. August 30

11797 A. M. Crossley, Glasgow. Improvements in preparing ferruginous material for smelting. August 31

11862 C. F. Clark and J. Sanders, London. Improvements in preparing moulds for casting hollow-ware, and in apparatus employed therein. September 1

11868 J. Gilligan, London. Improvements in the working up of scrap iron and steel, either separately or together in a puddling furnace. September 1

11898 N. Arthur, Heaton. Improved method and apparatus for bending angle, tee, and other sections of bars. Sept. 2

11900 A. J. Shannon, London. Improvements in the extraction of antimony from its ores. September 2

11928 J. W. Swann, London. Improvements in apparatus for indicating the presence of fire-damp in coal mines or other places. September 2

11945 H. A. Rowland, Manchester. Improvements in the casting of metals. September 3

12032 L. B. Atkinson, H. W. Ravenshaw, and F. Mori, Halifax. Improvements in machines for cutting, boring, or drilling coal or other minerals. September 6

12042 W. P. Thompson—From C. Kellogg, United States. Improvements in machines for rolling seamless tubes, pipes, or other hollow articles from hollow ingots. Complete specification. September 6

12111 W. P. Thompson—From E. Dumas, Paris (agent for Bickford, Smith & Co.) Improvements in electric fuses for mines. September 7

12162 C. Humfrey, Liverpool. Improvements in or appertaining to the manufacture of sodium. September 8

12210 J. T. King—From H. Kennedy, United States. Improvements in connection with hot blast stoves and furnaces. Complete specification. September 9

12269 G. Hardy, Abram, Lancashire. An improved miners' safety lamp. September 10

12272 G. Siddell, Sheffield. An improved process in iron and steel. September 10

12277 A. J. Shannon, London. Improvements in the treatment of zinc ores. September 10

12332 S. Pearson, A. W. Turner, and W. Andrews, Birmingham. A new process of extracting aluminium from minerals, and also making aluminium alloys therefrom. Complete specification. September 12

12346 J. D. Ellis, London. Improved method of making iron or steel castings. September 12

12347 T. J. Tresidder, London. Improved means for hardening metal. September 12

12353 H. Le Neve Foster, London. An improved fire-resisting compound, especially suitable for forming the stoppers and nozzles used in steel melting operations and other similar purposes. September 12

12378 B. H. Thwaite, Liverpool. An improved pneumatic steel process, and plant therefor.

12458 H. Bird, Liverpool. Treating the residual spent iron liquors resulting from the manufacture of copper from burnt cupreous sulphur ores to obtain a certain oxide of iron therefrom, and apparatus to be used therefor. September 14

12486 O. M. Thowless, London. Improvements relating to the production of sodium and potassium, and to apparatus therefor. Complete specification. September 14

12540 A. B. Cunningham, London. Improvements in the manufacture of sodium and potassium, and in apparatus therefor. September 15

12575 A. Feldman, London. Improvements in the production of aluminium and alloys of aluminium. September 15

12590 H. Lane, London. Improvements in shaping, forming and manipulating metals. September 16

12616 J. Thomas, Middlesbrough-on-Tees. Improvements in ingot moulds. September 17

12683 F. M. A. Laurent-Cely, London. Improvements in the manufacture of spongy lead suitable for electrical accumulators. September 19

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

10868 J. Lea and H. R. Hammond. Operating on zinc ore for producing chlorine and zinc, and utilising the said zinc for coating metals. August 31

11249 W. S. Squire and S. C. C. Currie. Obtaining zinc in metallic form from alkaline solutions of zinc oxide. September 7

11303 E. Larsen. Manufacture of furnace slag and of cement partly made therefrom. September 10

12011 T. Blackmore. Metallic chill core. September 11

12362 C. J. Sandahl, J. Birchall, and J. Musson. Manufacture of iron and steel, and blast furnaces employed therein. August 27

12363 C. J. Sandahl, J. Birchall, and J. Musson. Manufacture of iron and steel. August 27

12630 W. S. Squire and S. C. C. Currie. Obtaining metallic zinc from its ores. September 7

12729 G. M. Edwards. Process and apparatus for treating, dressing, and cleaning tin and other mineral ores. August 27

13503 E. Wheeler. Production of metal bodies or ingots. August 31

13562 P. M. Justice—From W. B. Spear. Coating metal sheets with other metal. August 27

13680 B. C. Tilghman. Drawing iron and steel bars through dies to produce a smooth surface suitable for shafting. August 21

13920 T. Nordenfelt. Manufacture of iron and steel castings. August 27

14061 J. B. Hannay. Obtaining gold from refractory ores, etc. August 21

14169 T. Nordenfelt—Partly from C. G. Wittenström, E. Faustman, and P. Ostberg. Bessemer converters, and manufacture of castings thereby. September 10

14220 R. W. Lindsay and W. Darwen. Manufacture of tubes of copper or copper alloys. August 31

14385 E. Patterson and W. H. Strype. Miners' safety lamps. September 14

14407 O. M. Thowless. manufacture of aluminium chloride, and extraction of aluminium therefrom. September 21

14568 A. Howat. Electric safety lamps. September 10

14903 J. G. Cranston. Machinery for drilling rock, etc. September 14

14974 M. Settle. Electric safety lamps for use in mines. September 21

15001 A. M. Clark—From H. A. Brustlein. Process and apparatus for hardening shells and other steel articles. September 10

15206 E. C. Molloy. Apparatus for amalgamating gold and other precious metals. September 21

15476 A. Wilson. Manufacture of compound armour plates. September 3

1887.

2602 C. A. Burghardt and W. J. Twining. See Class XVIII. August 24

9471 J. B. D. Bolton. Process and apparatus for casting metallic ingots in a sectional mould. September 7

10100 W. J. Wilder. Process of coating metals. September 3

10815 W. P. Thompson—From M. G. Farmer. Process and apparatus for procuring aluminium. September 17

XI.—FATS, OILS AND SOAP MANUFACTURE.

APPLICATION.

12181 W. H. Gilruth, London. Improvements in apparatus for extracting oil or juice from seeds, nuts, fruits or leaves of plants, or any analogous substances. September 8

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

11981 A. Hodgkinson. See Class VI.

14835 F. T. Archer, G. W. Hardy, and F. J. Archer. Lubricating composition. September 7

1887.

10783 J. Sears. Compound preparation of cotton seed oil. September 7

XII.—PAINTS, VARNISHES AND RESINS.

APPLICATIONS.

11805 T. Banner, Liverpool. See Class III.

12631 H. J. Allison—From G. W. Barker, United States. Improvements in paints and paint compounds. Complete specification. September 6

12338 W. Fordyce, Glasgow. An improved anti-fouling composition for ships' bottoms and other submerged surfaces. September 12

12388 E. C. Atkinson, London. Improvements in and machinery for packing paste blacking and other similar semi-liquid matters. September 13

12632 J. C. Lyman—From J. H. Lyman, United States. An improvement in paint. September 17

COMPLETE SPECIFICATION ACCEPTED.

1886.

11889 F. M. Lyte. Manufacture of pigments. September 17

XIII.—TANNING, LEATHER, GLUE AND SIZE.

APPLICATION.

12,396 J. Pujos, London. The manufacture of leather from rabbit skins. September 13

COMPLETE SPECIFICATIONS ACCEPTED.

-1887.

9193 H. H. Lake—From A. M. Bowers. Machines for softening and otherwise treating leather. August 21

10121 J. W. Vaughan. Machines for unhairing and green shaving hides and skins.

XV.—SUGAR, GUMS, STARCHES, ETC.

APPLICATIONS.

11393 O. Bowen and J. Cobeldick, London. An improved deodorising, decolourising and filtering medium. August 20

12596 C. H. J. Franzen, London. Process for manufacturing white, lump or loaf sugar directly from boiled refinery mass. Complete specification. September 16

12597 C. H. J. Franzen. Process and apparatus for treating raw, clarified or perfectly white sugar masses in loaf forms by means of the centrifugal machine. Complete specification. September 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

17041 R. Campbell—From J. Foster and J. Campbell. Triple effet evaporating vacuum pans, for boiling sugar and other evaporating purposes. September 14

1887.

10157 J. T. Griffin—From R. J. Henderson. Indiarubber compositions. September 17

10458 J. T. Griffin—From R. J. Henderson. Manufacture of soft or spongy material from rubber compound. September 7

XVI.—BREWING, WINES AND SPIRITS.

APPLICATIONS.

11376 F. G. Burton and T. S. Coleman, Burton-on-Trent. Cleaning malting tiles, and removing therefrom sediment or deposit formed therein by barley or other grain and malt whilst in the course of steeping and drying, and also for cleaning and removing coatings formed on brewing and other coppers after boiling, and also the glutinous and other substances from refrigerators, after use in cooling process of beer and other liquors. August 20

11584 A. J. Boult—From B. Bruel. See Class XXII.

12057 A. G. Brookes—From C. G. P. de Lavel and A. Bergb, Sweden. Improvements in purifying yeast. September 6

12329 W. G. Hicks, Ramsgate. Improving furnaces used for drying the barley in the process of making malt, for drying hops and other similar purposes. September 12

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

12291 E. Manbre. Compounds for the manufacture of ale, stout, porter, lager, etc., and apparatus for making said compounds. September 3

14468 E. Piot. Distilling apparatus, applicable to the concentration and rectification of alcoholic and other liquids. September 10

14873 H. H. Lake—From M. Hanford and C. C. Hanford. Cooling of liquids, and apparatus therefor. August 31

1887.

8260 M. Lachmon—From J. J. Rauer. Apparatus for automatically supplying gas to closed vessels at a regulated pressure. August 31

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, ETC.

APPLICATIONS.

A.—CHEMISTRY OF FOODS.

11927 A. McDougall, jun., London. Improvements in the manufacture or preparation of concentrated extracts or essences of tea, coffee and the like with cream or milk. September 2.

12065 H. H. Lake—From J. H. Stebbins, jun., United States. An improved food compound. Complete specification. September 6

12431 H. Stollwerck and L. Stollwerck, London. Improvements relating to the treatment of cocoa to facilitate the transport thereof, and for other purposes. Complete specification. September 13

12520 J. M. Mitchell, Chicago, United States. New and valuable improvements in the preservation of perishable articles of food, and other perishable matter, by means of ozone or other gases. September 15

12595 W. H. Beck—From E. A. Dexmier, France. A new or improved preparation of coffee, and process for manufacturing the same. September 16

B.—SANITARY CHEMISTRY.

11367 G. Thew, J. Stansfield, and G. Long. See Class II.

11185 J. H. Barry, London. Improvements in treating and purifying sewage, the same being applicable for other disinfecting purposes. August 23

11534 T. M. J. Truchelut and J. N. Truchelut, London. A new or improved process and apparatus for the treatment of sewage and other matters, for extracting or neutralising ammonia and sulphur compounds. August 24

11947 G. Liscoe, London. An improved method and means of separating the solids from the fluids of sewage matters. September 3

12212 F. W. Durham, London. An improved construction of furnace for burning town refuse. September 9

C.—DISINFECTANTS.

11393 O. Bowen and J. Cobeldick, London. An improved deodorising, decolourising, and filtering medium. August 20

12029 J. Bennett, London. A new disinfectant. September 5

12222 R. V. Tuson, London. Improvements in the preparation of materials to be used as disinfectants, deodorisers, and antiseptics, as well as for the destruction of parasites infesting man and the lower animals, and for similar uses. September 9

12392 G. Van Overbeck de Meyer, London. Improvements in apparatus for disinfection. September 13

12483 J. Bennett, Goole. A new disinfectant. September 11

COMPLETE SPECIFICATIONS ACCEPTED.

A.—CHEMISTRY OF FOODS.

1886.

13731 E. Terrant. Manufacture of biscuit bread. August 27

13955 H. Stockman. Curing articles of food, and disinfecting. September 3

1887.

10915 H. H. Lake—From H. C. Andrews. Apparatus for drying or curing fruit, tobacco, etc. September 17

10917 H. H. Lake—From T. C. Oakman. Apparatus for drying or curing fruit, tobacco, etc. September 17

B.—SANITARY CHEMISTRY.

1886.

15222 W. Burns. Purifying sewage and other foul liquids, and making oil, alkali, and cement from sewage precipitate, and apparatus therefor. September 21

XVIII.—ELECTRO-CHEMISTRY.

APPLICATIONS.

11369 C. Gauzentès, Bradford. Improvements in electric batteries. August 20

11390 J. S. Stevenson, London. Improvements in the manufacture of elements or plates for secondary batteries or electrical accumulators. August 20

11443 J. S. Sellon, London. Improvements in secondary batteries or electrical accumulators. August 22

11502 E. F. H. H. Lauckert, London. Improvements in dynamo-electric and electro-dynamic machines. August 23

11513 H. Tudor, Liverpool. Improvements in electrodes for electric accumulators or secondary batteries. August 24

11923 C. L. R. E. Menges, London. Improvements relating to the manufacture of plates or electrodes for primary or secondary electric batteries, and to apparatus therefor. September 2

12017 P. L. Verchère, London. Improvements in the manufacture of carbons for voltaic batteries and certain other electrical apparata. September 5

12175 W. B. Adams, London. Improvements in secondary batteries. September 8

12203 T. L. Hemming, Birmingham. Improvements in dynamo-electric machines. September 9

12252 R. P. Sellon, London. Improvements in dynamo-electric machines. September 9

12528 J. A. Timmis, London. Improvements in the construction of secondary batteries. September 15

12542 T. C. Lewis, London. Improvements in electrical storage batteries. September 15

12676 W. T. Goolden and L. B. Atkinson, London. Improvements in dynamo-electric generators and motors. September 19

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

12818 W. W. Beaumont. Secondary batteries. August 31

13618 W. R. Johnston. Manufacture of carbons for electrical and other purposes. August 24

13712 A. M. Clark—From The Electrotechnische Fabrik Cannstatt. Dynamo electric machines. August 27

14563 J. S. Sellon. Secondary batteries. September 14

14757 W. Lahmeyer. Dynamo electric machine. September 17

14765 C. Lever. Dynamo-electric machines and electric motors. September 17

16810 T. Goodman—From C. Gasner, jun. Galvanic elements.

1887.

990 S. W. Maquay. Means for feeding electric batteries, and for removing the plates therefrom. September 7

2662 C. A. Burghardt and W. Twining. See Class X. August 24

10217 J. Serson and J. O. Whitten. Galvanic batteries. August 24

11188 H. H. Lake—From W. E. Case. Conversion of chemical energy into electrical energy, and apparatus therefor. September 17

11189 H. H. Lake—From W. E. Case. Apparatus for the conversion of heat into electrical energy. September 17

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

11610 J. E. Warren and F. A. Cloudman, London. Improvements in means or apparatus for effecting the recovery of chemicals from spent liquors of pulp digesters. Complete specification. August 26

11735 J. Baldwin, King's Norton. An improved mode of pressing paper whilst in the process of manufacture, securing an equal surface on both sides of the paper, and obtaining the conditions produced by hand-pressing. August 30

12642 R. Squire, London. Improvements in apparatus for the manufacture of paper. September 17

12686 R. Ellis, London. Improvements in the manufacture of pulp for making kamptulicon, linoleum, and paper. September 19

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

13827 B. Makin. Fitting cylinders with blades used in macerating materials for pulp for the manufacture of paper, millboards, etc. August 27

1887.

6171 F. Voith. Machines for the manufacture of paper pulp. September 17

10306 G. R. Gill. Utilisation of paper, paper board, pulp, or any preparation of which paper forms the base, for the manufacture of geometric models. August 31

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

11617 O. Imray—From the Society of Chemical Industry, Switzerland. Manufacture of the ethylether of a new acid. September 3

14618 O. Imray—From the Society of Chemical Industry, Switzerland. Manufacture and treatment of a compound of phenylhydrazine, with a new ethylether. September 7

1887.

7261 C. T. Arnold—From C. W. Arnold. A dental anodyne, or local anæsthetic. September 3

XXI.—EXPLOSIVES, MATCHES, ETC.

APPLICATIONS.

11658 E. Edwards—From R. Sjöberg, Sweden. Improvements in explosives. Complete specification. August 27

12297 W. T. Chamberlain, London. A new method of enclosing high and sensitive explosives in shells and other projectiles. September 10

12424 E. D. Muller, London. Improvements in explosive compounds. September 13

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

14803 Sir F. A. Abel. A manufacture of smokeless explosive. September 14

1887.

6071 F. D. Banister and W. Stroudley. Fog signal apparatus for railways. September 17

XXII.—GENERAL ANALYTICAL CHEMISTRY.

APPLICATION.

11584 A. J. Boult—From B. Bruel. Improved apparatus for testing alcohol. August 25

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SESSION 1887–88.

Prospective Arrangements.

Nov. 7.—Mr. C. T. Kingzett, F.I.C., F.C.S., "Note on the Comparative Antiseptic Action of Chlorides, Nitrates and Sulphates."

" Discussion on Mr. John Ruffle's Paper in July Number of Journal (1887), on "The Correct Analysis of Superphosphates, Plain and Ammoniated."

Dec. 5.—Professor Dewar, M.A., F.R.S. (President of the Society), "The New Weldon-Pechiney Process for the Manufacture of Chlorine from Chloride of Magnesium."

Communications to be addressed to the Local Secretary.

Communications.

REPORT ON SECTION III. OF THE MANCHESTER ROYAL JUBILEE EXHIBITION.—THE CHEMICAL AND ALLIED INDUSTRIES.

BY WATSON SMITH,

Lecturer in Chemical Technology in the Victoria University, etc.

Before proceeding to describe some illustrations of the results of chemical research of more modern date having a direct bearing on the chemical industries, a report on this, probably the most complete exhibition of objects illustrative of the progress, advance, and present position of the chemical industries that has ever been brought together, with a description of certain interesting relics of chemical and physical discovery that have had the most important influence on the growth of chemical science, and hence on the development of chemical industry, will be desirable. To commence with scientific celebrities belonging to Manchester, there is a most interesting selection of the apparatus employed by John Dalton in his classical researches. Here one may see how the most homely utensils are made useful for doing the highest class of scientific work, and how so humble an instrument as an old-fashioned penny earthen inkpot or a soda-water bottle may be rendered classical. The MS. of the "Principles of Chemistry," with the original table of atomic weights as first determined by Dalton, will be to chemists objects of the deepest interest. Dr. J. P. Joule, F.R.S., has lent for exhibition the very apparatus with which he determined the mechanical equivalent of heat. It consists of a small iron cylinder furnished with a central shaft and agitating apparatus and a cover fitted with holes for the end of the shaft and for a thermometer with which to measure the rise of temperature produced in the conversion of mechanical energy into heat. The important result attained by Joule he expressed thus:—The actual quantity of heat developed by friction is dependent simply on the amount of force expended, without regard to the nature of the substances rubbed together, and the numerical conclusion deduced was that the quantity of heat capable of raising the temperature of 1lb. of water by 1° F. requires for its evolution the expenditure of a mechanical force adequate to lift 772lb. one foot. It may be added that a good sketch of Joule's apparatus, and description of his method of using it, is given in the *Phil. Trans.*, 1850, Part I.

Here may be seen the very first lamps constructed by Davy, whilst patiently feeling his way towards a light which could be used with safety in our coal-mines. Four or five of the Davy safety lamps in various stages of construction are exhibited.

Also Davy's chemical balance, an unwieldy looking object compared with the delicate instruments of to-day, is shown.

Perhaps the greatest discovery made by Davy was that recorded in the *Phil. Trans.* for 1808, when he succeeded in decomposing the alkalis potash and soda by electricity, producing the respective alkaline metals, potassium and sodium. A portion of the very galvanic battery used is shown, together with the laboratory note-book, which is opened at the page in which the record may be read in Davy's handwriting. Sodium is now an article of commerce, and fine specimens of it may be seen at Stand 804, just opposite, shown by the Magnesium Metal Company, Limited. It is chiefly used in the manufacture of aluminium.

One of Faraday's greatest discoveries was that of the possibility of liquefying certain gases, up to that time regarded as permanent, by means of strong pressure.

Specimens of liquefied gases are shown in sealed tubes. These are hydrochloric acid, cyanogen, ammonia, arseniuretted hydrogen, hydrobromic acid, chlorine, chlorine and sulphuric acid, sulphuretted hydrogen and hydriodic acid.

Faraday's laboratory note-book, which is also exhibited, is opened at the place where this discovery is recorded.

Coal-tar distillers, gas manufacturers, and aniline dye manufacturers will be greatly interested to see the very first specimen of benzene as it was originally isolated and prepared by Faraday. It was called by him "bicarbide of hydrogen," the old formula of benzene being $C_{12}H_6$.

The other specimen, also contained in a sealed tube, is one of carbon tetrachloride prepared by him.

A plate of earthenware is shown on which characters have been inscribed, burnt in and glazed; the characters are in the handwriting of the great chemist, Berzelius.

Passing on to those exhibits illustrating chemical research, it may be noted that some of the discoveries which have had the most important influence on the development of chemical industry were made *accidentally*, during investigations in quite other directions.

SIR HENRY E. ROSCOE, M.P., F.R.S. (No. 741)—This exhibit comprises a collection of specimens of pure vanadium and tungsten, with various compounds of these rare metals, illustrating Roscoe's researches. Roscoe found vanadium in deposits near Alderley, and when subsequently John Lightfoot showed the important influence this metal was capable of exerting, even in mere traces, in printing aniline black, Roscoe suggested to Mellor of Patricroft, the industrial preparation of vanadium compounds for the use of the printer of aniline black. Mellor procured a quantity of the raw material from Mottram, near Alderley, and manufactured vanadium compounds for a considerable time. The specimens exhibited illustrate a very completely worked-out research in inorganic chemistry.

DR. EDWARD SCHUNCK, F.R.S. (No. 741A).—The specimens exhibited consist for the most part of natural colouring matters. Some of them, it will be observed, are colourless, or only slightly coloured; these are chromogens—*i.e.*, bodies which, when suitably treated, yield colouring matters. As an example of a chromogen we may take orcin, a colourless crystallised substance contained in various species of lichen, which, by the combined action of air and alkalis, yields orcein, the colouring matter to which orchil and litmus owe their dyeing properties. Orcin was discovered by Robiquet, an eminent French chemist. Dr Schunck many years ago discovered lecanorin, a body which, when acted on by alkalis, splits up into orcin and carbonic acid, and is the substance, or one of the substances, originally contained in the lichens which are employed for dyeing purposes. Since then a great number of similar substances, some well crystallised and all of them interesting, have been obtained from lichens. It is difficult to understand what function these well-defined chemical substances perform in the cells of such lowly organised plants as lichens. Whether so far as the plant is concerned they simply represent excrementitious matter is doubtful, but they certainly afford us a very beautiful though somewhat fugitive dye, orchil, and a pigment, litmus, much used by chemists as a reagent for acids and alkalis.

Another instance of a chromogen is seen in rubianic acid, a substance crystallising in yellow needles, obtained from the root of the madder plant, *Rubia tinctorum*. This root has been employed for ages in the East for dyeing turkey-red and other colours, but it was not until about the year 1835 that the substances to which it owes its tinctorial properties were detected.

Alizarin, the most important of these substances, was discovered and described by Robiquet. Specimens of this colouring matter in various states, and also of purpurin, another colouring matter contained in the root, and closely allied to alizarin, will be found in the showcase. Alizarin yields a variety of colours on calico—red, pink, black, lilac, etc.—according to the mordant used and the treatment employed. Now this substance, alizarin, is not contained as such in the plant—*i.e.*, it is not there in a free state, but exists in combination with glucose, forming a peculiar compound, rubianic acid, which is itself quite incapable of dyeing, and only exhibits tinctorial properties after decomposition with acids or ferments—*i.e.*, after it has split up into alizarin and glucose (grape sugar). It is the natural ferment of the root which in the ordinary process of dyeing with madder causes the decomposition of the glucoside (such is the name given by chemists to this class of substances) into alizarin and glucose. It should be stated that Rochleder was the first to discover a glucoside yielding alizarin by decomposition with acids. He called it ruberythric acid, but since this differs in some of its properties as well as in composition from rubianic acid the latter name is retained. The characteristic property of rubianic acid—that of yielding a potassium salt crystallising in plum-coloured needles (of which a specimen is exhibited)—is not mentioned by Rochleder. It was the analysis of this salt which led to the conclusion that alizarin contains 14 atoms of carbon, a fact of importance in connection with the artificial production of alizarin, which, if due attention had been given to it, would have shown that the attempts made to obtain the latter from naphthalene, a substance containing only ten atoms of carbon, could not possibly succeed. The other substances extracted from madder—rubian, rubiadin, purpuroxanthin, etc.—are mere chemical curiosities of no practical importance. The very beautiful substance, munjistin, obtained by the late Dr. Stenhouse from munjeet or Indian madder, should, however, not be overlooked. Purpuroxanthin, which is a product obtained by reduction from purpurin, is isomeric with alizarin, but does not dye mordants. Munjistin is purpuroxanthin carbonic acid, and rubiadin is probably methyl-purpuroxanthin.

The artificial production of alizarin from anthracene, a coal-tar constituent, is one of the most important discoveries of modern times, from a scientific as well as a practical point of view. The history of this discovery and its practical consequences will doubtless be discussed in connection with other exhibits, and may therefore be passed over here. It may, however, be mentioned that during the process of making artificial alizarin as originally carried out a considerable amount of another substance is formed, which was noticed first by Dr. Schunck, and named anthraflavic acid. This was shown by Dr. Perkin to be isomeric with alizarin, though quite incapable of combining with mordants. By fusion with caustic alkali, anthraflavic acid is converted into flavopurpurin, which is isomeric with ordinary purpurin, and is endowed with marked tinctorial properties. It is now prepared on a large scale for the use of dyers.

Chrysammic acid, the salts of which are coloured and remarkable for their golden, semi-metallic lustre, is also a derivative of anthracene. It was, however, obtained originally by the action of nitric acid on aloes. It belongs to the same class of compounds as picric acid, and, like the latter, may be employed for dyeing purposes.

Indigo, the well-known blue dye, is obtained, as most people are aware, from the leaves of various plants. In what state the colouring matter is contained in the indigo plant was formerly unknown, the leaves showing no blue tint when fresh and uninjured, but having the same green colour as any other leaves. Dr. Schunck showed that the colouring matter is contained in the plant as a pale yellow glucoside, easily soluble in water, which he called indican. This, like other glucosides, is decomposed by acids, splitting up into indigo and a peculiar kind of sugar, and thus the fact of indigo, which is an extremely insoluble body, being removed from plants by means of cold water was easily explained. There is a specimen of indican from *Indigofera tinctoria* among the exhibits, but, being a body very easily decomposed, it has already begun to show signs of change, the surface being covered with a blue film of indigo. Its physical properties are not interesting; it never assumes a crystalline form, always appearing as a yellow syrup. All commercial indigos contain a certain proportion of a red colouring matter. This red colouring matter was first obtained by Dr. Schunck in a state of purity, and called by him indirubin. It is a very interesting body, crystallising in red needles, subliming unchanged, and yielding solutions of a fine crimson colour. It has the same percentage composition as indigo blue, but is a more stable body. In dyeing it affords crimson in place of blue shades. Dr. Schunck has shown that by treating indican in a particular way before acting on it with acid it may be made to yield indirubin only, and as the latter would probably turn out a valuable dyestuff, on account of its great stability, a means is pointed out whereby the manufacturer would be enabled to produce a true red in place of a blue indigo.

As a curiosity interesting to physiologists as well as chemists, the specimen of indigo from urine may be pointed out. Dr. Schunck first showed that all urines, whether pathological or not, contain an indigo-producing body in minute quantities. The chemical nature of this body was first ascertained by Baumann, who showed that it was not a glucoside like the indican of plants, but the potassium salt of a peculiar acid, indoxyl-sulphonic acid.

The substances from cotton here exhibited are more interesting to the bleacher than to the dyer, since they represent together the matter which is removed from cotton fabrics during the bleaching process. Among them will be found a dark brown colouring matter which is the substance causing the brown tinge seen in raw cotton. All cotton, however white it may appear, contains some of this colouring matter, but the so-called Nankin cotton has more of it than other kinds. During the bleaching process it is partly removed by treatment with alkaline lye, and in part it is destroyed by the action of chloride of lime. The cotton wax may have something to do with the property that the cotton fibres possess of adhering to each other.

Dr. J. Peter Griess, F.R.S. (No. 7416).—In this exhibit we have specimens illustrative of the discovery of diazo and azo compounds, more especially the azo colours; also specimens of fabrics dyed with these beautiful and brilliant colours are shown. The history of the discovery of the first diazo compound, which was made in the year 1858, is thus related by Dr. Griess, in a letter to the writer:—"Dr. Gerland, when working in the laboratory of Professor Kolbe in Marburg, investigated the action of nitrous acid on amidobenzoic acid at the request of Kolbe. Thus the oxybenzoic acid was prepared, indicating a chemical change then considered of much importance. In like manner I investigated a means of converting picramic acid (amidodinitrophenylic acid), into the oxydinitrophenylic acid, $C_6H_2(NO_2)_2(OH)_2$, but I obtained instead of this latter a compound possessed of such striking and peculiar properties that I at once concluded it must belong to a completely new class of compounds. Analysis soon showed me that this peculiar compound had the composition $C_6H_2(NO)_2N_2O$. Naturally I soon submitted many other amido compounds in like manner to the action of nitrous acid, and obtained thus in almost every case the corresponding diazo compound. But the circumstance to which I was indebted for my success in obtaining the diazo compounds was that of the treatment of the amido compounds with nitrous acid in the cold, whereby the immediate conversion of the diazo compounds into other products was prevented, whereas in the earlier experiments of Hunt and Gerland a higher temperature was always attained, and consequently no diazo compounds could exist. Having obtained these diazo compounds, I then tried their action upon all possible substances, amongst which, of course, are the numerous class of amido compounds. I found that the diazo compounds combine directly with these, forming frequently brilliantly coloured substances which dye directly animal fibres. The first colouring matter thus prepared by me, which I obtained in the years 1861—62, was the benzene azo-α naphthylamine (see *Phil. Trans.* 1864, Part III. 679). It was first prepared on the large scale, to the best of my recollection, in the years 1865—6, by Caro, who was then chemist in the works of Messrs. Roberts, Dale & Co., of Manchester. I first recommended the oxyazobenzene obtained by me for use as a colouring matter in *Liebig's Ann.* 137 (1866)."

It will be observed from this, as in the case of Perkin's mauve, that these bodies were never thought of until they appeared, but came unexpectedly and unsought. At the present moment the conditions on which the formation of coal-tar colours depend are so well understood, that in forecasting a new substance it is not only possible to predict of what colour it will be, but also whether it will be a dye soluble or insoluble in water, etc.

The following azo dyes of principal historic interest are exhibited by Dr. Griess:—

1. *Benzene-azo-phenol.* Discovered 1861—63. See *Phil. Trans.* 1864, III. 689.
2. *Benzene-azo-α-naphthylamine.* Discovered 1861—63. *Phil. Trans.* 1864, III. 679.
3. *Diphenyl-disulpho-azo-α-naphthylamine sulphonic acid.* The first known cotton dye of the Congo red type. Discovered 1882. Eng. Pat. 1099, January 9, 1884.
4. *Dimethylaniline-azo-p-benzene sulphonic acid* ("Helianthine" or "Orange No. III."). Described *Ber.* **10**, 528.
5. *β-Naphthol-azo-p-phenol sulphonic acid.* First known red azo dye. Eng. Pat. 3698, October 4, 1877.

6. *Anisol-azo-β-naphthol sulphonic acid* ("Anisol red"). Eng. Pat. 4726, November 20, 1878.

The first diazo compound—viz., *diazodinitrophenol*, was discovered in 1858. (*Liebig's Ann.* 106, page 123.)

Dr. W. H. Perkin, F.R.S. (No. 741c).—This is an exhibit of very special interest, inasmuch as it marks a completely new era in the history of colouring matters and dyes. Perkin was the discoverer of the first coal-tar colour, but, singular to say, he did not in the experimental research he was carrying out expect a colour, and in fact, from the scientific standpoint, he did not want a colour. He was working in 1856 on aniline with a view to produce quinine, but obtained mauveine or "mauve" instead. Specimens of the original mauve are shown, both solid and in solution. The only small use to which mauve is now put in this country is for colouring postage stamps. It has been completely superseded by the finer methyl violets. Perkin patented his method for producing the colour, which was by oxidising sulphate of aniline, containing also sulphate of toluidine, with potassium bichromate, forming sulphate of mauveine or "mauve." A specimen of safranine is also shown, produced by the oxidation of the mauveïne.

In the year 1869, Graebe and Liebermann having shown that alizarin is an oxidised derivative of anthracene, Perkin devised a method of manufacture which was subsequently known as the English method, and by its use the necessity of first oxidising anthracene to anthraquinone was avoided. The anthracene was chlorinated, dichloranthracene being formed, which on treatment with fuming sulphuric acid, yielded the sulphonic acid of dichloranthracene. But on heating the mixture, hydrochloric acid and sulphurous acid were evolved, and a conversion into a sulphonic acid of anthraquinone took place.

The German method involved the direct oxidation of anthracene to anthraquinone by means of bichromate of potash and sulphuric acid, and the subsequent heating with strong sulphuric acid to ensure sulphonation. The sulphonated product is in both methods then fused with considerable excess of caustic soda, when the alkali abstracts the elements of the sulphuric acid and leaves a hydroxy product, which may be alizarin or one of its congeners. Specimens are shown of a wide series of anthracene, anthraquinone, and alizarin derivatives. Perkin also discovered a valuable means of purifying anthracene, by distilling it from potash. By this method, the Germans say, a 10 per cent. loss is sustained, but Perkin denies that such is the case. The residue is then found to contain a remarkable substance called carbazol, a body containing nitrogen; a specimen is shown of this beautiful body.

But alizarin is only one of a series of colours produced from anthracene, and the great advantage of the synthetical methods of preparing these colouring matters from the one common source, anthracene, is that according to desire, either one or other colour of this series may be obtained, whereas in working the madder root, the dyer must take and use what nature has put into his hands. Perkin also succeeded in preparing artificially for the first time the odoriferous principle contained in the sweet-scented Tonka bean—viz., *coumarin.*

Specimens of *cinnamic acid*, first prepared by Perkin, are also shown. Cinnamic acid is remarkable as being the raw material used in the preparation of artificial indigo.

Prof. C. Schorlemmer, F.R.S., and Messrs. R. S. Dale, B.A., and C. Schorlemmer (741a).—In the showcase in which Dr. Schunck's specimens are displayed will be found a small case of bottles and specimen tubes containing preparations neither large in bulk nor striking to the eye. Nevertheless, these specimens illustrate a very important series of chemical investigations. There are, firstly, a series of samples of the pure constituents of American petroleum, separated and prepared for the first time by Professor Schorlemmer. Schorlemmer conclusively proved that these constituents are not alcohol radicles, as was at first believed, but the hydrides of those radicles. The final result of this research was the grand division of organic substances into the paraffin series and the aromatic series. It has been stated that American petroleum contains absolutely none of the members of the benzene series, but this statement Schorlemmer shows not to be true, for amongst his little specimens may be seen some crystallised dinitrobenzene, which he prepared from Pennsylvanian petroleum.

Secondly, specimens of pure aurin and aurin derivatives, substances of considerable interest to the dyer, illustrating the joint researches of Dale and Schorlemmer, are also shown.

GROUP I.—CHEMICAL AND PHYSICAL APPARATUS.

W. H. Bailey & Co., Albion Works, Salford (No. 701).—This firm exhibits apparatus and machinery used chiefly by chemical manufacturers, bleachers, engineers, etc. Especially is the exhibit interesting for the variety of pyrometers shown, some of these, as well as other physical apparatus, being the inventions of Mr. W. H. Bailey. The question of the precise temperature at which a large number of chemical and physical changes occur, is one which has only recently received attention. The carrying out of operations on the large scale involving chemical changes is being brought into continually closer approach to scientific and laboratory method, and thus, just as the thermometer is essential in the latter, so the pyrometer must be adopted in the former. This firm exhibits Hargreaves and Robinson's hydrochloric acid pump, stopcocks for hydrochloric acid, and lead-lined valves for acids and sours. A pump for raising an almost equally corrosive liquid — viz., bleaching liquor, is also shown. Of patent pressure recorders, air compressers, pyrometers for all kinds of special purposes, such as for blast furnaces, japanners' stoves, portable army ovens, biscuit bakers, confectioners, for the Hargreaves and Robinson salt-cake plant (a model of which can be seen just opposite Messrs. Bailey's stand), etc., there is a great variety. The large automatic mortar and pestle exhibited is a curious as well as ingenious piece of mechanism.

Messrs. Doulton & Co., Deansgate, Manchester, and Lambeth Pottery, London.—This firm shows at Stand 702 interesting specimens of earthenware acid pipes, pumps, and taps of various sizes. Besides these, a feature is made of retorts, stills, receivers, condensing worms, store jars, chlorine retorts, unglazed chemical pipes for boiling in tar, specimen of hydrochloric acid pipes which have been in actual use, stoneware jars and bottles, with patent screw stoppers to 3in. diameter; 24in. diameter stoneware pipes, free from iron, for acid towers; plumbago and other crucibles, and various goods capable of resisting the action of fire.

Messrs. Follows & Bate, Limited, Gorton, Manchester (No. 703), exhibit apparatus used by wholesale drug and fine chemical manufacturers, as well as by viticulturists. A specimen of an edge runner mill, with granite rollers, measuring 18 by 6, and granite bed 2ft. in diameter; drug mills for grinding such friable materials as gentian, ginger, and copperas; also a powerful tincture press so designed that no part of the material operated upon can come into contact with iron or other metallic substance used in the construction of the press. The size of the hopper of this useful apparatus is nine gallons, and the calculated pressure of the plunger is six tons. A small iron circular tincture press, capacity one gallon, for chemists, a 65-gallon wine press and a grape crusher with rollers 29in. by 7in., numerous specimens of granite pestles and mortars, and an assortment of hand-power horizontal mixers for light powders, liquids, semi-liquids, and soluble compounds are also exhibited.

William Allen, Union Brass and Iron Works, Great Ancoats Street, Manchester (No. 717).—In this exhibit are shown Allen's improved filter-press in its complete form, and fitted up with 24 chambers; also a 3in. ram pump to be used with it. The press is suitable for the filtration of products in almost all kinds of chemical works. He also exhibits his patent regulus screw-down acid jug-valve, made of regulus metal, his plugs and seatings, cocks and injectors.

Messrs. Shaw & Connolly, electrical engineers, Manchester (No. 706), display Miles Settle's patent electric miners' lamps, as used at Darcy Lever Colliery, Bolton, and Madeley Colliery, Staffordshire: patent water cartridge, exploded by electricity, and all the necessary apparatus: mine signals, some fine specimens of the deep-seam cannel, a collection of cables and derivations for mine lighting, and a remarkable fossil tree (a Lepidodendron) from the Bolton coalfield.

Messrs. Shaw & Connolly, Varley Street, Manchester (No. 707), also exhibit insulated wires, as well as cables for submarine, torpedo, electric light, telephone, and telegraphic purposes. Five special varieties of insulated wires are shown, suited for different circumstances and purposes; also flexible cords, of which a large number of specimens are to be seen. There are wires differently insulated to suit all the following exigencies:—Great dryness, for internal work where walls are rather damp: decided dampness and exposed position (this variety the best to use in cotton mills, weaving sheds, and the like), when laid under water or subject to temporary permanent heat, also exposed to acid or other chemical fumes or to sea water. Besides these there is a variety like the last, but with additional coverings to protect and preserve from mechanical injury. This is the variety used by Holroyd Smith, and alone found available for the collectors of his electric tramways. A portion of such a collection is shown. Owing to the increase in size of dynamos, it was found necessary to provide a copper conductor of very large section for the connections, which at the same time was to be flexible enough to handle with the greatest ease. A piece of the largest cable ever made for this purpose is exhibited; it is used on an Edison-Hopkinson dynamo made for Germany, and is required to carry the current for 1400 lights. It is composed of 1813 copper wires, stranded in the best manner possible, and this has been done so successfully that, although the copper cable is $1\frac{1}{8}$in. in diameter, it can be easily tied into knots with the hand.

Specimens of cables used for telephone, electric light, torpedo, mine signalling, blasting, domestic, and other classes of work are exhibited. Cables for transmission of power are also coming into use, and as an example the cable is pointed to which is used by Messrs. Mather & Platt, and specially constructed by Messrs. Shaw & Connolly, to transmit the power to work their bleaching plant from the dynamo-house.

J. W. Lovibond, St. Ann's Street, Salisbury (No. 704), exhibits an apparatus for measuring colours called a tintometer. We believe this apparatus has a useful future before it. It is a new instrument, by means of which the depth of colour in liquids and solids can be accurately measured in degrees and placed in their position in a permanent colour scale, and mainly consists of a standard scale made of coloured glasses numbered according to their depth of colour, and an instrument for holding the glasses and the object to be measured. It is likely to be of service wherever colour is an index for manufacturers or where a permanent record of colours is desirable.

Edward Ward, F.R.M.S., 249, Oxford Street, Manchester, exhibits microscopes and appliances for microscopic investigation. Mounted slides and unmounted specimens, and photographic apparatus and lantern slides of scientific apparatus. An interesting feature of this exhibit is a special row of microscopes ready mounted and furnished with objects to be viewed at any time by those interested in Entomology and Natural History.

Joseph Davis & Co., Fitzroy Works, Kennington Park Road, London, S.E. (No. 705), exhibit Royal Polytechnic and other barometers, optical and scientific instruments of various kinds.

The Committee of Section III. and Watson Smith (No. 709).—Model of the Hargreaves salt cake plant, as used for the direct conversion at a high temperature (about 500° C.) of common salt into sulphate of soda, by means of sulphurous acid, steam, and air.

Harden Star and Sinclair Fire Appliance Company, Limited, Victoria Street, Manchester (No. 710).—All kinds of fire appliances. The Lucigen light apparatus, used during the dark evenings of last winter to enable the Exhibition workpeople to continue the erection of the buildings by night, is exhibited. It is a simple but very effective means of utilising the "creosote oil" of the tar distilleries, recently become so cheap as to be almost a waste product.

Joseph Casartelli, Market Street, Manchester (No. 712).—All kinds of surveying, mining, and engineering instruments, thermometers for industrial and other purposes, as well as hydrometers, etc., in which the special features of accuracy and lightness combined with strength are desired.

Franz Mueller, formerly Dr. H. Geissler, of Bonn, Germany (No. 713).—This exhibit contains, amongst other things, a complete Geissler's mercury air pump, with all the accessories, also sets of Crookes', Geissler's, and Puluj's tubes and apparatus. Attention must be especially called to the new form of the Crookes' apparatus containing rhombs of phosphorescent minerals, which on being electrified become apparently incandescent, and radiate the most beautiful coloured light. There is to be seen also a new electric radiometer, which carries phosphorescent wings. The fine show of delicate standard or normal thermometers will be interesting to the scientific chemist and chemical physicist. All the finer thermometers are constructed of Jena normal glass. The series of clinical thermometers contains instruments each of which is furnished with a kind of registering vernier with zero point graduation. A baro-thermometer is exhibited the thermometer of which is divided into $\frac{1}{100}$ths of a degree. This extremely sensitive instrument marks differences of height of only two metres ($6\frac{1}{2}$ to 7 feet). These are perhaps among the most striking objects in the valuable collection shown by the Geissler Institute. A beautiful illuminated display was made at this stand during the visit of the British Association.

F. C. Rein & Son, Strand, London (No. 715), show acoustic apparatus and instruments for deafness. **John Heywood**, Ridgefield, Manchester (No. 722), shows a completely fitted up chemical laboratory table, with all the newest appliances; whilst **Messrs. Mottershead & Co.** and **Messrs. James Woolley, Sons & Co.**, vie with each other in the beauty and interest of their exhibits of chemical and physical apparatus (Nos. 720 and 722a). The **Rex Bituminous Coal Company**, Hulme Hall Road, Manchester (No. 719), exhibit specimens showing the advances in the manufacture of patent fuel, a branch carried on to a wonderful degree of perfection in France and Germany, where coal is scarcer and dearer than in this country.

Henry Simon, Mount Street, Manchester (No. 718), exhibits models and drawings of apparatus by the use of which the smoke and fumes from coke-ovens of the beehive or open variety are completely abated, and in place of that smoke, tar and ammonia are obtained. The ammonia-water is worked up into sulphate of ammonia and liquor ammoniæ, whilst the tar is distilled and products obtained from which coal-tar colours are prepared. The colours thus made are exhibited, as well as fabrics dyed with them. There is shown a model of a Simon-Carvès recuperative coke oven, with adjustments for the recovery of by-products, and also a drawing giving a sectional elevation of the coke oven, with the apparatus for the automatic discharge of the finished coke.

There is also shown a model of a continuous ammonia still (Simon's patent), so arranged that either ammonia solution ("liquor ammoniæ") or sulphate of ammonia can be made at will, and that whilst the crude ammonia water is being fed in at one end, the liquors exhausted of ammonia down to some two-hundredths of a per cent. are running off at the other by a suitable overflow pipe. A drawing is shown of a sulphate of ammonia works arranged on Simon's principle at the Stafford Corporation Gasworks, and another of a liquor ammoniæ works as erected on the similar principle at the Michigan Ammonia Works, Michigan. Processes have, as is well known, been devised for extracting the benzene hydrocarbons from coal gas, so that they might be eventually worked up into aniline colours. We observe that a series of products similarly recovered from the gas of the Simon-Carvès coke ovens is exhibited. The gas was treated by the large Swiss colour manufacturing firm, Messrs. Durand & Huguenin, and an interesting series of aniline dyes thus obtained is shown, together with silks dyed with these colours.

The East Lancashire Chemical Company, Fairfield, near Manchester (No. 721), exhibits plant for bleaching cotton and linen yarn and cloth by the "blanchine" process—*i.e.*, using blanchine instead of soda ash, but no lime, and only very little bleaching powder and acid; a starch substitute for stiffening, and goods thus stiffened; also a patented substitute for bone size used for stiffening fustian goods. Of bone size it is alleged that it smells badly and communicates its odour to the goods; this substitute is guaranteed to do the work without communicating any odour. There is also a powder soap specially adapted for the "white grounds" of alizarin prints; it is commended by the firm on the score of economy and effectiveness. A variety of other drugs and chemicals used by calico printers and dyers, with models of apparatus, is exhibited at this stand.

George E. Davis, 301, Great Clowes Street (South West Gallery, No. 937), exhibits specimens of raw materials and products used and produced in apparatus and plant, the drawings of which are shown. The following is a list of the principal items in this collection:—

1. Drawings of the Poirion evaporator, with samples of esparto liquor and recovered ash.

2. Drawings of plant erected for making liquor ammonia direct from gas water.

3. The drawing of a pyrites smalls burner is shown. Seville smalls may be burnt in it with as much as 8 per cent. of Cu, so that half of this copper becomes soluble in acidulated water alone, and when the residue is calcined with salt, the spent ore or "blue billy" contains less than 0·15 per cent. Cu.

4. Specimens of benzene, toluene, xylene, solvent naphtha, naphthalene, anthracene, and sulphate of ammonia, made by Davis's patented carbonising process from the celebrated Rockingham coal.

5. Drawings of kilns for burning the spent oxide of gas-works. In these kilns every provision is made for the thorough combustion of the organic matter before coming in contact with the nitrous gases. If not burnt, the carbonic oxide or organic substances would reduce those nitrous gases and cause an undue consumption of nitre.

6. Drawing of a hydrochloric acid condensing tower of the usual pattern, except with regard to the method of taking off the acid, which is novel.

7. Glover tower on Davis's pattern having a low form, and only seven feet of packing, which in practice, it is claimed, has been found to answer very well. These towers are packed with a special blue brick, and the area of the tower is apportioned to the work to be done in it, the height always remaining the same.

8. A copper calciner, fitted with a Mond's smokeless fireplace.

9. Samples of products obtained on an industrial scale from the condensed gases from bee-hive coke ovens.

10. Samples showing the Davis and Aitken method of treating sewage and refuse water from various manufactories. Specimens are shown of the Salford sewage treated by this process, and the refuse water of a dyeworks before and after treatment.

GROUP II.—HYGIENE.

Messrs. Mottershead & Co. (No. 723), exhibit Benger's natural digestive ferments, peptonised foods, fluids and powders. The writer showed that beef tea prepared by adding a very little of the "Liquor" preparation to mince beef and water contains just three times as much nutritive matter as ordinary beef tea prepared from just the same proportions and quantities of mince beef and water without the addition of the "Pancreaticus Benger." A similar experiment, followed by the same success, was observed on adding some of the fluid to thick gruel or arrowroot, these compositions soon becoming liquefied through the partial conversion of starchy matter into glucose. These experiments were described by Sir William Roberts in the course of a lecture before the College of Physicians, London.

Messrs. James Woolley, Sons & Co., Market Street, Manchester (No. 725), exhibit antiseptic preparations, and all kinds of elegant and useful toilet articles, both perfumed and antiseptic.

Burroughs, Wellcome & Co., Snow Hill Buildings, London, E.C. (No. 724).—Professor Oscar Liebreich, of Berlin, first successfully investigated the chemical composition of the fat or grease of the wool of sheep, and found it to contain cholesterin. The commercial article is termed "lanolin," and it has a marvellous power of forming an emulsion on shaking up with water and of penetrating the skin when applied to it. This firm shows specimens of lanolin, lanolin pomades, soaps, cold creams, and ointments of various kinds.

M'Dougall Brothers, Port Street, Manchester (No. 726), exhibit a large variety of carbolic and sulphurous disinfectants in powders, liquids, and soaps: also Morris, Little & Son, of Doncaster (No. 727), show similar preparations, dog soaps containing phenols, etc.

Winser & Co., of Harter Street, Manchester (No. 728), lay stress on their new antiseptic and disinfectant which they term "salufer," chiefly composed of alkaline fluosilicates. It is stated that 1½ parts of this compound have greater power of preventing the growth of mildew on flour paste or cloth sized with flour or starch than 14 parts of the best chloride of zinc in the commercial form.

F. J. Harrison & Co., Limited, of Leicester (No. 729), and Swan & Leach, of Albert Square, Manchester (No. 730), show many varieties of sanitary and disinfecting soaps, soap powders, and preparations for household, toilet, and other uses.

GROUP III.—DESTRUCTIVE DISTILLATION.

The Broxburn Oil Company, Limited, Royal Exchange Square, Glasgow (No. 750).—This firm exhibits specimens of the products obtained by the destructive distillation of Scottish boghead shale, together with samples of the raw material itself. It is an industry originally founded by the late Dr. James Young, F.R.S., about thirty years ago. Dr. Young commenced, however, not with boghead shale, but with the boghead cannel itself, a mineral the identity of which with cannel coal was disputed in a celebrated lawsuit started to upset Young's claims. This suit failed in its object, and so vigorously was the manufacture of paraffin oils, naphthas, and wax pushed that the mineral became speedily exhausted. A fine specimen of this now extinct Scotch mineral, presented to the writer by the late Dr. James Young, is to be seen at Stand 781. In the great lawsuit already referred to the presence of a single characteristic coal fossil in the mineral would have quickly decided the case and have saved much expenditure of money, but no fossils were to be found in this boghead cannel. It is interesting, however, to mention that Professor W. Boyd Dawkins, when recently in Australia, identified a cannel which is practically identical with the old Scottish boghead, and fine specimens were brought over by him, and are now to be seen in the Geological Museum of the Owens College. The interesting point is that the Australian boghead *does* contain fossil remains. The first record we have of the manufacture of paraffin wax is that by a Manchester man (nevertheless a Scotchman), Mr. John Thom, of Birkacre (and of the firm of M'Naughton & Thom), who made it before the year 1835 by Reichenbach's process from the products of the distillation of wood, as he informed the writer. He has still a specimen of the paraffin wax then actually put in the market. Mr. Thom was then the chemist in a works at Camlachie, near Glasgow. The present approximate annual production and value in the United Kingdom of the staple articles manufactured by the paraffin oil trade represented over £2,250,000. In the year 1886, to produce this value in the staple articles, there were consumed 1,816,600 tons of shale, and in the manufacturing processes there would be over 500,000 tons of coal consumed. The capital invested in the paraffin oil trade amounts to about £2,000,000. The articles exhibited by the Broxburn Company are (1) crude oil; (2) sulphate of ammonia; (3) the refined products of the crude oil, which are burning oil in several qualities, naphtha of shale spirit, lubricating oil in various qualities, ordinary and debloomed; solid paraffin scale, the same in a refined state as wax of various qualities and candles prepared from it. The specimens of candles vary from the cheapest to the finest hand-painted kinds for drawing-room use.

The Linlithgow Oil Company, Limited, Edinburgh, and 4, St. Ann's Square, Manchester (No. 748).—This is also one of the Scottish shale distilling firms, and exhibits fine specimens of its raw and manufactured products, similar to those of the Broxburn Company.

The Dee Oil Company, 5, Cross Street, Manchester, and Saltney, Chester.—We now pass on to a handsome exhibit, illustrating the extraction of paraffin wax and paraffin products, not by destructive distillation from shale or cannel, but by direct distillation from crude American petroleum residues first deprived of their light naphthas in the States before export to this country. This is a special line of paraffin industry of itself, and the annual production and value in this country of the staple articles thus produced amount to about £150,000. For this an annual consumption of raw materials takes place represented by about £50,000. The works of this firm are established just on the borders of Cheshire and Flintshire, at Saltney, near Chester, and the history of the oil trade in the locality of North Wales is one of peculiar interest. The trade may be said to have had its origin in the discovery of "curley cannel" coal in Flintshire, on the borders of Cheshire, about 26 years ago. This discovery led to the establishment of many companies and works in Flintshire for the production of paraffin oil, and the new industry was commenced with great vigour. However, American petroleum also came to the front, and the competition became too severe for the Flintshire paraffin industry. Burning oil reaches this country from the United States far cheaper than it could be made here from English products. At the present moment there is not a single firm in North Wales producing oils from the curley cannel of the district, which, moreover, is nearly exhausted. During the decadence in this locality of the cannel-paraffin industry, one of the last of the surviving companies—viz., the Coppa Oil Company, who amalgamated with the Dee Mineral Oil Company, which then assumed the title of the Dee Oil Company, under which title it trades at the present time. There is a lesson for chemical manufacturers in this little history, one which as to facts has been repeated and will be repeated scores of times. It is this:—In times of change, depression, and revolution of circumstances only those can survive and continue to flourish who possess elasticity and energetic mental and physical vigour, backed up by and supported with scientific knowledge and intelligent observation. It is clear that the Dee Oil Company possessed these qualities, and the subsequent history of the firm shows that they were thoroughly needed. Thus, somewhat later, it was found that the paraffin scale and crude wax market became glutted, and no competition could be longer undertaken in that direction. The Dee Company therefore utilised the apparently hard circumstances by at once erecting its own candle works, where it could manufacture its own raw material into candles and so remove it beyond the region of impracticability and danger. To cut down other expenses the company further erected its own sulphuric acid works, and will shortly put up its own stearin plant. Competition was thus fought with its own weapons. The samples of manufacture exhibited comprise specimens of crude petroleum as taken from the American wells, refined petroleum, burning oils and residuum, which, as has been stated, is the material used by this firm. From it are manufactured lubricating oils of different brands, cylinder oils, and a special class of oils termed "valvolines" sterling. They are oils for internal lubrication, and are said to be superior to even the best makes of cylinder oils. They are especially recommended for use with sight-feed lubricators and in all high-pressure steam cylinders. They are remarkable for a high flash point (510° to 550° F.) a low setting point (under 32° F.), and a great viscosity even when exposed to high temperatures. An entirely new method is used for their preparation, avoiding, it is said, distillation and treatment with acids and alkalis. Three grades are exhibited—"torpedo oil," for use on torpedo boats, launches, etc.; "dynamo oil," adapted for electric machines; "gas engine" and "ring spindle" oils. We observe also a preparation for therapeutic use, *oleum Declina*, a medicinal oil for skin diseases. Besides these we see many other varieties of oils, and also fine specimens of paraffin wax, and candles, both plain white and coloured.

Messrs. Ragosine & Co., 7, Idol Lane, Great Tower Street, London, E.C. (No. 733).—This exhibit is one illustrative of the advanced present position of the Russian petroleum industry. Two of the most wonderful things in connection with this industry are its apparently inexhaustible stores of natural raw material in the neighbourhood of Baku, South Russia, and the enormous rapidity with which that industry has developed. To give an idea of this advance and development, it may be interesting to sketch the history of the firm whose beautiful exhibit is under consideration — that of Ragosine & Co. In 1876, when the monopoly in petroleum at Baku was abolished by the Russian Government, the production began at once to increase enormously, but so far the only valuable products obtained from the crude oil were spirit and burning oil. Since the Russian crude oil only yields 27 to 30 per cent. of these, there remained an enormous production of residuum, which was for a long time used as fuel or entirely wasted. It was Victor Ivanovitch Ragosine who first suggested the utilisation of the heavier portions of the crude oil for the manufacture of machinery oils and greases. The firm of V. I. Ragosine & Co. was founded by him in 1876, at Nijni Novgorod, with a capital of 200,000 roubles. A refinery was built at Balachna, on the Volga, in 1876, and a second at Constantinow in 1880. The capital of the Company was raised by successive fresh issues to 3½ million roubles, and in 1880 this Company obtained an imperial charter. The works at Balachna and Constantinow are supplied with raw material from Baku, by a system of tank barges, which are towed up the river during the month of May. The two refineries together have storage in iron tanks (each of about 2500 tons capacity) of upwards of 30,000 tons of crude oil and residuum. The plant at the two works includes 54 stills, and is capable of treating 35,000 to 40,000 tons of crude oil per annum, and of producing from 30,000 to 35,000 tons of lubricating oil, etc. The oils made from the Russian petroleum were first introduced into England in 1878. No mineral oils of the same "body," it is said, have been seen before, and this "body," or better, "viscosity," of the Russian mineral lubricating oils indicates their special advantage. The viscosity of Russian oil of specific gravity 0·915 is about six times that of American oil of the same specific gravity at 60° F. The viscosity diminishes rapidly as the temperature rises, but even at 120° F. the Russian oil is claimed to possess three times that of the American of the same specific gravity. As compared with colza and olive oils, the Russian of 0·905 specific gravity has roughly about two or three times the viscosity at 60°; at 120° F. they are about equal. These statements are confirmed by the tables of William McIvor and Boverton Redwood. Hence (1) high viscosity—*i.e.*, lubricating power; (2) freedom from acid; (3) absolute immunity from "gumming," since oxidation and drying cannot take place; (4) very low freezing point. The Russian crude oil contains practically no paraffin. A valuable product, viz., paraffin wax, is lost by this peculiarity, but the cost of freezing out the scale from the lubricating oil is saved. The burning oils, "petroleum" of specific gravity 0·826, No. 3, now largely used in this country and said to have a higher flash point than the corresponding American product, and equal illumination, "pyronaphtha" and "Australine," special oils of very high flash points—viz., 200° and 130°, and used in specially-constructed lamps, are pressing the American oils very hard. When the inert residuum of the American petroleum is destructively treated in red hot tubes, a large amount of charring takes place, and very little—scarcely any—increase of value in the distillate occurs; but if Russian petroleum residues are similarly treated, as was first discovered by Letny, and Liebermann and Burg of Berlin, these residues are converted, it is true with much charring, into the true coal-tar products, benzene, toluene, napthalene, anthracene, etc. Besides a fine collection of crude pretroleum, with naphthas, lubricating and burning oils of all kinds, as well as oils for other special uses, a set of interesting specimens of aromatic hydrocarbons, such as are obtained from gas tar by the tar distiller, and used in the making of aniline and other coal-tar dyes, is exhibited. Those specially interested on proceeding to Stand No. 781, may see there a specimen of crude anthracene obtained from the Russian petroleum in the way specified, and another of 20 per cent. alizarin prepared from the anthracene, and finally a piece of printed and dyed cotton in the colouring of which some of this alizarin was used. It has been, however, sufficiently proved by numerous practical experiments that the method of preparing coal-tar hydrocarbons by carbonising the petroleum or residuum will not pay, and we believe the process is now entirely or almost entirely abandoned.

J. C. & J. Field, Upper Lambeth Marsh, London (No. 752).—This firm, though also manufacturing and exhibiting a special kind of soap, is best known for its "ozokerite" candles, ozokerite being a peculiar mineral wax occurring largely in Galicia, and containing a very considerable proportion of paraffin. It is thus a kindred substance with crude pertroleum. Ozokerite was probably formed by the denuding action of water on peaty and similar vegetable remains, the vegetable part being gradually removed and the insoluble resins washed away or deposited. Till about 1770 wax and tallow were the sole ingredients of candles. The wax candles were "rolled," the tallow "dipped" or "moulded." The wicks in all cases were of twisted cotton, except in the cheaper tallow candles, in which rushes, partly stripped, were used. In 1850, James Young having isolated paraffin, J. K. Field took out a patent for manufacturing candles therefrom, which at once became very popular. Subsequently various members of the Field firm patented different forms of the candle—spiral, cable, etc.,—to which the plastic and transparent paraffin readily lent itself. In 1872 the attention of F. Field, F.R.S., was drawn to the mineral wax ozokerite, long known in Galicia. In 1874 a patent was taken out for the distillation of the crude earth wax, and the white, very hard paraffin now known as ozokerite was produced (melting point 142° F.). The recent introduction of semi-refined paraffin scale into the candle trade has almost annihilated the composite and tallow candle branch of the industry. The amount of candles and night-lights produced in Great Britain annually cannot be much under 30,000 tons: probably it exceeds this estimate. Price's Company turn out over 60,000,000 night-lights annually. The amount of palm oil imported into England exceeds 40,000 tons; tallow (exclusive of home consumption), 20,000 tons. (See Field's Cantor Lectures, *Journ. Soc. Arts*, 1884, and Rep. on Oils and Fats, C.I.E., 1886.) The principal part of Messrs Field's exhibit, the "samphire soap," is an article made by Dr. Alder Wright's ammonia process, and in this process all free alkali is removed. Moreover, a small quantity of free iodine is introduced, and glycerine of specific gravity 1·26 is substituted for the 20 per cent. of water usually present in toilet soaps. Eucalyptol, the essence of the *Eucalyptus globulus* in an iodised and semi-saponified form, is finally added.

PRICE'S PATENT CANDLE COMPANY, LIMITED, Belmont Works, Battersea, London, S.W.—This exhibit is one made by a firm which has a remarkable history. It is owing to a discovery made by a member of this firm that cheap and pure glycerine may now be had in abundance. To describe the development of the firm in detail would be out of the question, for, to begin with, more than 80 patents have been held by Price's Company. The great French chemist Chevreul, now over 100 years of age, but still active as a chemist, in 1811 began his researches on the constitution of fats and oils, and in 1823 he completely published his discoveries in this direction. In conjunction with Gay Lussac he attempted the industrial application of the scientific principles he had made known, but did not attain the success he doubtless anticipated. It was reserved to M. de Milly to lay the foundation of the stearic candle manufacture in 1832. In 1833 the "Bougies de l'Etoile," as the candles of MM. de Milly and Motard were called, were sold in Paris at about 1s. 8½d. per pound (retail), and at this price were placed on the market to the extent of about 25 tons per annum. In 1829 Mr. James Soames, of London, separated cocoanut oil into its solid and liquid components by pressure. He took out a patent for it. The patent was purchased by Mr. William Wilson and his partner, who worked under the title of "E. Price & Co." They perfected it, and produced by its aid cocoanut candles and lamp oil. In 1847 the concern passed into the hands of "Price's Patent Candle Company," Mr. William Wilson becoming the first chairman, and his two sons—J. P. Wilson and G. F. Wilson—the managing directors. The plaited wick, patented in France in 1825 by Cambacéres, was introduced into England by Henri Meyer, subsequently manufactured near Derby by Mr. Thomas Topham, and he in 1836 was supplying the wick to E. Price & Co. In the year 1840 Mr. J. P. Wilson, whilst endeavouring to produce a cheap self-snuffing candle for the coming illumination in honour of the marriage of Her Majesty Queen Victoria then approaching, succeeded in making such candles of a mixture of equal parts of stearic acid and cocoanut stearin. They gave a brilliant light, required no snuffing, and could be sold retail at 1s. per lb. The new candles came rapidly into notice, and the sales advanced in a manner entirely without precedent. They were termed "composite," because of the mixture of materials in them. Such was a new and successful departure in illumination for our homes and on festive occasions at the date of the marriage of Queen Victoria.

In 1840 George Gwynne took out a patent for the distillation of the fatty acids in vacuo. It is these fat acids which, chemically united with glycerine, form true fats, much as sulphuric acid united with soda forms a salt, sulphate of soda. The knowledge which had already been acquired that these fat acids could be distilled without destruction or decomposition was thus for the first time commercially applied. But in 1842—43 Messrs. Price & Co., in the names of W. C. Jones and G. F. Wilson, patented a still more important discovery, superseding the first. They discovered that all the good effects of the vacuum process could be gained by substituting the use of free steam. Thus the costly vacuum still was avoided. With respect to the hardening of fats, Fremy, another great French chemist, had shown in 1836 that treatment with 50 per cent. of their weight of sulphuric acid in the cold was needful. In commerce this was impracticable. Clarke and Gwynne patented a process based on the foregoing in 1840, but Jones and Wilson subsequently proved that if the mixture were warmed, not cooled, then 33 per cent. of sulphuric acid would suffice and still all the good results be obtained that were realised in the other process. Another commercial success was the result. In 1848 the night-light patent of G. M. Clarke, and in 1849 the night-light business of S. Childs were acquired, a new factory was erected, and in 1852 the sale of night-lights already amounted to over 12 millions per annum. Some years before the English millowners could be induced to use oleic acid instead of olive and other oils for the oiling of wool, that acid, as produced in large quantity in the manufacture of stearic or hard candles, had been thus successfully used on the Continent. The process of Messrs. Price & Co. by distillation appeared likely to remove the impediment in this country, and so in 1851 the English patent of Messrs. Alcan and Peligot (another noted French chemist) was secured for the use of oleic acid as a "cloth oil." However, it was only after some time the prejudice of the Yorkshire millowners was overcome. In 1854 R. A. Tilghman took out his English patent for acidifying fats and separating them into fat acids and glycerin by means of contact with water under high temperatures and pressures. The Company took an exclusive licence under this patent. However, a still further and very material advance was made when Messrs. G. F. Wilson and G. Payne, in 1855, discovered that neutral fats could be broken up (a kind of partially destructive distillation or, better, analytic distillation or hydrolysis) by distillation with superheated steam alone. Before the close of this same year Mr. G. F. Wilson secured another discovery and patent for his firm of great commercial importance and scientific interest. He found, namely, that glycerin could be distilled without decomposition by the use of steam. Previous to this date a chemically pure glycerin had never been seen. Under the new patent such a product became not only possible but commercially so. In 1850 James Young obtained his celebrated patent for the production of paraffin hydrocarbons by the destructive distillation of coal at a low red heat. In 1853, seeing the progress of Mr. Young's paraffin industry, Mr. Warren de la Rue took out patents for working the Burmese or Rangoon petroleum. Hardly had the first exports of some 10,600 gallons of burning oil prepared from this Rangoon petroleum to New York in 1859 been effected when "oil was struck" in America, and this new discovery of petroleum upset all calculations as to the value of the Rangoon article. Meanwhile Messrs. Price & Co. turned their attention to the perfection of the candle and other machinery. The increased use of American burning oil had no slight effect on the Company's sales, for whereas in the five years 1857 to 1861 46,905 tons were got rid of, in 1862 to 1866 only sales of 43,609 tons were effected. The firm now carried the war into the enemy's camp, and from using paraffin scale from Scotland and the United States a forward movement was made, first in the patenting a new process for producing fine white paraffin wax without the use of the dangerous spirit generally used in the washing processes, and secondly, in enlarging and improving its paraffin refinery at Battersea. At the present time, it is said, Price's Company is the largest refiner of paraffin in the world. By this indomitable perseverance and intelligent co-operation with circumstances the falling off already referred to in the transition period was soon recovered, the previous highest sales surpassed, and in the five years 1882 to 1886 the saleable produce rose to 80,205 tons. At present the approximate annual production of the articles manufactured by Price & Co. is 18,000 tons: value about £700,000. The annual consumption of raw materials is about 19,000 tons. The present annual production of paraffin candles in this country is 27,000 tons; of stearin candles 7500 tons.

After what has been recorded of the invention of a new and brilliantly burning candle, just in time for household use and for purposes of festive illumination about the period of Her Majesty's marriage, it would seem natural that some special memento might be afforded of such an occasion in the Exhibition: this has been the case, for Messrs. Price exhibit a life-size bust of Her Majesty in pure white stearic acid, standing on a pedestal of the same fat acid, supported on a cube of the material used in the manufacture of the gold medal palmitin candles. The soaps exhibited by this firm are extremely varied, and are of excellent quality. An interesting exhibit of candles, night lights, tapers, etc., and the machinery used in forming them is to be seen in the Machinery Annexe, Stand No. 416.

I. Levinstein & Co., Manchester (No. 742).—There is here a model of its kind, for it is both eminently beautiful as well as instructive. Very artistic, too, is the arrangement of the little pavilion, which forms the show-stand, for if the visitor go inside it he at once loses sight of any specimen of dye, colour, or other material used in the preparation and colouring of the exquisite ornamental silks, wools, and flowers, which are so arranged as to make the interior resemble that of a conservatory. Let him proceed to the outside, and immediately on passing the doorway he at once loses sight of the ornamental and artistic embellishments, and a series of elegantly arranged chemical specimens presents itself. He may now see and examine all the materials and products through every stage, from the raw coal to the finished dye and colouring matter, as well as other useful coal-tar products. But Mr. Levinstein has so devised it that not only are the specimens and samples shown, but they are exhibited in the proportions in which they are practically obtained in the factories, so that, commencing with the cubical block of coal weighing 1 cwt., the specimens shown in the lower compartments of the pavilion represent also the proportions by weight obtainable from the 1cwt. of coal aforesaid. We observe on the 1cwt. block of coal a small bottle containing saccharine from coal tar, the announcement of the manufacture for the first time of which was made by Mr. Levinstein nearly two years ago. The little sample in question represents the actual proportion obtainable from the large block of coal on which it rests. Besides the raw and intermediate products, which are shown in all completeness of detail, about 100 different coal-tar dyes are also exhibited. As regards illustrations of dyeing power as exhibited in the superficies of fabric which can be dyed to a full shade, the 1cwt. of coal already mentioned is here again brought usefully into requisition, and around the block are arranged some folds of flannel dyed scarlet, and representing accurately, therefore, the amount of scarlet-dyeing power (if it may be so described) that resides in the 1cwt. of coal. Especially we notice fine specimens of the eosines, naphthol yellow and azo-scarlets for which this firm has obtained such celebrity.

Messrs. Josiah Hardman & Co., Miles Platting, Manchester (No. 747).—An accurate and beautifully constructed model of the tar distillery in its most complete form first strikes the eye of the visitor. This model is moreover no fanciful representation, and to show how thoroughly its arrangement and planning have been thought out and designed, it is modelled to scale, and on its premises are arranged sulphuric acid chambers, with all the paraphernalia of a vitriol works, so necessary an adjunct in these days of low prices, when materials must be as far as possible manufactured direct rather than bought. As regards the splendid collection of specimens, these are arranged so as to exhibit not only quality but also proportion by weight derived from a given unit weight of raw coal. A large cubical block of coal is shown and the weights of useful products derived also, and, further, the quantities of different fabrics that can be dyed with the given proportions of colours that may be extracted from the block are exhibited. This furnishes an interesting and striking idea of measurement of the colouring capacity that is latent in ordinary gas coal. The exhibit of course includes crude as well as purified products obtained from coal tar, ammoniacal liquor and spent oxide.

Messrs. Hardman & Holdens, Miles Platting, Manchester (No. 746).—A kind of branch firm of the foregoing. Here is seen a most attractive and interesting exhibit arranged to illustrate the manufacture of alizarin from coal tar, and showing a series of chemical products with their derivatives, remarkable for their purity and beauty. The practical application of alizarin to cotton is shown by a variety of dyed and printed yarn, cloth, velvet, etc. Alizarin colours on fabrics are also shown alone as well as in conjunction with other dyes. Special prominence is given to the exhibition of specimens illustrating the advances made in the dyeing of silk and wool with alizarin. Skeins of silk in six colours, showing four shades of each, also examples of dyed and printed silks, form a new and pleasing feature in the exhibit. Moreover, samples of wool in various shades, also cloths and tweeds in which alizarin-dyed wool predominates, are shown. The old original madder in various forms is not forgotten, and some specimens of madder-dyed and printed fabrics are exhibited, among the most interesting being the Indian dresses, woven and dyed with munjeet (*Rubia munjista*) by the natives.

It was not until the expiration of the German patents that Hardman & Holdens, who were first in the field, were able to start their alizarin work. There are now three English makers, and it seems probable that ere long England will make all the alizarin she consumes. One effect of this competition following the expiration of the patents has been that whereas four years ago the price of alizarin was 2s. 6d. per lb., the present market price is only 8½d. per lb.

Messrs. Sadler & Co., Limited, Cleveland Chemical Works, Middlesbrough (No. 744).—This firm makes a specially interesting exhibit of coal-tar products, crude and refined, and amongst the latter notably alizarin, aniline, and other coal-tar dyes; likewise acids, alkalis, and other chemicals are represented as being manufactured for use or in order to the working up of by-products. It is worthy of mention that Messrs. Sadler & Co. were the first manufacturing chemists to recognise the practical value of the coal-tar from the coke ovens on the Simon-Carvés system as worked by Messrs. Pease & Partners, at Crook, near Darlington, and long before other manufacturers were willing to admit the genuine character of that tar and ammoniacal water, or thought anything about the subject, this firm had made contracts for both products and worked them to profit: and hence Messrs. Sadler & Co. were certainly the first firm, at all events in this country, to make alizarin and other coal-tar colouring matters from coke-oven tar. As a record of enterprise, the foregoing may be placed at the head of the brief list now to follow. Alizarin is one of the specialities of this firm, and in its manufacture Messrs. Sadler enjoy the advantage not only of making the raw material, anthracene, direct from coal tar, but they make at the same time all the other chemicals which are necessary for its complete production. By their process they produce an article of exceptional purity. The beautiful dyed and printed specimens illustrating the effect of Messrs. Sadler & Co.'s alizarin and allied colours on the fibre were furnished, we understand, by Messrs. E Potter & Co., of Dinting Vale. With regard to aniline colours. Messrs. Sadler & Co. commence with the tar, distil it, and proceed onwards to the finished colours. Their magenta is produced by the nitrobenzene process. Another dyestuff—viz., Bismarck brown, is made by a patent process direct from dinitrobenzene, the benzene for this being extracted from coal gas.

This firm manufactures oxalic acid largely from sawdust. Amongst the alkali products, soda is made from salt, which occurs largely in the strata below the ground on which the factory stands, and the sulphuric acid from pyrites obtained from the Cleveland hills in the neighbourhood. Fuming sulphuric acid, considerably used by the dye manufacturer, Messrs. Sadler make from bisulphate of soda.

Epsom salts, for a great number of years made in Middlesbrough from the magnesian limestone, are now entirely manufactured from kieserite, a refuse product of the Stassfurth mines.

All the waste products of the factory which possess any value for the purpose are mixed with dissolved bones and superphosphate, which is also made in large quantities and sold in the form of manures.

The British Alizarin Company, Limited, Silvertown, London, E. (No. 736).—This beautiful exhibit, mainly a reproduction of the one which excited so much admiration in the late International Inventions Exhibition, and which gained a gold medal there, is not only of present interest, but it illustrates well the history of the development of the madder and alizarin industries.

1st. Is a series of specimens illustrating the growth and form of the madder plant and various dyeing products derived from it. These natural dyes have been superseded by the "alizarins." Specimens are also shown of cotton prints prepared with madder colours.

2nd. There are specimens showing the crude products from the distillation of coal-tar.

3rd. Specimens illustrating the process of the manufacture of alizarin, flavopurpurin, and anthrapurpurin from crude anthracene, together with others exhibiting some of the chemical properties of anthracene and its derivatives, as well as further specimens of the pure chemical substances which occur along with pure anthracene in crude coal-tar anthracene.

4th. Numerous specimens of printed and dyed cottons, muslins, velvets, cretonnes, etc.; also others of dyed turkey-red cloths and yarns produced with the alizarin colours of the British Alizarin Company, Limited. Some of these specimens show the alizarin in conjunction with other colouring matters.

5th. According to an instructive system of arrangement, a series of samples illustrating the various stages of cotton printing and dyeing with alizarin is shown—*e.g.*, cotton cloth in all the following conditions and in the following order:—Grey, bleached, mordanted, fixed, dyed, oiled, steamed, cleared and finally finished.

6th. Specimens exhibiting the shades obtained by the same mordant from alizarin, anthrapurpurin, and flavopurpurin respectively.

7th. A "five-striped swatch" (mordanted and dyed cotton cloth), showing the colours produced by various mordants from the same alizarin dye-bath. Besides the foregoing are two Indian figures, draped in native costume, printed with alizarin, and numerous samples of wool and silk dyed with the same colouring matter.

Messrs. Brooke, Simpson & Spiller, Limited, Hackney Wick, London, E.; also 106, Portland Street, Manchester (No. 732).—This firm is one which has a history, for in earlier days, under the style of Simpson, Maule, & Nicholson, it acquired a European reputation for violet and blue dyestuffs. The magentas and acid magentas produced by Messrs. Brooke, Simpson & Spiller have a reputation for exceeding purity and beauty of colour. Dyed and printed patterns indicate the applications of the dyestuffs exhibited.

Society of Chemical Industry of Basle, Switzerland, formerly Messrs. Bindschedler & Busch (No. 743).—W. G. Thompson & Co., Cooper Street; and O. Isler & Co., Marsden Street, Manchester.—The writer has had the privilege of inspecting the works, laboratories, and offices of this, the foremost of Swiss colour and dye manufactories, comprising aniline and azo colour factories, and also an extensive alizarin works. The laboratories are extensive, excellently arranged, and form a leading feature of the establishment; they are manned by a staff of 15 chemists. Throughout the works, cleanliness and good order are qualities which at once strike the visitor; excellent discipline is also everywhere observable. There are from 350 to 400 workmen and foremen. To give an idea of the steam power required in a factory of this kind we may mention that 11 steam boilers, representing in the aggregate 1100 horse-power, are regularly at work. No less than 22 steam engines are in operation for the communication of power. The specialities quoted by this firm from a long and well-classified list of their products are the following:—Violet 5 B crystals, ethyl purple, Victoria blue B and 4 R, night blue, auramine, tartrazine, acid magenta, fast green 3 B, crystals acid violet 7 B, alkali violet.

St. Denis Dyestuff and Chemical Company, Limited (Poirrier & Co.), St. Denis, Paris, and 3, Booth Street, Manchester (No. 740).—This exhibit is well worthy of the foremost firm in France in the manufacture of dyestuffs. Amongst the colouring matters shown, we observe some interesting ones of the azo class, and not the least so that one termed "roccelline."

Manchester Aniline Company (Charles Truby & Co.), 55, High Street, Manchester, and Clifton Junction (No. 738).—This exhibit comprises specimens of aniline oil for dyeing, calico printing, and colour making, of essence of mirbane (nitro-benzene) for scenting soap, dinitrobenzene and toluene, pure naphthalene, nitronaphthalene, arseniates of soda, oleine as alizarin oil, soluble oil, and all the special materials for sizers and finishers.

Von Hohenhausen & Co., Yew Tree Chemical Works, 303, Collyhurst Road, Manchester (No. 745).—An elegant display of all the materials used by the calico printer and dyer which come under the headings of mordants, dung substitutes, preparing liquors, assistants, etc., together with some special dye-stuffs. The sulphocyanides and acetate of chrome deserve special mention.

Dan Dawson Brothers, Milne Bridge Chemical Works, Huddersfield (No. 737), exhibit a neatly-arranged series of specimens illustrating the chemicals and coal-tar dyes manufactured by them.

Charles Lowe & Co., Reddish, near Stockport, and Piccadilly, Manchester (No. 739).—With the name of Charles Lowe that of chemically pure carbolic acid is intimately associated. Mr. Lowe was the discoverer of a finely crystalline hydrate of carbolic acid, and the name of his firm has for long been taken as a guarantee of excellence and purity of manufacture of the carbolic acid preparations and derivatives — some of them dyestuffs — which are manufactured there. A novel method of exhibiting the phenol- and other colours in a kind of glass case is adopted.

J. C. Siegerist, 41, Faulkner Street, Manchester (No. 731), representative of the Fabriques des Produits Chimiques de Thann et de Mulhouse, Alsace.—In the first place are exhibited colours in dry, paste, and liquid states, specially prepared for calico printing. These colours are, almost without exception, "finished colours"; that is to say, specially prepared colours, which, in order to be printed upon the cloth, simply require mixing with a thickening such as starch, gums, albumen, etc., according to the nature of the colour. No mordants having to be added to these colours by the printers, the latter are easier for them to manipulate, and are said to give more satisfactory results as to uniformity of shade, etc., than colours made up by themselves. There are colours for ordinary calico printing, indigo discharge, and others for printing on alizarin red-dyed cloth. The principal feature in the latter (both blues) is that they are simply printed on the cloth with a thickening, steamed, and then washed. This gives a very good imitation of indigo discharge on turkey-red. There is also one colour (Alsace green) for piece dyeing, and this colour can be discharged. With the exception of a few, these colours are said to be fast to light and soap. We observe (2) colours for printed wall papers; (3) colours for wool dyeing. Amongst these is an aniline blue which gives shades equal to indigo. The colour is even faster than indigo both to light and soap, and no acid can discharge it. It stands milling and felting perfectly well. (4) Chemicals used as mordants, etc.; (5) substances used in the making of aniline colours; (6) chemicals for producing blacks on cotton goods; (7) aniline colours for wool, silk, and cotton; (8) glycerines made from pure stearin; (9) albumens; (10) Senegal gums.

B. Kuhn, agent for **L. Durand and Huguenin**, Basle, Switzerland, 55, Bloom Street, Manchester, and 36, St. Mary-at-Hill, London, E.C.—An interesting display of coal-tar colours is shown for dyeing and printing wool, cotton, silk, etc., with patterns to illustrate the shades and character of these colours. Special dyes for leather are also exhibited, with specimens of that material dyed and printed. An interesting feature of the exhibit is, however, the new coal-tar medicaments shown. First we observe "*salol*," or phenyl salicylate, which has been recently applied with success as an anti-rheumatic. It is better to take than salicylic acid, which deranges the stomach. The salicylic acid of the salicylate (salol), however, is, after all, the effective agent, but the decomposition necessary to set free that acid from its combination with the phenol only takes place when the dose of salol reaches the duodenum, and consequently only after it has passed through the stomach. "*Antifebrine*" is the second therapeutic agent exhibited; its true name is *acetanilide*. The therapeutic name indicates its use.

GROUP VII.—DYES AND COLOURING MATTERS FROM OTHER SOURCES THAN COAL-TAR.

Of colouring matters or other principles, the chemical constitution of which is still unknown to us, we have those contained in most of the dye-woods—*e.g.*, logwood, fustic, quercitron bark, Persian berries, etc., and also tannic acid. (See Stand No. 796.) Many of these are of the very greatest importance to the textile colourist, and hence recourse must still be had to Nature's resources. It is interesting to note that nearly all the colouring matters above referred to are such as require the aid of mordants in order to develop and fix upon fabrics the colours they are capable of producing.

Millward & Cryer, 10, Greenwood Street, Manchester (No. 795).—The exhibit of this firm includes samples of indigo and the model of an indigo factory; specimens of the seed, plant, etc., and classified samples of indigo; specimens of refined indigo, and extract of indigo; patterns of fabrics dyed with indigo. Indigo is a colouring matter used as a dyestuff in India from the earliest times. Cloth dyed with indigo has been found in the old Egyptian tombs, and the process of preparing and manipulating the dye is accurately described by both Pliny and Dioscorides. The chief source of East Indian indigo is the *Indigofera tinctoria*, an herbaceous plant raised from seed, of which a sample is exhibited, which is sown in either spring or autumn. The plant grows with a single stalk to a height of about 3ft. 6in., and about the thickness of a finger. It is usually cut for the first time in June or July, and a second, or even a third cutting obtained later in the year. The number of leaves which the plant puts forth determines the value of the crop, as it is in the leaves that the colouring principle is chiefly contained. The crude mode of manufacture carried on in Bengal at the present day coincides exactly with the description of the processes given by Pliny and Dioscorides. When the leaves arrive at a proper degree of maturity the plants must be speedily gathered, and each cutting rapidly executed during the night, for the scorching sun would wither the branches and injure the produce. A great many hands are employed in the gathering process, and the surrounding villages are all requisitioned. The workmen are dispersed in the fields at midnight, and in the morning the produce of the harvest is deposited in stone troughs previously filled with water. Under the influence of the sun's rays fermentation soon takes place, and after about 48 hours the liquid is drawn off into shallow vats. Here it is beaten about by means of oars by the natives, who enter the vats, the object being to expose the liquid as much as possible to the action of the air. During this process the greenish yellow fermented extract from the leaves assumes a deep blue or almost black colour. The liquid is allowed to stand, and the indigo blue which has been formed gradually settles to the bottom as a fine powder. The supernatant liquid is drawn off and the indigo precipitate is boiled with water in metal vats in order to prevent further fermentation, which would injure the indigo itself. The indigo paste is then drained in filters, and the dark blue clay-like mass is cut into cubes, dried in open-air sheds, packed into chests and sent to the Calcutta market.

The fresh leaf of the indigo plant does not contain indigo, but a colour-yielding principle called *Indican*. Under the influence of the fermentation and the subsequent oxidation this colourless or faintly-coloured and soluble indican is decomposed or split up into glucose and indigo blue. The former remains dissolved in the liquid, while the latter, being insoluble, is precipitated in the beating or oxidation vats as described. From Allahabad eastward vast districts are to be found in which this forms almost the sole product manufactured. Oude, Tirhoot, Upper Behar, and a large area of Bengal are almost entirely in the hands of the indigo planters. The average annual production of East Indian indigo during the last 18 years may be placed at 120,000 maunds (about 74lb. to the factory maund), and the value over two millions sterling. The price of indigo has ranged within the same period, for fine Bengal and Tirhoot, from 8s. 6d. per lb. in 1870, when the crop was 92,000 maunds, to 5s. 3d. per lb. in 1878, when the crop reached 155,000 maunds, and is largely governed by the abundance or paucity of the crop, which in its turn is influenced by the monsoon or rainy season. Although the main supply of indigo is furnished from East India (consisting of Bengal, Tirhoot, Benares, Oude, Kurpah, Madras, and Bimlipatam qualities), yet there are also some considerable imports from Guatemala, from Caraccas in South America, and, in addition, from Java and some little from Manilla, the capital of Luzon, in the Philippine Islands; but all these last named occupy relatively a subordinate position. Recent experiments by R. C. Phillips have also shown that indigo can be easily grown on the West Coast of Africa, near the Congo.

E. D. Milnes & Brother, Lumn Mills, Lancashire (No. 796).—The main products exhibited by this firm are extracts used in dyeing, calico printing, and tanning of their own manufacture; also the raw materials from which such extracts are prepared; moreover, a number of chemicals and drysalteries employed in the same industries. The extracts exhibited comprise those of logwood, fustic, quercitron bark, Persian berries, sapanwood, sumac leaves, myrabolams, galls, divi divi, valonia, chestnut, oak bark, quebracho, and larch bark. The annual consumption of these articles in the United Kingdom already amounts to thousands of tons, and continues to increase rapidly. These extracts are simply aqueous decoctions of the above-mentioned vegetable products evaporated to the requisite consistency with special precautions; they are now obtained in a state of excellence formerly unattainable, and promise ere long to entirely displace the dyewoods and other raw materials from which they are prepared. The improvements effected consist mainly in the adoption of improved mechanical means for ensuring a thoroughly complete extraction of all valuable ingredients, and prevention of any deterioration or composition during both extraction and evaporation. This end is accomplished by the use of vacuum pans, in which the extraction can be effected at lower temperatures. Specimens of cloth dyed and printed with the extracts, etc., are shown in the same case, as well as fine examples of dyewoods.

Bourgeois Aîné, Rue de Caire, Paris; agent, Alfred Hallam, Post Office, Peel Causeway, Altrincham (No. 798).—The exhibit of this firm is composed chiefly of superfine colours for designers and engravers to calico printers. The colours are made up in five forms—viz., in tube, baton, flake, paste, and powder, and it is claimed for them that they are especially brilliant and opaque, and will work one over the other without loss of tone. These are the colours used in France in the production of the calico-print designs, etc., so well known in this district. A selection of drawing materials as used by designers is also shown.

GROUP IV.—LAKES, PIGMENTS, PAINTS AND VARNISHES.

Rawlins & Son, Brook Works, Rainhill, Prescot (No. 753).—A fine exhibit comprising the raw materials used in the manufacture of ultramarine, ultramarine in its intermediate stages, known as "raw ultramarine," "settled ultramarine," and "dried pulp ultramarine"; the finished ultramarine, and various manufactured goods illustrating its application in various industries; the raw materials used in the manufacture of "smalts," the fused cobalt glass or smalts in the intermediate stage, and the finished article ready for the market, together with manufactured goods illustrating its use.

Charles Scheu, 2, Cumberland Street, Manchester; and 65, West Regent Street, Glasgow (No. 754), exhibits very fine specimens of ultramarine colours, blue, green and violet, and the raw material used in their preparation; also a model of the form of furnace used in the ultramarine manufacture.

Robert Ingham Clark & Co., West Ham Abbey, and Leadenhall House, London, E.C. (No. 775).—A variety of varnishes for coachbuilders, decorators, heald manufacturers, etc., also carriage spokes, panels, and healds coated with these varnishes. An interesting collection is shown of fossil gums and resins used in the manufacture of varnishes, including gum amber from the shores of the Baltic, gum mastic from the island of Chois, gum kauri from New Zealand, gum animi from Zanzibar and Demerara, also gums from the interior of Africa—*e.g.*, Angola, Benguela, Sierra Leone, and red Angola copals, also gum copal from South America. Amongst these specimens are two which merit special notice—*i.e.*, a mass of gum kauri from New Zealand weighing about 200lb., and a mass of animi from Demerara containing embedded in its midst, a large number of ants and other insects. Both these pieces of gum are said to be the largest of their kind yet discovered.

William Pakeman, Manchester Road, Stockport (No. 756)—Specimens of mineral and vegetable pigment colours for the use of calico printers; also bronze powders and colours for paper stainers, printers, and manufacturers, all guaranteed free from arsenic; lakes and mineral colours for lithographic inks, etc.

Henry Crookes, A.R.S.M., M.S.T.E., 4, Westminster Chambers, London, S.W. (No. 757).—Shows a heat-indicating paint and some of its applications. The paint, which is a specially prepared iodide of mercury, or contains that substance, takes its name from the property it has of changing colour when heated to a certain temperature; the point at which the change takes place can be varied between 140 and 170° F. by certain modifications in the manufacture. Its principal use is to show when bearings of machinery or other surfaces liable to become overheated have reached a temperature which may be a source of danger; at such a point the paint changes its colour from a bright red to a dark chocolate. When allowed to cool it resumes its red colour, and this change takes place whenever the paint is heated and cooled. As examples of its application two flat-irons are exhibited, one painted a bright red, showing the colour of the paint at a low temperature; the other painted dark brown—*i.e.*, the colour which the paint assumes when the temperature rises over 150° Fahrenheit. Another application claimed for this paint is that it can be used for painting coils of wire through which electric currents have to pass; when the current exceeds a certain limit, the coil will become heated and the paint will change colour, thus indicating the rise of temperature.

Jos. B. **Freeman** & Co., Grove Works, Lombard Road, Battersea, London (No. 758), exhibit a kiosk painted with their patent non-poisonous white lead, also samples of the lead, and boards painted with it and subjected to the action of sulphurous fumes. This non-poisonous white lead consists mainly of zinc oxide and lead sulphate, specially prepared from metallic lead, mixed together, and finely ground under great pressure. Many attempts had previously been made to utilise lead sulphate as a pigment, but without success, the product being quite useless, possessing neither the necessary density, body, nor opacity. Moreover, a large quantity of oil is required in grinding it, and as a paint it is what painters term "slimy," and works very badly under the brush. The difficulties were finally overcome by adding about 25 per cent. of zinc oxide (in itself a substance possessing neither good body nor density), and subjecting the mixture to great friction and pressure under heavy edge runners. A complete change in the character of the substances employed is thus effected, such indeed as it would appear impossible to produce by any mere process of mixing, and a pigment possessing great density, opacity, and whiteness is the result. The whiteness is said to be greater than that of the finest white lead made by the Dutch process. As regards density, 3 cubic feet of lead sulphate weighing 170lb. per cubic foot and 1 cubic foot of zinc oxide weighing 58lb. when mixed together and treated by the above process yield the pigment in question, weighing over 200lb. per cubic foot. According to Professor Church, when surfaces coated with this paint are submitted for various periods to the action of air containing sulphuretted hydrogen, they remain unaffected, or are "only very slightly tinged;" when they are excluded from light for some time the paint does not turn yellow or buff—a well-known objection to the use of white lead.

Donald Macpherson & Co., Manchester Paint and Colour Works, Knott Mill, Manchester; and 106, Cannon Street, London (No. 761).—The articles exhibited are a kiosk illustrating the use of Foochow enamels, metallic paints for exterior, quick-drying enamels that require no stoving, and vases, bricks, and timber enamelled with the quick-drying Chinese enamels with which tea trays and papier-maché articles imported from China are coated. The paints have on drying an extremely hard, tough, glossy surface, are not affected by sulphuretted hydrogen, and will not crack, blister, or scale off. They are suitable for machinists, japanners, and other manufacturers who have to turn out goods as soon as finished, and yet require a highly enamelled surface.

Goadsby & Co.: office, 2, 4 and 6, Albert Bridge; works, Newton Heath, Manchester (No. 762), exhibit colours, paints, varnishes, etc., amongst which are a concentrated oil drier, used by linseed oil boilers and manufacturers of tarpaulin, oilcloth, and linoleum; it is said that 1 part of this drier to 20 parts of linseed oil makes it dry hard in about eight to twelve hours. Terebene is used by painters, decorators, etc., as a drier. Engine green is used for locomotive and other engines; it is stated that this paint does not change colour or crack even when heated by means of super-heated steam. Vermillionette is a substitute for vermillion, largely used at a time when genuine vermillion was high in price. It is a chromate of lead prepared in a special manner. A large number of prepared lakes of eosin are also called vermillionette by some makers, but though a good imitation in point of colour they do not stand exposure This colour is used by railway companies, manufacturers of printing inks, agricultural implements, etc. Goadsby & Co.'s paint detergent is used for washing down and cleaning off old paint and grease, and for washing lithographic stones and type. Varnish enamel paint, a combined colour and varnish, household paint ready for use, and peroxide of iron paint are also shown.

Griffiths Brothers & Co., 6, Dashwood House, 9, New Broad Street, London, E.C. (No. 763).—The exhibits of this firm comprise aquol, a washable water paint; vitros bath enamel, for enamelling baths, etc., without stoving: and Griffith's patent zinc white (sulphide of zinc). It is claimed for this latter article that besides being non-poisonous "it covers one-third more than white lead and 100 per cent. more than zinc oxide." It is said to have no chemical action upon metals, is not discoloured by foul gases or bilge water, and is fireproof and unaffected by a red heat. It is also said that the most delicate tints or "tones" can be produced with it not possible with lead. This zinc white is produced as follows:—Either zinc chloride or sulphate is precipitated by a soluble sulphide—sodium, calcium, and barium sulphides all having been used for the purpose—and precautions are taken lest any iron that may be contained in small quantities as an impurity in the zinc solution should be precipitated with the sulphide of zinc. The precipitate, being collected and dried, is calcined in a furnace, then raked out, whilst quite hot, into vats of cold water, when it is levigated and dried. An analysis by Dr. T. L. Phipson shows that the pigment consists of an oxysulphide of zinc. Pyrodene is a fire-proof paint for fireproofing wood, canvas, etc. It may be mentioned that all the timberwork of the Fine Arts Section of the Exhibition has been treated with Griffith's pyrodene and painted with aquol.

F. & C. **Osler**, Birmingham and London (No. 768A).—This firm shows an ornate glass fountain, playing, according to a device of Mr. I. Levinstein, fluorescent water—*i.e.*, a faintly alkaline solution of fluorescein. The basin is painted with black and white bands, and shows the fluorescence remarkably well, the water appearing yellow by reason of the light transmitted from the white bands, and sea-green when the black bands absorb the light. The non-poisonous nature of the fluorescein is illustrated by the fact that goldfish have been living in the water for two months.

GROUP V.—BLEACHED AND COLOURED FIBRE.

Ermen & **Roby**, Nassau Mills, Patricroft; and 14, College Land, Manchester (No. 771).—This exhibit of cotton yarns is divided into three groups—1, mending, knitting, embroidery, and crotchet cottons; 2, polished cotton; 3, sewing cotton on spools and in balls:—

1. The mending and knitting cotton being principally used for hosiery, it is important that the colours should be fast, so as to resist washing and exposure to the light Consequently the most permanent dyes are selected for these yarns, such as turkey reds, indigo blues, aniline blacks, etc. A large quantity of bleached knitting cotton is used. The same remarks apply in great measure to the embroidery and crotchet cottons; the colours are made as fast as possible. Crochet cottons are principally used in white.

2. Godfrey Ermen, late partner in this firm, was the first inventor and patentee of the process of polishing or glazing cotton thread, and the firm has made this article a speciality ever since. Polished thread is shown, wound on reels of various sizes. The aim of the firm has always been to combine elasticity and softness with strength, in order to produce the most suitable thread both for the sewing machine and for hand sewing.

This exhibit as a whole is rendered something more than striking—in fact almost magnificent—by being itself incorporated in another representation. In short, the items above given are incorporated in a model of the famous monument at Athens, erected B.C. 335, by Lysikrates to celebrate his victory for the best chorus at a dramatic contest. It takes the form of a small temple in the Corinthian style, showing the finest and purest style of Greek art. The height of the original is 35ft., Messrs. Ermen and Roby's *fac-simile* being 18½ft.

Ch. Weber & Co., Thann, Alsace (778).—The exhibit of this firm consists of cotton yarns, slubbings, rovings, etc., both dyed and bleached, in the cop, spools and bobbins. The process of dyeing and bleaching the yarn in this form is worked on the Continent, and as it dispenses with the operation of reeling, pirn-winding, etc., effects economy in space, plant, time, and labour. It is also claimed that when yarns are dyed in this form there is less waste and no shrinkage or loss in length.

Select Exhibit of Committee of Section III., collected by J. J. Hummel, Yorkshire College (No. 779).—A most valuable and instructive exhibit, collected and arranged with very great skill and considerable artistic effect. Messrs. E. Potter & Co., we are informed, supplied much of this valuable exhibit of calico prints, and placed their whole collection at Professor Hummel's disposal. Messrs. F. W. Grafton also contributed liberally. An illustration of the gradual advance in artistic design and colouring since 1785 to the present day is shown, the equal of which has rarely been seen and probably does not exist outside that belonging to the Société Industrielle de Mulhouse. A series of woollen patterns dyed with the natural colouring matters, and also with the artificial (coal-tar) colouring matters, is shown; also compound shades, dyed with mixtures of three colouring matters, of each class. Besides these, patterns of cotton and silk dyed with coal-tar colours obtained by Goppelsroeder's electrical method, and the apparatus by which aniline black is produced on cotton, and discharge white on indigo blue, by the aid of electricity.

William M'Farlane, Miller's Brook Dyeworks, Heywood, near Manchester (No. 780).—This firm exhibits specimens of dyed cotton yarns used in the manufacture of coloured textiles at home and abroad—*e.g.*, for dhootie, khakee, drill, and general trade, also specimens of dyed cotton, lace and lace yarns. The yarn is dyed in various forms—in hanks or bundles and in ball warps and chains. A special feature in this exhibit is the alizarin red dyed on yarn in the form of ball warp and chain. Until recently all yarn was dyed in the form of hanks, and the operations were almost entirely manual. The introduction of improved machinery, however, has made it possible to dye yarn in the form of ball warps and chains, and this method forms now a most important branch of the cotton yarn dyeing industry.

Select Exhibit of Committee of Section III., collected by Watson Smith (No. 781).

1. A series of silks dyed with coal-tar colours in all the prismatic shades according to a graduated system. These specimens were dyed by the eminent French firm, Marnas, Bonnet et Fils.

2. A set of specimens of fabrics printed and dyed in indophenol by the firm of H. Koechlin, of Lorrach, Alsace, as well as the indophenol white and blue in paste and powder. This dye was formerly proposed as a substitute for indigo, but its non-resistance to acids is much against it. Specimens of all the raw materials used in the preparation of the indophenol blue are shown, as prepared by Dr. Otto N. Witt.

3. A specimen of murexide, a crimson colouring matter, formerly prepared from guano, is exhibited, as originally manufactured by the late Robert Rumney, of Manchester, who first introduced the colouring matter into England. The discovery of magenta quickly crushed any hope of extending the use of this fugitive but beautiful red. A piece of cotton cloth printed with murexide is exposed, and though full and bright when first placed in the case, is now much faded.

4. Piece of calico printed with alizarin on different mordants: the alizarin used being a 20 per cent. paste prepared from anthracene, made in South Russia from Baku petroleum residuum, by passing through red-hot pipes filled with charcoal or coke. (See exhibit No. 733, Messrs. Ragosine & Co.) Specimens of the residuum and of the alizarin paste are also shown.

5. One pound each of the several kinds of coal used in the Manchester Gasworks for the mixture adopted in charging the gas retorts is shown, and by the side of these specimens a parti-coloured strip of cloth dyed with the exact amounts of the coal-tar colours that could be prepared from the products of the tar from one pound of such coal. The dyed strip of cloth thus strikingly represents the amount of colouring power in one pound of Lancashire gas coal.

6. Watson Smith exhibits chemically pure specimens of the aromatic hydrocarbon series, and of phenols contained in coal-tar.

7. The amount of bisulphide of carbon formed in coal-gas making varies directly with the temperature of distillation adopted, and hence where, as in London, coal is dear and the gas supply required very large, the highest temperatures are employed. A maximum of carbon bisulphide will of necessity be formed in such cases and appear in the tar. Watson Smith, by fractionally distilling a quantity of rectified benzene, obtained from the "first-runnings" of London coal-tar, succeeded in separating no less than 6 per cent. of pure bisulphide of carbon. A specimen of this bisulphide is exhibited, together with the original benzene from which it was isolated. A small specimen of chemically pure benzene prepared by passing phenol over red-hot iron borings is shown. Even ordinary alcohol is contained in some specimens of London rectified benzenes, formed by the action of the sulphuric acid used in the purification, on a certain quantity of olefiant gas dissolved in the crude benzene and the subsequent action of steam in the final distillation process. A specimen of such alcohol, separated by Dr. Otto N. Witt, is shown.

8. A specimen of sulphate of ammonia as obtained from the products condensed from the blast furnaces of the Gartsherrie Ironworks is shown, and also specimens of the tar and various hydrocarbons extracted from it by Watson Smith, both paraffins and members of the benzene series.

9. In order to prepare naphtha and acetic acid from wood, the latter must be submitted to a destructive distillation at a comparatively low temperature. Oak cropwood is used for this purpose, and the distillation takes place in cast or wrought iron retorts. Specimens of oak cropwood such as is actually charged into the wood retorts, and of charcoal left as a residue, are exhibited, and besides these, specimens of crude tar and acid, and also of the purified products, are shown.

It is generally said that pure commercial methyl alcohol made from wood must be obtained from Germany, as it is not prepared in this country. However, a specimen is shown here of a pure product made by a Glasgow firm for the use of dye and colour makers.

10. An exceedingly fine specimen of the Boghead cannel coal, now quite extinct, but from which Dr. James Young first prepared paraffin, is shown, with one of the Boghead shale at present used, and a collection of naphthas, burning oils, paraffin waxes, etc., prepared from the Scotch shale.

In a horizontal case are shown specimens of raw cotton in the pod, and even with the pod attached to the branches from the cotton tree, raw picked cotton, cotton silk of various kinds in the pod and picked, raw jute and jute fibres, China grass, various dyewoods, several species of indigo plant and colouring matter, with seeds of the *Indigofera tinctoria*. On the outside of the case the entire trunk of a cinchona tree is shown; also a set of cinchona barks, collection of twenty commercial gums, one of resins, and specimens of seed, stick and shell lac; Chinese insect wax, nutmeg in shell and fruit, cocaine plants and fruit, with active principles.

An interesting set of specimens illustrating the phosphate trade, and consisting of fine specimens of coprolites, apatites, etc., from the United States, is exhibited. Finally, a Chinese opium-smoker's tray is shown, with pipe and all the apparatus of the opium slave. Opium consisting of large balls, the commercial form, is also exhibited.

HENRY NEWALL & SONS, 10, Marsden Street, Manchester (782), exhibit wood pulps prepared by mechanical and by chemical processes for the manufacture of paper; also wood flour, used in making linoleum, wall decorations, and other fabrics, and in the manufacture of explosives. A special feature in the exhibit is the chemically prepared wood pulp, which shows a fibre much longer and stronger than that prepared by the mechanical process. The manufacture of wood pulp was commenced in Norway about the year 1870, from 500 to 600 tons being exported in that year. The industry has increased very rapidly, the production last year being about 100,000 tons. At first the wood pulp made by the mechanical or grinding process, and possessing very little fibre, was the only kind produced, but within the last few years chemical processes have almost superseded this method. By treating the wood with sodium sulphite a pulp with a long fibre suitable for better class papers is obtained, whilst mechanical pulp is only used for newspapers, wall papers, etc. A large amount of wood pulp is produced in Germany, but it is mostly consumed there, very little being exported. It is estimated that this year the production of this article will amount to 150,000 tons, valued at about £350,000.

GROUP VI.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

MESSRS. JAMES WOOLLEY, SONS & CO., Manchester (No. 785), exhibit an interesting collection o drugs of vegetable origin recently adopted as remedia agents, and solid and liquid preparations thereof adapted for medicinal use. Amongst the new remedies shown of vegetable origin are cocaine and strophanthus; whilst amongst those of coal-tar origin are antipyrine, antifebrine, and salol. Everyone has heard of the deadly Kombé arrow poison, used by the natives of the African coast. This poison is the extract of the seeds of the Strophanthus plant, and the chemical principle, a glucoside, is termed strophanthin. Mr. William Elborne, of the Owens College, has succeeded in isolating this poisonous glucoside in a state of purity. In small doses it is being used extensively in medicine as a valuable remedy in certain forms of heart disease. There are also specimens of various solid and fluid extracts, besides preparations of cinchona, opium, and nux vomica as directed by the "British Pharmacopœia" of 1885 to contain a definite proportion of active principle. The oleates shown are of considerable interest, and are prepared both by double decomposition and direct combination. They are principally used in dermatology. Besides these are to be seen ointments, pills coated by a soluble covering so as to temporarily conceal taste and odour, and a specially prepared cod liver oil, with emulsions of the same, etc.

THOMAS CHRISTY & CO., 25, Lime Street, London, E.C. (No. 787).—An interesting collection, containing in the dried state a variety of the plants, nuts, fruit, etc., from which the principal medicaments, extracts, alkaloids and essences—as well as foods—of vegetable origin are obtained. Besides these are also shown the prepared essences and other medicaments. It may not occur to those who admire the large quantities of rare alkaloids and extract preparations exhibited in some of the neighbouring showcases to Messrs. Christy's to inquire, "Where are the raw plants and drugs, nuts, roots, etc., obtained, from which these preparations are made?" The reply is, Messrs. Thomas Christy & Co. is one of the few firms in existence for collecting these. Amongst pharmacologists Mr. Thomas Christy's interesting periodical, "New Plants and Drugs," is well known, but a staff of experts is kept employed in foreign lands whose duty it is to investigate and report to headquarters, with the object of bringing new drugs and extracts to light. This firm has now a very considerable stock of raw plants and drugs, which, being convinced must be used some time, they offer to supply samples of to practical experimenters and scientific investigators for their researches. The exhibit is a collection of raw and manufactured drugs and their preparations, menthol and menthol cones, barks of various kinds, fibres, different specimens of gutta-percha, rubbers, tanning barks, dyewoods, etc., together with many other materials and finished products.

MESSRS. HOWARDS & SONS, Stratford, London, E. (No. 792).—Messrs. Howards & Sons have probably done more than any firm in practical experimental research and commercial enterprise to place fine quinine, as well as other preparations, at a moderate price in the market. Exceedingly fine and tastefully arranged specimens of cinchona barks and alkaloids are exhibited, as well as an interesting variety of organic acids and alkaloids used in pharmacy. The samples shown illustrate the great change which the introduction of cultivated bark has brought about in the quinine industry. The alkaloids exhibited by this firm are extremely pure. A beautifully crystallised specimen of iodoform is exhibited as the manufacture of Messrs. Howards. Specimens of coca leaves, of the cocaïne alkaloids and their salts, and of benzoyl-ecgonine, obtained by heating cocaïne with concentrated hydrochloric acid, are also shown.

E. MERCK, Darmstadt, London and New York (No. 788).—This firm, so well known for pharmaceutical preparations, alkaloids, and similar chemicals, makes a fine display. Without attempting to describe all the features of interest in the showcase of this firm, some preparations and substances found useful in the case of the most recent remedial efforts, may be desirable. In the first place, a colourless syrupy liquid is shown, *Lactic acid. alb.*, of specific gravity 1·21. It has been lately recommended by Mosetig-Moorhof for the purpose of destroying morbid and unnatural growths and formations. Internally used, it is recommended for diabetes, 5 : 300 per diem. A splendid specimen of *Aconitine nitrate cryst.* (Merck) is also to be seen. It is prepared from *aconitum napellus* by Duquesnel's method. The salt appears in the form of colourless crystals, soluble in water and alcohol. Its action on the animal economy is much more intense than that of the amorphous aconitine; it is, in fact, one of the strongest poisons known. The consumption in England and France is very considerable. Another specimen of great interest for the physician and student of medicine is that of *Apomorphine hydrochloride cryst.* It is a salt in the form of colourless crystals, soluble both in water and alcohol. The solution on exposure to air and light becomes gradually green, but the change is said not to diminish its physiological effect. Apomorphine is a certain emetic, 0·004 to 0·01grm., causing vomiting within six minutes. A valuable principle is the glucoside *Arbutin*, which is exhibited in white crystals. It is contained, along with tannic acid, gallic acid, and ursone, in the leaves of *Uva ursi.* Arbutin is easily soluble in water, but less so in alcohol, and it has a bitter taste. Even large doses do not produce fatal effects. It is a valuable medicine in the treatment of inflammatory catarrh of the bladder. The usual dose is three to four grms. in solution or as powder. Specimens of *Atropine* and its *sulphate*, of rare beauty as well as bulk, are shown. *Atropine*, melting at 239° Fahr. (Merck), absolutely pure, and especially free from daturine (so-called light atropine). The high melting point proves this. Moreover, its purity is indicated by its being in very hard, bright, and heavy crystals. Preparations containing daturine have a much lower melting point (about 223 to 226° Fahr.), and are never seen in such fine crystals as those which are free from it. *Atropine sulphate white cryst. neutral* (Merck): Extremely pure and absolutely neutral. A solution of 1 in 1000 produces mydriasis after 15 minutes; solutions of 1 in 200 have the same effect in from five to 10 minutes. The internal use of atropine as anti-spasmodic, anodyne, and sedative, as well as a means for limiting certain secretions, has increased, and especially since atropine has been recognised as a powerful *antagonist* to different narcotic poisons, such as morphine, digitaline, prussic acid, etc. Thus the most reliable antidote to atropine would be repeated injections of morphia, accompanied with skin excitation and artificial respiration. This property and fact of the antagonism of symptoms produced by certain alkaloids and principles is very singular, and likely to prove of great value in medical practice. It was referred to by Professor Leech at the Pharmaceutical Conference recently held in Manchester. Since the increase in demand for *Belladonna* root, and the consequent rise in price, the cheaper root of a kind of scopolia (false belladonna) has been extensively placed in the market, and has found a ready sale. The fact of many makes of atropia sulphate having varying melting points is thus accounted for. An interesting alkaloid shown is *Berberine*. It is found in the *Berberis vulgaris L.*, and also in many other plants. The specimen, a very fine one, is in glittering reddish brown crystalline scales, which begin to sublime at 392° F. The alkaloid is not readily soluble in cold water, but easily soluble in hot water and in alcohol, and nearly insoluble in ether and carbon bisulphide. The salts, hydrochloride and phosphate of *Berberine*, which are also exhibited, are readily soluble and are easily absorbed. The dose for indigestion and diarrhœa is about one grm. per diem. It is used also in cases of sickness during pregnancy and malaria.

A beautiful series of salts of *Caffeïne* is shown—*e.g.*, the benzoate, hydrobromide, hydrochloride, nitrate, salicylate, sulphate, valerianate, sodio-benzoate containing 45·8 per cent. of caffeine, sodio-cinnamylate with 62·5 per cent. of caffeine, etc. Mr. Merck made an interesting report on these salts and double salts as soon as he had succeeded in producing them in the form of true salts, especially the easily soluble double ones, instead of the indefinite mixtures hitherto known. According to Merck, Riegel and other investigators proposed these new compounds as substitutes for *digitalis*—a proposal of the greatest importance to the medical world. The effect of the injection of caffeine is perceived at once, and collateral effects, especially those of a cumulative nature, are absolutely excluded.

Camphor Monobromide and Dibromide.—Of these compounds the monobromide is chiefly in demand. It is but slightly soluble in water and glycerine. As sedatives these preparations are used for epilepsy (subcutaneously 0·1grm. dissolved in oil), for chorea, migraine, nervous palpitations of the heart (internally 0·1grm. to 0·5grm. in wafers); whilst in cases of delirium tremens doses of 1·5grm. are given. Fine specimens are shown of both these salts. An important compound, also shown, is Merck's *Cannabine tannate.* It serves in many respects successfully as a substitute for morphia, and together with the preparation named *Cannabinone* (a 10 per cent. trituration) we have two valuable hypnotics showing no unpleasant after-effects. The raw material is obtained from the *Cannabis indica*, a variety of the *Cannabis sativo L.* (*Uticaceæ*). The tannate is given in doses of 0·25grm. to 0·1grm.; in cases of delirium 1·5grm. The cannabinone (pure) is administered in doses of 0·05grm. to 0·1grm. The rare metal *Cerium*, in the form of its oxalic acid salt, even serves as a valuable medicament, and a sample of pure cerium oxalate is to be seen as a white granular powder, insoluble in water and alcohol, but soluble in hydrochloric acid. The dose is 0·05grm. to 0·15grm. It is used as an antidote to catarrhal affections of the stomach and bowels, sickness during pregnancy, and epilepsy. *Chrysarobin* prepared from *Goa powder* is another specimen of interest. This preparation is absorbed by the skin, and has thereby a stimulating effect. It produces vomiting and diarrhœa; and has a stimulating effect on the kidneys; this is the case also when applied externally. It is chiefly used for Psoriasis.

Among the finest specimens are the *Cocaïne preparations*, of which the hydrochloride and salicylate are shown. The hydrochloride is granular, crystalline, and white, and free from every impurity. Dr. Karl Koller, of Vienna, was the first to draw attention to the local anæsthetic properties of cocaïne, and to turn them to account. Dr. Brettauer, at Koller's request, explained and exemplified the discovery on the 17th and 18th September, 1884, before the Ophthalmological Society of Heidelberg. It is proposed to use the cocaïne in various ways. Emmert in the treatment of the eye proposes to use it as a salve with vaseline; Fodor to use it alone. To make its solutions keep well, many additions have been proposed. The simplest is an addition of glycerine. In tuberculous disorders of the air passages Meyer-Hüni recommends inhalations of cocaïne. Most painful injections of corrosive sublimate are made quite bearable by first adding to the mercurial solution only 0·05grm. of cocaïne per dose. Randolph and Dixon commend a concentrated solution of cocaïne hydrochloride in nitric acid as a painless causticising agent; the wound to be bound up with a bandage covered with cocaine salicylate. The best antidote against poisoning with cocaine is amyl nitrite, according to Schilling. When cocaine is heated with strong hydrochloric acid it decomposes, forming benzoic acid, methyl alcohol, and *Ecgonine*, a specimen of which is exhibited. *Ecgonine* was first discovered in Merck's laboratory.

Specimens of pure crystallised *Codeïne*, its soluble phosphate and salicylate, much in favour on account of stability of the solutions, are shown. The phosphate dissolves in four parts of water, and the solution, subcutaneously injected, produces no pain or reaction at the place of incision. The dose of the phosphate for diabetes Merck gives as 0·06grm. three times daily, increasing by 0·06grm. every eight days up to 0·54grm.; cod liver oil is taken at the same time. *Codeïne* is a methylmorphine.

Another useful vegeto-alkaloid, exhibited in fine crystalline condition, is *Colchicine*. It is found in all parts of the meadow saffron (*Colchicum autumnale L.*), and is a very strong poison. In doses of 0·0005 up to 0·002grm. two or three times a day it is a remedy for gout and rheumatism. For subcutaneous injection it is not to be recommended. For complaints of a convulsive nature, spasmus glottidis, tussis convulsiva, asthma, etc., a valuable remedy is coniine in the form of its salts. *Coniine* is an alkaloid of the *Conium maculatum L.*, which plant also contains two other alkaloids, conydrine and methyl-coniine. Our knowledge of the chemical constitution of coniine we owe to Hofmann and Ladenburg. Coniine has been recommended and used by Murawelff for toothache caused by decayed teeth: the pain ceases through the paralysis of the nerves. Of course the alkaloid is directly applied to the exposed nerve. Very remarkable is the antagonism of certain highly poisonous substances: such antagonism exists between coniine and brucine, for coniine, as Hugo Schulz has shown, paralyses the symptoms of brucine poisoning. Pure coniine is a colourless oily liquid, whilst the salts take the crystalline form. The hydrochloride crystallises best. The hydrobromide is a very constant compound, and contains a definite quantity of coniine. It is readily soluble in water, and thus easy to administer. The dose of coniine hydrobromide is 0·001 to 0·02grm. several times daily. Fine specimens of the above two salts are to be seen in the exhibit.

Cotoïne and *Paracotoïne* are very interesting bodies about which as yet very little is chemically known. Messrs. Merck show fine specimens of both in the pure state. Since the year 1873, various barks have been introduced into the market, which it was believed would replace the quinine or cinchona barks. These drugs were brought from Bolivia, though still more recently the old forests of Brazil have been made to furnish them. The barks mentioned appear to come from a species of *Rubiaceæ*. However, the crystallisable principle cotoïne was first isolated by Hesse, and it has the composition $C_{22}H_{18}O_6$. It is soluble with difficulty in cold water, easily in hot, also in alcohol and ether. Cotoïne and Paracotoïne are styptics, and have been found useful against diarrhœa and excessive perspiration. Particularly must cotoïne be considered as a preventive of diarrhœa in children and in cases of phthisis. The doses vary from 0·05 to 0·1grm. for cotoïne and 0·1 to 0·2grm. for paracotoïne. The relations of cotoïne and paracotoïne to each other seem to be remarkably similar to those of quinine and cinchonine.

Another rival of quinine is *Ditaine*, of which a well crystallised specimen is shown. It is a crystalline substance obtained from *Alstonia scholaris L.*, an apocynea found in the East Indian Islands. Ditaïne, it is stated, has effects similar to those of quinine, and is recommended against intermittent fevers.

A finely crystallised specimen of *Ethoxy-caffeïne* is exhibited. It takes the form of needle-shaped crystals, melting at 284° F., very little soluble in alcohol and ether, insoluble in water, and of very basic properties. The dose varies from 0·25 to 1grm. per diem. Ethoxy-caffeine is a sedative and a narcotic, and is of value in the treatment of migraine in cases where other medicines do not produce any effect.

Another very pure and beautiful preparation is *Merck's Helenine*. This is shown in the absolutely pure state, melting at 230° F., and consisting of colourless neutral crystalline needles. At one time an impure so-called helenine was used, and consisted mainly of powdered alant root. However, serious, even fatal, results followed the use of it, owing to other and foreign substances present. Merck now offers only the absolutely pure alkaloid. It is used for diseases of the respiratory organs, for reducing inflammation, and is said to speedily relieve chronic bronchitis.

Hydrastine (pure, crystallised), and *Hydrastine Tartrate* (pure, neutral).—The first of these interesting preparations is the alkaloid of the *Hydrastis Canadensis L.*, a ranunculacean plant found in North America. Pure hydrastine is almost insoluble in water, but the tartrate dissolves easily. In America hydrastine is recommended as an antiperiodic for fever with inclination to profuse diarrhœa, for certain diseases of the eye, of the skin, for hemorrhoids, etc. In Germany it is sometimes prescribed for its effect in contracting the uterus.

Hyoscyamine (pure and crystallised), from *Hyoscyamus niger*.—This is perhaps one of the most extraordinary of the alkaloids as regards the remarkable results in the treatment of diseases that are obtained with it. The specimens of the alkaloid and its salts, the hydrobromide and hydriodide, exhibited are perfectly pure. Hyoscyamine is isomeric with atropine and identical with daturine and duboisine. This preparation is used by oculists instead of atropine; subcutaneously as a hypnotic in cases of insanity, and as an antispasmodic in asthma, epilepsy, whooping-cough, chorea, etc. The dose as a hypnotic is up to 0·005grm. subcutaneously injected. *Pure Hyoscine* is amorphous and of a syrupy form, but its salts crystallise readily. The hydrobromide and hydriodide are in chief use as medicines. E. Merck produces both hyoscine and hyoscyamine on a large scale, and he claims that the articles sold in the market are generally of his preparation. The most wonderful feature in the properties of hyoscine is the power of tranquilising maniacs, and of all the remedies in use for this purpose it may be regarded as the most valuable on account of its prompt effect, and because it is not dangerous even to patients suffering in a high degree from heart disease. Experiments carried out by Professor R. Kobert and Dr. Sohr with hyoscine hydrochloride proved that the greater part of the hyoscine administered passes from the body through the kidneys. Doses of one milligramme of hyoscine applied subcutaneously increase the action of the heart and circulation, but have no influence on the respiration. The secretion of saliva is suspended by it, as also the action of the intestines due to nervous irritation. In therapeutics the effect of hyoscine on the healthy and the (mentally) diseased organism is of most particular importance: on the former, the effect is generally that of a narcotic, and on the latter, in all cases, the effect on excitable patients, even on raging lunatics, is sleep-producing and calming. Dr. Gamgee, F.R.S., late of the Victoria

University, told the writer that he had observed the effect of the subcutaneous injection of about 0·001grm. (between one and two hundredths of a grain) in the case of a maniac in a condition of which to say the strait-waistcoat and padded room were necessary would give but a mild notion of the frenzied state. That effect was a marvel; in a few seconds the patient being led away as tractable and harmless as a child, though with a stupefied and dazed expression of countenance. Of 101 subcutaneous injections of hyoscine hydrochloride in doses of ½ to 1 milligramme applied to a large number of patients in the Clinical Hospital for Mental Diseases at Dorpat during the months of July, August, September of 1886, not one failed to produce sleep, nor were in any case secondary effects observable. Almost in all kinds of diseases, accompanied by periods of excitement, either sleep or a calming effect had been produced, even when other means had been tried in vain, applied for the same purpose.

A useful preparation called pure *lacmoid*, in scales, is shown. It will be of interest to chemical analysts, as a substitute for litmus. It is extremely sensitive to acids and alkalis. A useful solution for testing is recommended by Merck, as follows:—0·5grm. lacmoid, 100cc. of water and 100cc. of alcohol of 96 per cent. strength.

Lithium Salts, the Carbonate, Hippurate, Citrate (crystallised), and Salicylate, are exhibited in great purity. The lithium salts have a more powerful diuretic effect than the salts of potassium.

Naphthalene.—Many people will look at this as a remarkable substance to propose as a medicine. If well purified, it is a valuable anti-diarrhoicum in cases of typhoid, diarrhœa, and intestinal complaints in case of phthisis. Not being absorbed by the bowels, this preparation has no general effect on the organism, but only on the mucous membrane of the bowels. Dose, up to 5grms. per diem.

Papaine.—This is a form of vegetable albumen capable of extraordinary powers of digestion, even greater than those of pepsine. It is obtained from the *Carica papaya L.* (*Papayacea*). One part of papaine peptonises and renders soluble 200 parts of blood-fibrin. It has been used very successfully for painting and so dissolving and removing the fatal membrane in cases of diphtheria. Merck states that most of the papaines in the market do not possess one-fourth the digestive power of his preparation.

Pilocarpine.—This alkaloid is exhibited in the pure state, and also in the form of salts, which are very fine examples as pharmaceutical preparations. The hydrobromide, hydrochloride, nitrate, and salicylate are shown, and also the pilocarpidine nitrate of Harnack-Merck. Pilocarpine is the alkaloid of the jaborandi leaves; it possesses a powerful diaphoretic salivating action. West recomends very small doses (0·005 to 0·01grm. subcutaneously) in cases of the nocturnal sweating of consumptive patients. Pilocarpidine was discovered in E. Merck's laboratory in the process of working upon a large quantity of jaborandi leaves. Pilocarpine and pilocarpidine produce the same physiological effect. This alkaloid has recently become of enhanced interest to chemists, since the mode of artificially preparing it by synthetical chemical processes has been discovered by two French chemists. Finally, magnificent specimens of strychnine in the pure crystalline state and of strychnine sulphate are exhibited. The best antidotes for this most deadly poison are paraldehyde and chloral hydrate. Fine specimens of *Veratrine* are shown. Used externally, the effect is that of a stimulant to the skin, whilst taken internally it acts as an antipyretic.

DR. THEODOR SCHUCHARDT, Goerlitz, Germany (No 790).—The following are specimens of special rarity and beauty in Dr. Schuchardt's exhibit:—*Metallic selenium*, its tetrachloride and tetrabromide; *Tellurium*, crystallised and sublimed, and its tetrachloride; fine specimens of *Germanium*, discovered by Clemens Winkler, with its sulphide and oxide; *Cerous sulphate*, crystallised with five molecules of water; *Yttrium nitrate*, crystallised; *Erbium nitrate*; metallic *Indium*, a magnificent specimen as a block, weighing 100 grammes, also its hexachloride, sulphate, hydroxide, and its double potassium chloride; *Gallium*, fine specimen of the metal, its ammonium alum, and other salts; *Thorium chloride*, *Tantalum chloride*, *Niobium chloride*, and an interesting specimen of crystallised *Osmic acid*. So much for the rare metals and their salts to be seen in this instructive cabinet. Amongst the organic preparations we note the following, of which it will not be easy to find similar examples, if examples at all, in the chemical collections and museums in this country:—α-Naphthoquinone and β-naphthoquinone (well crystallised); *Eupittonic acid*, the interesting colouring principle found in wood-naphtha and wood-tar. The following are derived from or contained in coal-tar:—Pyrene, together with its fine red picrate, so characteristic of it; chrysene, a magnificent specimen, pure white and crystalline; durene (tetramethyl-benzene), only recently discovered by K. E. Schulze in coal-tar; acenaphthene and pseudo-cumene, hydrocarbons of coal-tar. Thiophen and thiotolen, recently discovered by Victor Meyer. The phenol of thiotolen is also exhibited, together with a series of thiophen compounds, etc. α-α-Lutidine and α-γ-lutidine are finely exemplified; also the phenyl and tolyl pyrrols. Besides these are the following:—Crystallised sorbin and dextrose, galactose, inulin, a crystallised compound of dextrose with sodium chloride and a molecule of water; arabinose, inosite (crystallised), levulose, and maltose (crystallised). Amongst colouring matters are:—Orcein, dimethyl-*p*-phenylenediamine, tetramethyl-*p*-phenylenediamine, metaphenylenediamine, chlorophyll, phyllopurpurin, pyrrol red, etc.; whilst as specimens interesting to the pharmaceutical chemist are:—Hypnone (crystallised), glutamine hydrochloride, umbelliferone, terebene, sylvestrene, pinene, camphene (crystallised), limonene, borneol (artificial crystallised and natural crystallised), terebine hydrochloride, curarine hydrochloride, helenine (crystallised), tyrosine (crystallised), alloxan (crystallised), and finally tincture of strophanthus.

MESSRS. KAY BROTHERS, Lower Hillgate and St. Petersgate, Stockport (No. 794), exhibit a miscellaneous collection, comprising the following:—Simple and compound essences, extracts, etc., absorbent and antiseptic cotton wools—*e.g.*, pure absorbent, carbolised, sublimated, salicylated, and iodoformed. Glass valve tubes (Kay's patent). Disinfectants, a fusible cement for stone and iron work. Perfumery, syrups, medicinal extracts and essences of ginger, peppermint, sarsaparilla, taraxacum, and ergot. Among medicinal oils we note those of cod liver, castor, linseed, cotton seed, mustard seed, sweet almond, olive, sperm, and lard.

GRIMSHAW BROTHERS, Canal Chemical Works, Clayton, Manchester (No. 786).—This exhibit may be divided into three series:—

1. Zinc compounds used in manufactures and pharmacy, the chief of these being (*a*) chloride of zinc in the solid and liquid state, the former run hot into lead-lined casks for export (Messrs. Grimshaw were the first who made it largely in this form); (*b*) sulphate of zinc, commercial, and chemically pure. These articles are largely used in the sizing of cotton goods for the prevention of mildew; (*c*) Sulphide of

zinc, for rubber purposes and as a white pigment. Among the other zinc salts are ferrocyanide, silicate, carbonate, acetate, nitrate, oxide, tannate, bromide, iodide, chromate, phosphate, etc. Probably never before has such a complete set of commercial zinc compounds been shown. The spelter and the zinc ores and minerals which are the natural sources of zinc compounds are also to be seen.

2. Sizing materials for cotton warps and piece goods, also materials used in finishing the same.

3. Recovered indiarubber, substitutes for indiarubber, and chemicals and drugs used in the rubber manufacture. The recovered rubber consists of qualities which range in value from what is almost equal in value to native Para rubber down to qualities which are lower in price than the cheapest native rubber.

The substitutes for rubber are of lower value still. They are (many of them) more lasting in their nature than many forms of real rubber. Both the recovered rubbers and the substitutes are generally used incorporated with new rubbers. The colour of the substitutes varies from dark brown to white, according to their nature and the particular use to which they are put.

The rubber chemicals are used for vulcanising rubber, or colouring it, or giving it body, and consist of such substances as oxide of zinc, sulphide of zinc, sulphide of antimony (red), sulphide of lead, hyposulphite (thiosulphate) of lead, and many of the pigment colours which are used in paints. The rule in using these is that they must not be such as will be affected by combining with the sulphur in the vulcanisation process.

Vesuvian white is a special vulcanising material which Grimshaw Brothers make for use in the manufacture of tennis balls and some other articles. This firm also shows some solvents of rubber—viz., solvent naphtha, chloride of sulphur, bisulphide of carbon, etc., also indiarubber solution or varnish. In addition to the above three series, the following are illustrated :—

H. Grimshaw's patent process for separating and utilising the zinc and iron of galvanisers' waste. The zinc is dissolved by an acid solution of chloride of zinc, which thereby becomes more concentrated, and the iron is left in a pure state. The galvanised waste cannot be smelted, as the zinc makes the iron "short" or "brittle," whereas the iron after it has been treated becomes adapted for working up again.

AN INQUIRY INTO THE EXTENT TO WHICH CALICO PRINTING AND THE TINCTORIAL ARTS HAVE BEEN AFFECTED BY THE INTRODUCTION OF MODERN COLOURS.

(*A Paper read before the British Association, Manchester, 1887.*)

BY CHARLES O'NEILL, F.C.S.

The first of the modern colours was Mr. Perkin's aniline mauve, which was discovered and applied in the year 1856 (August) ; it was two or three years after (April, 1859) that the next modern colour, magenta or fuchsine, made its appearance ; the tide rose slowly in 1860 with purples, blues and violets, gained every year in force and volume, until the flood has now risen to such a height that one who would like to keep up with it stands astonished and dismayed at its extent, and well nigh confounded with the prospect before him. Nor is there any sign that we have got to high-water mark, for month after month chemists and colour manufacturers are patenting new colours or new processes in such numbers that only a specialist of specialists can pretend to follow or appreciate the work that is being done. I do not pretend to be that specialist, but having served my time to dyeing and calico printing before the beginning of the era of modern colours, and been in one way or another engaged in the business ever since, I am enabled to give some sort of account of the differences of the two periods.

The fixing of 1856 as the date when the modern colours came in cannot be seriously objected to, because it is evident that it is the artificial colours introduced in that year, and afterwards for a long time and even now spoken of as aniline colours, which occupy one's thoughts. Just before that date three new colours occupied attention ; these were murexide red, Chinese green or Lo-Kao, and the fast archil purple, but their life was short and their influence *nil* ; a little further back still catechu and ultramarine blue, accompanied by the use of albumen, one a natural and the other an artificial colouring matter, were very welcome additions to the materials of the printer, and still highly valued by both printer and dyer. If the term in the title of the paper had been artificial colours instead of modern colours the claims of Saxony blue or sulphate of indigo, used since 1740, would have to be considered as well as the red and yellow chromates of lead and Prussian blue or royal blue, and some others of great value, which may be considered quite as much made by art as aniline black or the azo reds are made by art ; but the most modern of these were in use long before the date fixed upon, and may be left without further notice.

The relations of the modern colours to the various textile fibres is so very different that it is advisable to treat them separately. In the first place I will take cotton, and afterwards wool and silk, and in cotton give precedence to calico printing. The two most important colouring matters in 1856 were indigo and madder. Neither of these colours could be directly printed on calico. Indigo indeed in the form of China blue, was printed, but it had to be subsequently fixed by a process analogous to dyeing, and it was not an important branch of the indigo styles. All attempts to obtain an extract of madder fit for printing had failed ; it was not until about ten years afterwards that the extract of madder came into the market, and for the first time the printer was enabled to produce by direct application upon the cloth the various colours yielded by madder. Of indigo little need be said. We have seen of late years some advance in the manner of applying indigo, new reducing agents, as the hyposulphite of soda and zinc dust, the actual printing of it by the glucose process of Schlieper and Baum, and the ingenious pigment coloured discharges of Camille Koechlin, but the fundamental indigo styles in which probably nine-tenths of all indigo imported is consumed, remain practically in the same state they were in in 1856. The artificial indigo of Baeyer is a scientific victory, not less remarkable than that of Graebe and Liebermann in the case of artificial alizarin, but it is not an economic success, and has had no visible influence in the trade. The madder styles of 1856 were of great excellence as produced by the best houses, quite as good or better than pure alizarin styles are now ; not that alizarin cannot be made to yield as good work as madder did, but the present conditions of the trade with regard to prices are unfavourable to the highest excellence in that class of prints. In the dyed madder and garancine styles, the designs were practically limited to the four or five colours yielded by madder or garancine, with the help of catechu brown or drab, catechu being the only colouring matter which could be worked in conjunction with the dyes; some years after the date taken, chrome yellow and orange were combined with madder colours, and for a time proved a great relief to printers, permitting a variety in design and colouring not before possible. If it was desired to combine such colours as blue, green, or other shades with madder colours, it could only be done by printing these colours with block after the madder colours had been dyed and finished. All this is changed now, and the calico printer can produce designs of ten, twelve or fourteen colours printed at one time, in which the reds, pinks, purples and chocolates may be alizarin colours, possessing all the stability of the old madder colours. Strictly considered the modern colours cannot be credited with this change, it was actually accomplished as soon as extract of madder was obtainable some two or three years before the discovery of artificial alizarin, but if artificial alizarin had not come up there could not have been the extensive production of many coloured fast cretonne styles which has been a characteristic of the trade for several years past, for extract of madder would always have been a more expensive form of madder and of restricted application. I do not stop to argue the question whether it is proper to consider artificial alizarin a modern colour or not, for the fact of its being identical with something obtainable from madder does not affect its claim to be a new substance. The introduction of this most important and most valuable of the modern colours has had for effect to cheapen the price of the best kind of calico prints: by best I mean those of most durable colours, and used for personal wear. So far it is a boon to purchasers of prints; how far it has benefited calico printers is another question. It would appear that the greater facility of producing passable colours has greatly increased production. The same works and machinery can with this and other modern colours turn out, say 50 to 70 per cent. more printed calico that could have been done in the old madder dyeing days. Even dyeing with artificial alizarin is going out for many styles. It is printed, steamed, passed through an open soaping machine for a few minutes, cleared and finished straight off. This is very different from the old madder dyeing, with first and second dunging, washing, dyeing, two or three soapings and clearing. Increased production without a corresponding increased demand of course leads to a gradual lowering of prices, until profits are cut down to a very low margin indeed. I think it may be held that the colour mixing made easy by the introduction of modern colours has much to do with the unremunerative condition of calico printing. As nearly as I can fix the date it would be in 1852 or 1853 that I saw the newly erected 20-colour printing machine at a now extinct works printing an 18-colour pattern. The same machine is now at another works, and I saw it lately printing a 14-colour design. I ask myself the question, what difference has the 34 years made in the character of the colours and the work, supposing that the colourist was using the best colours available at each time. The reds and pinks then were from cochineal, now they are from alizarin, the blues, greens, myrtles and olives were of the prussiate class, the greys, drabs, browns and chocolates were from the woods—logwood, sapanwood, sumach, etc. It may be said that only the black, which is from logwood, remained essentially the same at both dates, for even in the chocolates and other colours which depended mainly upon wood extracts, there was an admixture of modern colours, while the blues and greens, purples, etc., were unmixed modern colours, with the usual fixing agents. Of course one has to depend upon memory and impressions, for the prints of 34 years ago cannot be now seen in their freshness, but I think there has been no great change in results as far as regards quality of work. There has been a lessening of cost of colour, and a lessening of labour to the colour mixer, and undoubtedly some colours now are brighter than then, but there is not much in that; as to fastness of colour, except as regards the reds there has been no gain, perhaps even a loss.

None of the modern colours except alizarin and its allied blue and orange derivatives can be said to be fast colours upon cotton in the sense that madder or indigo are fast, but at the same time many of them are fast enough for the purposes to which they are applied, and have contributed in calico printing to give a variety in colourings which has no doubt extended the demand for printed goods. In plain dyed calicoes many fancy shades are dyed with these colours and serve well enough for a variety of uses, as linings for garments, hangings, and the like. Improvements in fixing have been introduced of late years, which have materially improved the stability and resistance of many of the colours. Lloyd and Dale's discovery of the utility of tartar emetic, patented in 1861, did not come to be generally used until the patent had expired, but it has been of great service; in combination with tannic acid in the colour, it gives fixity enough to many colours to resist soaping sufficient to brighten and clean the goods.

In the Silk Section of the Royal Jubilee Exhibition there are two exhibits which raise the question of modern colours as to stability. In one case there is a silk patch-work coverlet exhibited of many colours. It was made in 1850, six years before the first of our modern colours came into existence. A written notice informs the visitor that the silks were dyed in the "old fast unfading dyes," and further states that this coverlet "is a striking illustration of a lost Leek industry, a genuine representation of the old fast unfading dyes, which is still practised by us," the exhibitors, "for all purposes for which they may be required." The other exhibit of dyed silks has two sides to it—the silks on one side are said to be "in Eastern unfading dyes, identical in nature with the colours found in the ancient Oriental and Italian needlework, they will bear washing, and they are the same by gaslight as by daylight." On the other side the silks are said to be dyed by modern dyes, and marked for shipping. Of course, the implication in both these notices is that the old dyes are much faster, less liable to fade, and altogether better than the modern dyes; they really contain an assertion that if you want well-dyed silks you must discard the modern and go back to the ancient colours. The idea that all new dyes are bad dyes is one held by numbers of people, who are inclined at the same time to believe that in the old times there were no loose colours. The truth is that with the ancient dyes, as with the modern dyes, there was an abundance of loose, bad dyeing, and it is, perhaps, as well to show that, bad as the moderns may be, their ancestors were not a whit better, and that there were loose colours before aniline. There is a book on calico printing by C. O'Brien, dated 1791. This author had an exalted opinion of the art of calico printing, and condemns in strong language those printers who used only or mainly what he calls chemical colours in printing. He will not give receipts for these colours lest he should increase the number of bad men who used them. He says, in the chapter on colour-making: "By permanent colours every one in the printing line considers those that are not to be removed by soap, sun, nor air; the others are of various kinds, as some withstand washings, but will fly on the air; others will withstand neither, and others only for a little time." Further on he says: "Arbuthnot made some stir with green stalks in light chintz, which soon flew (faded), and no provision being made to supply the vacant parts the cloth then had a truly ludicrous appearance, the flowers seeming scattered here and there without stalks or any other appendage;" and, again, "it is notorious that in many commissioned and other shops, the lowest chemical work, even with such colour as almost, literally speaking, would *shake off*, is warranted and ticketed as 'fast,' and often called chintz." Both in 13th and 23rd of George III. the Legislature interfered with the dyers to stop certain loose colours. Bancroft gives the essence of these Acts, but elsewhere I have read the occasion of their enactment. It was the case of a Government contract for the supply of blue cloth, for navy purposes. It should have been indigo blue, but it was logwood and copper blue. The cloth passed inspection, but as this colour is one of the worst possible, and will not stand 24 hours' sunshine without fading into a dismal brown or buff, the results were disastrous, and the enraged Government threatened to impose the enormous penalty of twenty pounds per piece upon cloth so dyed in the future. Bancroft quotes a curious case of a certain Dr. Richard Williams, who was granted the sum of £2000 in 1773, by Act of Parliament 13 George III. chap. 77, for his discovery of a fast green and yellow dye on cotton yarn and thread. The secret was not to be disclosed for fear the foreigner should reap advantage from it, but Williams supplied the materials to the dyers. It was soon found the colour was no good, as it could not stand light though it would stand soap; yet the inventor was supported by the favourable testimonials of persons to whom he had made presents of pocket-handkerchiefs with borders of yarn woven in which had been dyed with his yellow and green. The colours lasted well enough in pockets, that is in the dark, but faded in the light. These are examples from the literature of the subject, but anyone of sufficiently extended experience knows well enough that loose colours are not peculiar to the modern era. The range of modern colours, just like that of the ancient colours, includes fast and loose, and it mainly depends upon the dyer to select those which are suitable. There are cases in which the dyer has no control, as, for example, in the old safflower pink: it is ordered and must be supplied. There is nothing but safflower which will dye the peculiar safflower pink, and no art or skill can make that colour fast or durable. The same may be said of many light shades dyed with the old dyes, annatto, turmeric, or cudbear, upon either silk or cotton; so with some of the new colours, as eosin, fluorescein, peacock blue, and some others; they are weak colours, and nothing can be done to strengthen them. But to say that the modern colours mostly in use for silk and wool dyeing are characterised by general instability and proneness to fade is not at all true. I think I may go so far as to say that all or nearly all the colours upon the Leek quilted silk could now be dyed with modern colours which would keep their quality as long and as well as those actually on the quilt. If the wholesale condemnation of modern colours that one sometimes hears had any truth in it they must have gone into disuse long ago, for purchasers of dyed goods do not twice purchase a false and deceitful colour. But the opposite is the case, the consumption is increasing; and the respectable dyer knows how far he can use these colours without bringing discredit upon himself.

Whatever may be the true state of the case with regard to cotton, I consider that the introduction of modern colours in the dyeing of silk and wool has been of great service. Between the greater number of these colours and the animal textile fibres there is a direct and powerful attraction which it is the part of the dyer rather to restrain and modify than to assist. For the most part no mordant of any kind is required; simply heating the fibre in a solution of the colouring matter, with, perhaps, addition of a little acid or sulphate of soda, and finally washing, constitutes the whole of the dyeing. Compare cochineal scarlet upon wool with azo red, called fast red or rocceline. They can hardly be distinguished from one another by shade, but the difference of the dyer's work in their production is quite remarkable. In cochineal scarlet the uncertain tin mordant has to be made and applied by prolonged heating with the wool, and then the cochineal dyed upon it, a process requiring much care, and attended with uncertainty in unskilful hands, but the dyeing with azo red is a simple mechanical operation, which can hardly miss at all. This colour threatens to displace cochineal much the same as alizarin has displaced madder. But it is in the fancy shades upon silk and wool that the modern colours have been most useful. Great fastness of colour is not required for these textiles; in a number of cases they are never intended to be washed or treated with acid or alkaline liquids, but the hue of colour should be fresh and the fibre undulled. These conditions the artificial colours fulfil admirably. Some mistakes, no doubt, have been made in employing very fugitive dyes, with loss and annoyance to all concerned, but they can be avoided.

Seeing the comparative ease and facility with which the modern colours can be applied to textiles, it may be asked whether this has not a deteriorating influence upon the foremen dyers and colour mixers, who do not seem to be required to exercise the same care and skill as formerly, and who might be expected therefore to become careless and unprogressive; well, it is true the work seems easier and less responsibility attaches to the foreman, who uses rather than makes colour, but in all reasonably large and active dye-houses, doing a variety of colours, there must be the same watchfulness now as ever there was, for, if it is easy to dye with these colours, it is quite easy also to spoil cloth with them; besides, there is no place of general dyeing that has given up the old dyestuffs, and the dyer must know how to produce blacks, browns, slates, drabs, buffs, etc., which are still made from the more ancient wares.

Except madder and cochineal, it does not appear that the old colouring matters—such as catechu, fustic, logwood, sumach, and peachwood—have been much, if at all, affected by the advent of the modern colours; their consumption has not diminished nor their price gone down. Logwood still remains a main source of black colours upon wool and cotton. Aniline black has been of very great service in calico printing, possessing a stability to which no other black can lay claim, and working very well in some combinations where logwood black would have been very poor. I am thinking of the styles containing much alizarin red and black as well as the chrome orange and aniline black style, both of which had a considerable success. But yet nearly all the blacks in combinations of more than five or six colours are still logwood blacks, but the old iron mordant has been displaced generally by acetate of chromium. I may say, in passing, that the introduction of acetate of chromium as a fixing agent in steam colours, both of the ancient and modern class, has been a conspicuous boon to printing, hardly second to any other material introduced of late years. The dyed blacks and black and whites, called sometimes the mourning style, are yet almost universally produced from logwood; logwood black is soon injured by light and air, and it would be desirable to replace it by aniline black. But there are difficulties in the way, the aniline black, which is dyed in a vat with bichromate of potash, aniline salt, with acids and metallic salts, may be called a precipitate black; it has the disadvantage of rubbing off and soiling white articles. The oxidation black, if that name may be given to the printer's black where the colour is developed through the agency of chlorates and metallic salts, does not rub off and is unexceptionable in hue and stability, but it has the fatal tendency of affecting the fibre, softening and tendering it, unless it be applied with the utmost skill, and, I may say, also the utmost good luck.

Thus I have glanced and touched at some points in textile colouring bearing upon the subject of the theme submitted to me. There is nothing, of course, scientific or even definite in what has been said: it is more properly to be called a speculation, probably a good deal influenced by my personal surroundings or even prejudices; but, in fact, neither I nor any other can at the present time give more than an imperfect estimate as to how the tinctorial arts have been influenced by the modern colours, for we are in the middle of the battle of the colours and can only darkly discern what is going on.

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THE THREE ISOMERIC PYROCRESOLS.

BY DR. W. BOTT,

The Owens College, Manchester.

(Read before the British Association, Manchester, 1887.)

ABOUT five years ago Prof. H. Schwarz, of Graz, in Austria, announced the discovery in coal tar of three new isomeric bodies, which he termed α-, β-, and γ-pyrocresol, and to which he assigned the formula $C_{28}H_{26}O_2$, which later on was corrected to $C_{15}H_{14}O$. A few months before Schwarz's publication appeared, I had been examining a certain by-product obtained during the preparation of phenol and cresol at the chemical works of Messrs. C. Calvert & Co., Bradford, and had succeeded in isolating from it three new substances and prepared several derivatives of them, and I soon recognised Schwarz's pyrocresols to be identical with the bodies I had obtained. I communicated with Prof. Schwarz upon the matter, and we agreed to jointly pursue the further study of the pyrocresols. Unfortunately neither Prof. Schwarz nor I have been able to give very much time to the work until quite lately, so that the investigation is far from complete at present. In a paper prepared by Prof. Schwarz and myself, and read before the Chemical Section of the British Association, at Manchester, in September, we have given a condensed and revised summary of all the facts already known concerning the pyrocresols and part of our new results; the present paper is a more detailed recapitulation of the joint one referred to, with special regard to the more recent results, which have been obtained principally by myself. I may add that, as Prof. Schwarz has now given up working in this direction, I shall continue the work alone, and, in a paper sent to the German Chemical Society, I have reserved to myself the further study of α-, β-, and γ-pyrocresol.

The pyrocresols occur in varying though small
may ties in certain kinds of acid oils or phenols.
wood, re cting such oils with caustic soda a solution is
for even in ch turns turbid on diluting—even after
depended main. tion—and the free phenols obtained
admixture of mod tracts by acidifying with mineral
greens, purples, etc., w nation leave a pasty residue
with the usual fixing age
somewhat resembling butter in appearance, and containing a considerable percentage of pyrocresols. The yield of this pasty residue seems to vary with the experimental conditions, it apparently increases whenever the walls of the retort become superheated during the distillation. The freshly made, crude product has a dark yellow colour, but on exposure to light and air it turns dark brown or purple. It begins to boil about 180—185°, the distillate upwards from about 325° solidifies on cooling: it is yellow between 330—350°, darker and of a softer consistency above 350°; finally a little charcoal remains in the retort. All the distillates collected at various temperatures are soluble in alcohol and acetic acid with a greenish fluorescence, which becomes less intense upon purification, and is to a certain extent discharged by nascent hydrogen.

In order to prepare the pure substance, the crude product is best pressed between hot plates, so as to effect a partial separation of the α- and β-compound from γ-isomeride, which accumulates in the liquor coming off on pressing. By long protracted crystallisation of the dry residue from boiling ligroïn and benzene the pure α-pyrocresol is first obtained, the β-isomer passing into the mother-liquors along with considerable quantities of the α-compound. The latter can to a certain extent be removed by partial evaporation, and from the residue obtained on complete evaporation of the mother-liquors the β-isomeride is prepared by frequent re-crystallisation from alcohol. The γ-pyrocresol is isolated in a similar manner from the liquor obtained on hot-pressing. It is beyond the scope of this paper to give a more minute description of the mode of preparing the pure pyrocresols; suffice it to add, that the process is a very long and tedious one, and one involving considerable loss of material; but, so far, it has been found impossible to find a better mode of separation. There is one circumstance worthy of mention in connection with the preparation of the pyrocresols, more particularly of α-pyrocresol. When prepared from the freshly made, crude material, the pure product is readily obtained perfectly white; whilst that prepared from material which has been kept for some years, exposed to light and air, shows a pink colour, which cannot be altogether removed by protracted crystallisation nor by boiling with zinc dust and caustic soda. By cautious treatment with chromic trioxide and acetic acid, the colour can, however, be got rid of.

α-*Pyrocresol*, $C_{15}H_{14}O$, is by far the best defined of the three isomers. It can be readily obtained in large shining plates, exhibiting a beautiful bluish fluorescence, and resembling pure anthracene in appearance; also in smaller needles. It is readily soluble in benzene, chloroform, carbon tetrachloride, carbon disulphide, etc.; less so in acetic acid, alcohol, and ether; and quite insoluble in water and alkalis. The latter do not act upon it even under pressure, and it is also not acted upon by acid chlorides like acetyl chloride or solution of phosgene gas, nor by phosphorus trichloride—from all of which it may be re-crystallised without decomposition. It melts at 196°, the solidifying point varying slightly within 4—6° below the melting point. The most striking property of α-pyrocresol, however, is the ease with which it sublimes; so great indeed is this tendency that it makes it impossible to determine the boiling point of α-pyrocresol. Sublimed α-pyrocresol forms beautiful white fluorescent flakes, which are exceedingly light and bulky, so that a very small quantity of pyrocresol suffices for the experiment. The vapour density of α-pyrocresol has been determined, and is in accordance with the formula $C_{15}H_{14}O$.

γ-*Pyrocresol* differs from the α-compound by its much greater solubility in all solvents: the crystals are less well-defined, and invariably needle-shaped. Its melting point lies at 104—105°, and it does not sublime, although it may be volatilised without decomposition, so that its vapour density can be determined. The properties of γ-pyrocresol are altogether less marked than those of the α-product, and the same applies to their respective derivatives.

β-*Pyrocresol*, melting at 124°, stands intermediate between the α- and γ-isomers. It forms needles or laminæ smaller than those of the α-compound, and, like the latter, it can be sublimed, though less readily. Its solubility is about the mean of those of α- and γ-pyrocresol.

OXIDES OF PYROCRESOL: $C_{15}H_{12}O_2$.

Upon oxidation, the pyrocresols take up one atom of oxygen.

α-*Pyrocresol Oxide* melts at 168°, and forms long yellowish needles, turning darker on exposure to light. It is much more soluble in acetic acid and alcohol than pyrocresol itself, and does not sublime readily; although it may be volatilised without change, and admits of a vapour density determination.

γ-*Pyrocresol Oxide* solidifies at 77°, and crystallises in small rhombic plates, which turn red on exposure to light.

β-*Pyrocresol Oxide* is less well defined, its solidifying point lies at 95°.

The oxides above described are prepared by oxidising pyrocresol in acetic acid solution with chromium trioxide, diluting with water, and re-crystallising the precipitated and well-washed oxides from alcohol. They are indifferent bodies, insoluble in water and alkalis. By gentle reduction with HI, at a moderate temperature, they yield pyrocresols again. Upon very energetic reduction, however, they are completely decomposed, yielding products identical with those derived from the pyrocresols themselves, and which will be described later on.

NITRO-COMPOUNDS: $C_{15}H_8(NO_2)_4O_2$.

α-*Tetranitro-pyrocresol Oxide* crystallises from nitrobenzene or glacial acetic acid in small yellowish plates, which, on heating, burn with a flash. It is insoluble in caustic potash, and sparingly soluble in alcohol.

β-*Tetranitro-pyrocresol Oxide* resembles the α-compound, but is more soluble in alcohol.

γ-*Tetranitro-pyrocresol Oxide* forms a granular mass, and has a distinct yellow colour. It is also more soluble in alcohol than the α-derivative.

Nitric acid alone fails to nitrate pyrocresol completely, and chiefly gives rise to oxides. It is therefore best to act upon the oxides at once with nitrating mixture, boil, dilute, wash, and crystallise from hot glacial acetic acid. The product is then washed with absolute alcohol, and dried at 100°.

Upon reduction in alcoholic solution with sodium amalgam, or in acetic acid solution with zinc dust the nitro-oxides yield amido-derivatives, which have not yet been obtained pure, but are being further investigated at this moment.

HALOGEN DERIVATIVES.

When α-pyrocresol is dissolved in chloroform, or carbon tetrachloride, and dry chlorine passed through the boiling solution for a few days, it assumes a very pungent odour, quite different from that of chlorine, and strongly reminding of the smell of acid chlorides; more particularly of phosgene gas. Upon standing this odour disappears, and a white, granular mass separates, which can be re-crystallised from boiling benzene. Upon analysis and re-crystallisation this turned out not to be a uniform product, though crystals were obtained *approximately* answering to the formula $C_{15}H_{12}OCl_2$. By repeated crystallisation we expect before long to obtain a perfectly pure substance. The corresponding β- and γ-compounds have not as yet been prepared.

α-*Dibromo-pyrocresol*, $C_{15}H_{12}Br_2O$, is obtained by mixing acetic acid solutions of pyrocresol and bromine. The precipitate is a mixture of the dibromo-compound with an unstable perbromide, which can be removed by washing with strong alcohol. The dried precipitate is then re-crystallised from boiling benzene, and thus obtained in the form of thick, elongated plates, melting at 215°.

β- and γ-pyrocresol form similar derivatives with bromine.

A number of experiments have been made to exchange the oxygen in pyrocresol for chlorine, as such a substitution would doubtless afford a clue as to the relative position of the oxygen atom. The replacement has been effected in the case of α-pyrocresol; the β- and γ-isomeride have not yet been examined.

Upon gently heating a mixture of α-pyrocresol with phosphorus pentachloride, the mass assumes a dirty green colour, and with chloroform or benzene yields a beautiful, intensely green solution. Upon continued heating in an oil-bath the colour disappears, and if the mixture is then boiled with water, filtered and washed till the filtrate is perfectly free from chlorine, a residue remains containing chlorine. This may be dissolved in chloroform or benzene, but the solutions cannot be made to crystallise, they invariably dry up to a hard, transparent resin resembling shellac.

Since direct treatment with PCl_5 seemed to lead to no satisfactory result, a solution of α-pyrocresol in carbon tetrachloride was mixed with one of PCl_5 in the same solvent, and boiled. A dark yellow powder was precipitated which, however, turned out to be very unstable, readily decomposing with formation of an oil, or resin, so that it could not be re-crystallised. During the above decomposition the intense green colour already referred to is again noticed, and upon washing the precipitate with glacial acetic acid it gradually disappears, yielding a dark green solution. Further experiments will have to show whether this interesting body can be obtained pure and in a crystallised state.

SULPHO DERIVATIVES.

α-Pyrocresol can be sulphonated, though not very readily, and the sodium and barium disulphonates have been prepared. Upon trying to sulphonate the oxide, the latter was found to separate unaltered upon diluting the solution. From this it would appear that the hydrogen atoms in pyrocresol which can be replaced by (SO_3H) are identical with those which upon oxidation are exchanged for oxygen.

REDUCTION OF THE PYROCRESOLS.

As the reduction of oxygenated aromatic compounds has, in many cases, led to the discovery of their mother substance, and thus finally to that of their constitution, it was one of the first things to try and reduce the pyrocresols. Schwarz's experiments to that effect, however, met with no success on account of the great stability of these bodies, and only recently I have been able to reduce α-pyrocresol, and to satisfy myself by preliminary tests that also β- and γ-pyrocresol can be reduced in a similar manner, though the reaction has, so far, been more closely studied in the case of the α-isomer only.

Pure α-pyrocresol was heated with 80 parts of a saturated solution of hydriodic acid in glacial acetic acid, in sealed tubes, to 250—300°. From 1—2grms. of pyrocresol were used at a time, and in some cases aqueous HI saturated at 0° and excess of amorphous phosphorus were used. After heating for two days a copious separation of iodine had taken place, and an oily liquid had separated on the surface of the mixture enclosed in the tubes. The contents of the latter were then neutralised with caustic potash, and distilled with steam, when colourless oil passed over, which was dried by caustic potash, and repeatedly distilled over metallic potassium, so as to free it from traces of iodine which seemed to obstinately adhere to it and caused it to turn violet on heating. Finally, a colourless non-fluorescent oil was obtained, which on fractionation proved to be a mixture of compounds. It began to boil at about 70°, then, excepting one or two short stoppages, the temperature quickly rose, becoming stationary for some time about 275°, the last portions passing over above 300 with slight decomposition. The part boiling at 275° was collected separately and analysed, the following data being obtained :—

(1.) 0·305 substance gave 0·9405 CO_2 + 0·4235 H_2O.
(2.) 0·2205 substance gave 0·6825 CO_2 + 0·3105 H_2O.

I.	II.	Calculated for $C_{15}H_{32}$
C = 84·09	84·46	84·905 p.c.
H = 15·42	15·64	15·095 p.c.
99·51	100·10	100·00

The above analyses agree sufficiently well with the formula $C_{15}H_{32}$, still the result cannot be taken as conclusive with regard to the exact amount of hydrogen, or the number of hydrogen atoms contained in the molecule. Three vapour density determinations were then made by Victor Meyer's method, a diphenylamine bath being employed, and an atmosphere of dry hydrogen being substituted for the one of nitrogen generally used. Upon trying to determine the vapour density in air a dissociation occurred, and a similar, though slight decomposition takes place even in hydrogen, when the diphenylamine bath is replaced by once of anthracene. The following results were obtained :—

I.	II.	III.	
G = 0·1035	0 0820	0·1045	Calculated for $C_{15}H_{32}$: d = 106.
V = 11	8·7	11·8	
K = 10·5	6·5	9·8	
B = 757	763·2	755	
d = 7·69	7·51	7·23	
110·96	108·48	104·32	

mean 107·92

As the small quantity of the reduction product at present at our disposal did not admit of anything like a complete examination, we had to be satisfied with a few preliminary tests. Strong nitric acid or nitrating mixture fail to nitrate the oil ; upon boiling, a kind of resin is formed which is lighter than water. Bromine and strong sulphuric acid have no perceptible action upon the oil. The higher boiling portion distilling at 275° is a perfectly colourless, non-fluorescent, thick oil, having a faint odour reminding of paraffins, and does not solidify even in a freezing mixture.

A considerable time ago we had already tried in vain to reduce α-pyrocresol by means of zinc dust, and Schwarz's experiments seemed to confirm our own negative result. Recently we have, however, repeated the experiment and found that on slowly passing α-pyrocresol over a long layer of heated zinc dust in a current of dry hydrogen or carbonic oxide gas, a yellow, soft mass is formed, having a strong, sweet smell, reminding of anis-seed oil. When distilled with superheated steam it yields an oil, which, as far as we are able to judge at present, is identical with that obtained by reduction in the wet way. The solid residue left upon distilling consists of unaltered α-pyrocresol.

The further investigation of these reductions is being proceeded with.

With regard to the constitution of the pyrocresols we cannot at the present stage of our work offer any definite opinion, still we may safely draw divers conclusions from the results so far obtained, more particularly in the case of α-pyrocresol.

The empirical formula $C_{15}H_{14}O$ is in concordance with the results of the analysis and the vapour density determination, still it cannot be said to have been proved beyond doubt, as a very small difference in the percentage of hydrogen could not possibly be determined by either method. In the worst possible case the formula must, however, be a very close approach to the truth. Taking the formula for granted, the first question arising is that regarding the position of the oxygen atom. Since the absence of an hydroxyl group is evident, from the fact that neither alkalis, nor acid chlorides, nor phosphorus trichloride have any action upon pyrocresol, we must assume the oxygen to be directly linked to carbon, and this again admits of two possibilities. We may suppose the oxygen to be contained in a carbonyl group C = O, which would impart to pyrocresol the general character of a ketone. Schwarz, in fact, at one time believed α-pyrocresol to be a ditolyl ketone $C_7H_7.CO.C_7H_7$, and although the properties of dibenzyl and ditolyl ketones as described by Fischer and Weiler (*Ber.* vii. 1183) and E. Hepp (*Ber.* vii. 1439) are different from those of α-pyrocresol, still it might have been an isomeric ketone. In order to settle this question we tried to combine α-pyrocresol with hydroxylamine and phenylhydrazine but without success, neither α-pyrocresol nor the β- and γ-isomers act upon hydroxylamine or Fischer's reagent, however one may vary the experimental conditions. The absence of a carbonyl group is made still more probable by the fact that no acid oxidation product of α-pyrocresol could be obtained and no disubstituted methane—like ditolylmethane—seems to be formed upon reduction. We can at the present time epitomise our views in saying that we believe α-pyrocresol and its isomerides to be anhydrides like diphenyl ether, consisting of two chains held together by oxygen, thus :

$$\begin{matrix} CxHxC & \\ & O \\ CyHyC & \end{matrix}$$

As to the structure of the two chains and the relative position of the oxygen atom connecting them, we cannot express any decisive views until we shall have more closely studied the reduction products and the chloride obtained with PCl_5. As the reduction of α-pyrocresol gives rise to the formation of a mixture and one of the constituents of this mixture contains the original number of carbon atoms, it is possible that the other products have resulted from the reduction of the separated chains, and that this dissociation has taken place at the point where the oxygen atom is attached, in which case the reaction would be directly indicative of the relative position of this oxygen atom. The chemical nature of the reduction products remains to be ascertained. The properties of the high boiling hydrocarbon are different from those of known compounds having a similar composition—viz., pentadecane $C_{15}H_{32}$, quindecon $C_{15}H_{26}$, benylene $C_{15}H_{28}$, triamylene $C_{15}H_{30}$, etc., etc. ; it may possibly not be a paraffin, but belong to the class of hydrocarbons which Markownikow and others have termed "naphthenes," though this is at present a mere speculation. There is no doubt that the continued investigation of the reduction products will soon throw light upon the matter, and ultimately upon the structure of the pyrocresols.

In conclusion, we may add that a number of experiments—some on a large scale—have been made with a view of obtaining an insight into the origin and mode of formation of pyrocresols in coal tar, which would furnish a valuable clue to their synthesis. Some of the results have already been made known at the recent meeting of the British Association, but as their discussion is beyond the scope of this report, we reserve these and subsequent results for a separate paper.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS AND MACHINERY.

Improvements in Apparatus for Preventing Corrosion of, Preventing Incrustation in or Facilitating the Removal of Incrustation from Steam and other Boilers. S. Hoyle, Accrington. Eng. Pat. 11,025, August 30, 1886. 8d.

WHEN zinc is used as an electrode in the interior of a steam boiler for the purpose set forth, the patentee proposes to use it in a cylindrical form mounted upon a cup-shaped brass tray pivoted on a stud in the interior of the boiler, at such a point that the motion of the water causes an oscillation, thus keeping the point of contact clean and bright.—C. C. H.

Improvements in Filters for Filtering Water for Manufacturing Purposes. C. Hird, Huddersfield. Eng. Pat. 11,304, Sept. 2, 1886. 8d.

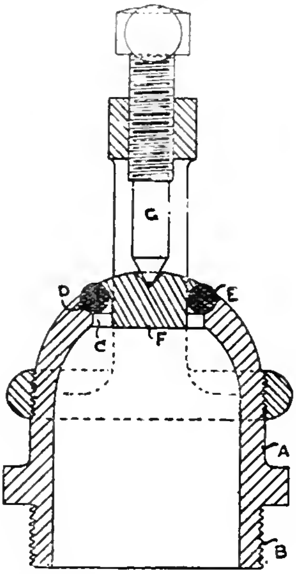
A SQUARE or oblong tank is provided with perforated sloping shelves one above the other, upon each of which is a bed of filtering material kept in place by means of a perforated corrugated plate. The water is admitted at the bottom of the tank and on to a perforated plate, which catches and retains the coarser impurities ; it ascends through the filtering beds and flows off at the top of the tank. Wash-out and drain cocks are provided for removing the sediment which accumulates between the filtering beds.—C. C. H.

A Cock for Charging Air and Liquor combined into Stills and other Vessels. J. Harvey, Port Dundas. Eng. Pat. 5358, April 13, 1887. 11d.

THE object of the improved cock is to prevent the collapse of a still, into which liquor is being charged, owing to the formation of a partial vacuum due to the condensation of steam or vapour within the still. It consists of a cock with two passages or pipes at right angles to and one above the other ; the lower pipe is connected with the bottom of the still and serves for the admission of the liquor. One branch of the upper pipe is open to the air and the other connected to the upper port of the still. The plug of the cock is hollow, but the upper and lower portions are separated by a cast diaphragm. It follows that when the lower port is so placed as to admit liquor to the still, the upper port is open to the air and the upper part of the still.—C. C. H.

Improvements in Fusible Plugs for Steam Boilers, Feed Water Heaters and other Appliances connected with Steam Boilers. W. Williams, Peckham. Eng. Pat. 3364, March 4, 1887. 8d.

THE improved fusible plug is made as shown in the drawing attached : A is the gun-metal body screwed into the flue of the boiler at B from the water side of the boiler. F is the loose or falling plug forced by the pressure screw G upon the ring E of soft fusible metal which rests upon the seating D ; the action of such a plug is well understood.—C. C. H.



An Improved Screen-bottom for Bone Charcoal Washing and Filter Tanks. A. Van Kroger, San Francisco, U.S.A. Eng. Pat. 9909, July 14, 1887.

THE screen-bottom forming the lower part of the base of the charcoal washing tank used in sugar refineries is formed by a number of frames ; each frame has solid sides grooved at the bottom edge for a jointing material, and the top and bottom of the frame is formed of perforated plate. The space between the two plates is packed with sand, fine gravel or other suitable material. The fine char which would otherwise be carried away, is retained during the washing.—C. C. H.

A Combined Evaporating and Calcining Furnace. F. Siemens, London. Eng. Pat. 13,789, Oct. 27, 1886. 8d.

THE improved furnace is shown in the accompanying drawings ; Fig. 1 is a longitudinal section, Fig. 2 a sectional plan. Gas from a producer enters the furnace at G, meets with air entering the flue I and the flame generated passes into the interior of the furnace at E.

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* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows :—

If the price does not exceed 8d.........	½d.
Above 8d., and not exceeding 1s. 6d...	1d.
,, 1s. 6d., ,, ,, 2s. 4d...	1½d.
,, 2s. 4d., ,, ,, 3s. 4d...	2d.

A portion of the flame passes over the hearth A, and the remainder emerges therefrom through the passages D, circulates round the evaporating pan C and back to the body of the furnace through D' ; the consumed gases leave the furnace at MM. If a stronger heat is required in the pan C, bricks covering a number of openings *b b* are removed, admitting a larger portion of the flame underneath the pan C. The dried material removed from the pan is fed on to the hearth of the furnace through passages K K leading from the upper surface of the setting of the pan to the hearth A, from which, after calcination, it is removed through the doors L L.
—C. C. H.

Fig. 1.

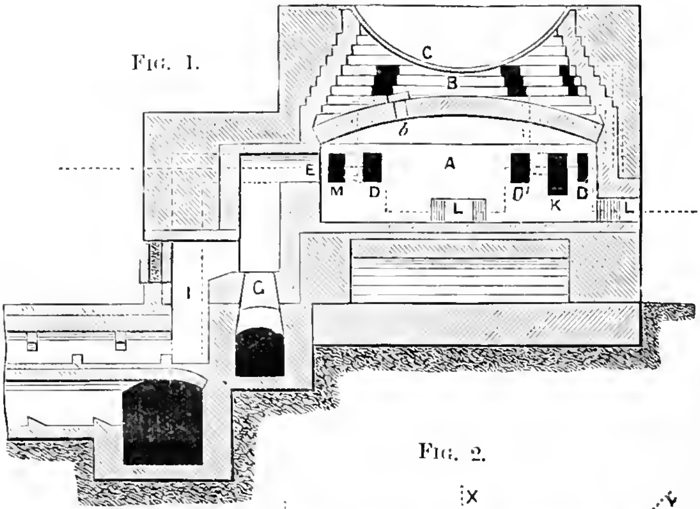
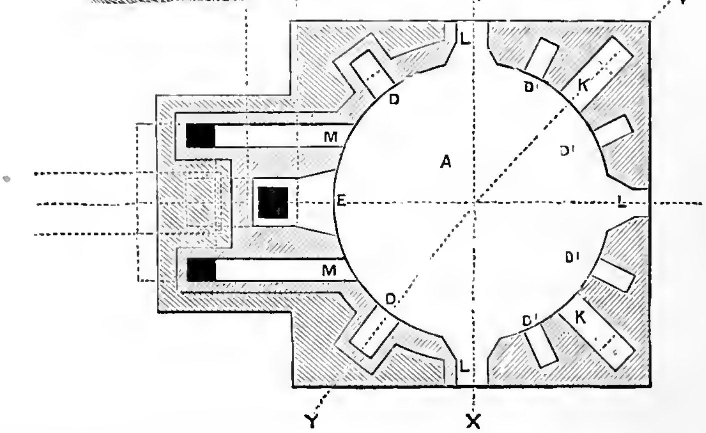


Fig. 2.



II.—FUEL, GAS AND LIGHT.

The Influence of the Composition of Petroleum and of the Salts contained therein on its Illuminating Power. E. Alftan. Zap. Imp. Russk. Techn. Obszcz. 1887, **21**, 107.

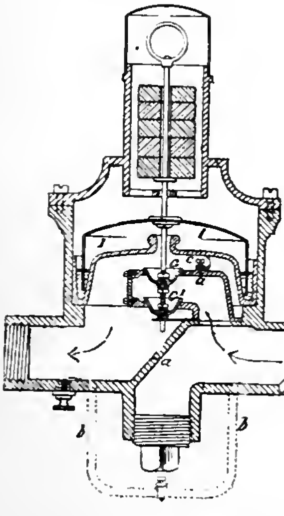
While petroleum is now commonly tested in regard to alkalinity or acidity, the influence of the ingredients on the luminosity of the flame has been neglected. The author has distilled an ordinary commercial sample of Nobel's petroleum into three fractions :—(1) with sp. gr. of 0·7647 and boiling point under 150° ; (2) with sp. gr. of 0·8287 (normal) and boiling point between 150° and 270° ; and (3) with sp. gr. of 0·867 and boiling point over 270°. The two latter were then mixed in various proportions and sufficient of the light distillate was added in each case to bring the product down to the normal sp. gr. of 0·8287. These mixtures were then burnt severally in a Kuhmberg lamp and the decrease in illuminating power determined photometrically, always after known periods of time. With mixtures containing 20 per cent. of heavy hydrocarbons the decrease in luminosity after eight to nine hours amounted to 7·3—9·5 per cent., with those containing 20—40 per cent. the decrease was 22—48 per cent., and with one made up with 50 per cent. of No. 3 the loss of light was 56·7 per cent. In the last-named mixtures the wick was more sooty than in the first. The author ascribes the diminished luminosity to the slow rise of the heavy oil in the wicks. In regard to the presence of salts, the bases most frequently occurring are iron oxide, lime and magnesia. A sample of petroleum insufficiently neutralised with soda, either gives an acid reaction, when it becomes yellow on standing in iron vessels owing to the solution of iron, or else it contains organic salts, in which case it burns so badly that the flame may even become extinguished after one or two hours. It is found that the presence of 0·1grm. of iron salts per 1000grms. of petroleum is not prejudicial, and this is an exceptionally high percentage ; but even 0·02 per 1000 of lime or magnesia salts may suffice to reduce the luminosity by 30—40 per cent. after eight hours, and 0·1 of lime per 1000 lowers it 85·5 per cent., while the same proportion of magnesia compounds reduces it 94 per cent. This remarkable difference in the effect of iron oxide and of these bases is traced by the author to the fritting together of the latter in the wick, with consequent obstruction to the passage of the petroleum, whilst the iron oxide remains pulverulent at the summit of the wick or falls away as a powder. It is especially to be observed that no lime or magnesia have been found in samples having an acid reaction ; by creating, however, a demand for alkaline petroleum it is quite conceivable that a product containing these objectionable impurities might find its way into the market.—W. G. M.

Improvements in the Manufacture of Gas from Mineral Oil and in Apparatus therefor and connected therewith. J. M. Turnbull, Edinburgh. Eng. Pat. 11,833, Sept. 17, 1886. 8d.

REFINED or "medium" oil is admitted to the interior of an externally heated retort. The cross section of the retort is such that a ridge running down the centre leaves a hollow on each side, which may be filled with open refractory material in order to expose a greater surface, and so assist the gasification. The gas thus generated passes through a cooler and washer of ordinary form to the gasholder or bellows, which is made like a photographic camera expanding vertically upwards in a suitable frame. The topboard of the gasholder, when this latter is full, comes in contact with a weight at the end of a rod, and, raising this, effects the shutting of a tap which stops the oil supply to the retort. The supply is thus automatically regulated.—A. R. D.

Means for Indicating Escape of Gas: Specially Applicable for Buildings and Domestic Use. J. Stott, London. Eng. Pat. 13,577, Oct. 23, 1886. 8d.

THIS invention is intended to be applied to an apparatus such as that described in Eng. Pat. 10,348 of 1886, and is illustrated in the accompanying figure. A hole *a* in some convenient part of the apparatus, or a by-pass *b*, allows the escape of a minute quantity of gas even when the valves G, G_1, are seated. Thus if the gas, after having been turned off at the meter, be turned on again, sufficient will escape at the open burners to indicate the state of affairs, but not enough to do harm. When the burner taps are closed, this gas will accumulate under the float I, and, causing the stop valves, G, G^1, to rise, allow the main supply to pass through and be lighted in the usual manner. The hole *a* is fitted with a regulating screw *c* to determine the size of the passage.—A. R. D.



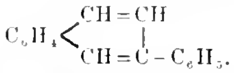
Apparatus for Inducing Complete Combustion of Mineral Oil, Gases or Smoke, to be used for Heating or Lighting Purposes. G. T. Chinnery, Gateshead. Eng. Pat. 13,752, Oct. 27, 1886. 6d.

THE oil is incompletely burned in a vessel provided with a cover and fitted with a steam-coil to warm the oil if necessary. Inside the vessel is also placed an ejector so disposed as to draw off the vapours and gases formed by the incomplete combustion going on in the vessel, and discharge them by an opening in the cover. The ejector is fed with compressed air, steam, or air and steam together. This mingling with the oil gases forms a highly inflammable mixture, which burns with a white light and great heat.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Constitution of the Hydrocarbon $C_{16}H_{12}$ from Styrolene Alcohol—Phenylnaphthalene. T. Zinke. Annalen, **240**, 137—146.

IT has already been shown that the constitution of the hydrocarbon $C_{16}H_{12}$ obtained from styrolene alcohol and phenylacetaldehyde is represented by the formula $C_6H_5.C_4H_2.C_6H_5$, it being assumed that the condensation takes place in two stages as in the case of the condensation of acetaldehyde to crotonic aldehyde. Further researches on the constitution of this hydrocarbon tend to show that it is β-phenylnaphthalene, the reaction which gives rise to its formation probably including the following phases :—(1.) Two molecules of the phenylacetaldehyde unite to form 1 molecule of an aldole having the formula : — $C_6H_5.CH_2.CH(OH).CH(COH)C_6H_5$. (2.) This aldole then parts with 1 molecule of water, being resolved into *diphenylisocrotonic aldehyde* $C_6H_5.CH:CH.CH(COH)C_6H_5$. (3.) The latter also loses 1 molecule of water, of which one hydrogen atom is absorbed by a phenyl group, by which means the naphthalene ring is formed, thus :—



$$C_6H_4\left<\begin{array}{l}CH = CH\\ \quad\quad\;\;|\\ CH = C - C_6H_5.\end{array}\right.$$

β-phenylnaphthalene. The formation of the above aldole may be explained also by assuming that a phenyl group takes part in the condensation, in which case the following intermediate product is obtained :—$C_6H_5.CH_2CH(OH).C_6H_4.CH(COH)$. The reaction which gives rise to the formation of this compound corresponds with von Pechmann's synthesis of coumarin. This product then loses 2 molecules of water in two phases, an aldehyde being first formed, which is subsequently converted into the hydrocarbon thus :—$C_6H_5.CH:CH.C_6H_4.CH_2.COH$ and

$$C_6H_5.\overset{\llcorner}{C}:CH.C_6H_4.CH:\overset{\lrcorner}{C}H.$$

β-phenylnaphthalene. The author has prepared β-phenylnaphthoquinone, the hydroxyquinone and the amido-methylamine and aniline derivatives. In confirmation of the view that this hydrocarbon is phenylnaphthalene it is stated that on oxidation the theoretical amount of benzoic acid is obtained. Moreover, on oxidation with potassium permanganate the hydroxyquinone forms phthalic anhydride and an acid of the formula $C_6H_4CO(COOH)_2$, together with benzoic acid, a circumstance which affords additional proof to the correctness of the author's opinion regarding the constitution of the hydrocarbon. Unsuccessful attempts were made to prepare this compound by synthesis. The author also failed in his endeavours to obtain diphenylisocrotonic acid from phenylacetaldehyde and sodium phenylacetate.—D. B.

Pyrene. E. Bamberger and M. Philip. Annalen, **240**, 147—192.

NEARLY all the contents of this paper, which gives a complete resumé of the researches on pyrene, have been previously published. After some historical references, the authors allude to the numerous investigations on the constitution of pyrene, and point out that it has been established beyond doubt that pyrene represents a combination of a naphthalene nucleus with two benzene nuclei. In the experimental portion of the paper the authors describe in detail the preparation and properties of pyrene and a large number of its derivatives. The raw material from which the hydrocarbon was extracted was the by-product formed in the condensation chambers when mercury ores are smelted (in Idria). This product, called "stuppfett," has been investigated by Goldschmidt and Schmidt (*Monatsh. Chem.* 1881, 1), who isolated about twelve different substances therefrom, among which pyrene occupied the second place as regards yield. The extraction of pyrene from this material was effected by the authors by digesting the mass with alcohol on a water-bath, decanting the alcoholic solution and collecting and pressing the residue. The latter was then extracted with boiling alcohol, in which it all dissolved with the exception of a small quantity of inorganic matter. On cooling, a yellowish brown crystalline powder separated, which was collected on a filter and pressed. From this the pyrene was obtained by fractional crystallisation of its picrate from alcohol, in which medium it is the least soluble. The picrate was then decomposed with ammonia and the hydrocarbon recrystallised from alcohol.—D. B.

Action of Sulphuric Acid on Ozokerite. R. Zaloziecki. Dingl. Polyt. J. **265**, 178—184.

It is known that the yield of ceresin is largely affected by the purification of ozokerite with sulphuric acid, from 15 to 30 per cent. being lost during this operation. The author has attempted to determine the conditions under which the most favourable results are obtained. He finds that between 160° and 200° the yield is approximately the same, being, if anything, in favour of the higher temperature. This apparently anomalous result is explained by the fact that on increasing the temperature the sulphonic compounds originally produced are decomposed with regeneration of sulphurous anhydride and hydrocarbons. Two reactions appear to govern the action of sulphurous anhydride at high temperatures, the one occasioning the decomposition of the organic matter with separation of carbon and formation of water and sulphurous anhydride, and the other effecting the splitting up of the sulphonic acids with reproduction of certain constituents. The former constitutes a source of loss; the latter one of gain. It is stated in conclusion that the residual waste acid may be employed with advantage for the purification of a fresh portion of ozokerite, inasmuch as it contains a considerable quantity of free sulphuric acid; and the heavy, spongy precipitate facilitates the clarification of the mass by absorbing the separated particles and precipitating them.—D. B.

Amount of Nitrogen in Different Coals and Production of Ammonia therefrom. E. Schilling. Dingl. Polyt. J. **265**, 218—222.

The specimens of coal examined represent all the best known types found in different parts of Germany and used for gas making. The following results were obtained:—The amount of nitrogen in the coals ranged from 1 to 1·5 per cent., whilst the coke which they produced contained from 1·2 to 1·4 per cent. The coke from cannel coal, however, contained less nitrogen. The amount of nitrogen present in coal diminishes with an increase in the percentage of oxygen. The production of ammonia varied considerably, ranging from 0·094 to 0·284kilo. per 100kilos. of coal. It rises and falls with the total nitrogen present in the coal. The yield of ammonia from 100 parts of total nitrogen gave a mean of 14 per cent., the maximum result being 20 per cent. The addition of 2·5 per cent. of lime to coal influences the production of ammonia in various ways, some specimens being unaffected whilst others exhibit a considerable increase in the yield of ammonia.—D. B.

Conversion of Higher Homologues of Phenol into Primary and Secondary Amines. R. Lloyd. Ber. **20**, 1254—1265.

Isobutylphenol, isamylphenol, thymol and carvacrol, when heated to 320—350° with zinc bromide ammonia and ammonium bromide, or the corresponding chlorine compounds, give the corresponding primary and secondary amines. Carbonaceous matter is also formed. Carvacrol gives a yield or 70 per cent. of the amine; the other phenols vary between 45 and 60 per cent. On the whole the homologues of phenol appear less capable of reacting than phenol itself.

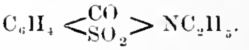
Carvacrylamine is an almost colourless oil, which solidifies in a freezing mixture and boils at 241—242°. Diphenisobutylamine $(C_4H_9C_6H_4)_2NH$, diphenisamylamine $(C_5H_{11}.C_6H_4)_2NH$, dithymyl- and dicarvacrylamine $(C_3H_7CH_3.C_6H_3)_2NH$, are only liquids boiling above 300°, which, on distillation, are colourless, but rapidly darken. All these amines yield characteristic platinum double salts.—J. B. C.

Substituted Naphthylene Diamines. J. Annaheim. Ber. **20**, 1371—1374.

The preparation of these compounds is based upon the well-known reaction of Merz and Weith for converting phenols into amines. If dioxynaphthalenes be substituted for phenol, naphthylene diamines are obtained. In this way dioxynaphthalene condenses with aniline and aniline hydrochloride to form diphenylnaphthylenediamine $C_{10}H_6:(C_6H_5.NH)_2$. The action takes place at 145—160°, and no dehydrating agent is necessary. It is a solid body, crystallising in brilliant plates. Similar compounds are obtained with para- and orthotoluidine and xylidine, etc.—J. B. C.

Ethereal Salts of Benzoyl Sulphimide and of o-Sulphamido-benzoic Acid. C. Fahlberg and R. List. Ber. **20**, 1596—1604.

Benzoyl sulphimide, when neutralised with caustic soda or sodium carbonate and evaporated, yields a sodium salt. The dry salt, heated with ethyl iodide to 230°, yields the ethyl ether of the imide. It has the formula $C_9H_9SO_3N$. This compound is decomposed with hot HCl, and gives *o*-sulphobenzoic acid and ethylamine, just as the imide yields sulphobenzoic acid and ammonia. This compound must, therefore, have the formula—



$$C_6H_4 < \begin{matrix} CO \\ SO_2 \end{matrix} > NC_2H_5.$$

Heated with alcoholic potash, a compound of the formula $COOK.C_6H_4.SO_2.NKC_2H_5$ is obtained, and on acidifying the aqueous solution the free acid $COOH.C_6H_4.SO_2NKC_2H_5$ is precipitated in the form of an oil, which solidifies on standing. The ethereal salt of *o*-sulphamidobenzoic acid is prepared by passing HCl gas into the alcoholic solution of benzoyl sulphimide. It has the formula $SO_2.NH_2.C_6H_4.CO_2C_2H_5$, and is isomeric with *o*-ethylamidosulphobenzoate. Heated with potash, not the free acid, but the potassium salt of the sulphimide is obtained. An analogous compound to the above is obtained by passing HCl gas into an alcoholic solution of sulphamidobenzoyl sulphimide.

As *o*-sulphamidobenzoic acid cannot be obtained from its ethereal salt, the authors attempted to prepare the ethereal salt from the acid. Ortho-toluenesulphamide, on oxidation with K_3FeCy_6 yields the acid. On passing HCl gas through the alcoholic solution, the sulphimido compound is obtained, but on treating the sodium salt of *o*-sulphamidobenzoic acid with ethyl iodide the ethereal salt is formed.

Its identity with that from benzoyl sulphimide was further confirmed by comparison of its characteristic decomposition products.

1. The sulphimides of aromatic hydrocarbons are, therefore, the anhydrides of the corresponding *o*-sulphamidocarboxylic acids. Both compounds are strong acids, and yield ethereal and metallic salts.
2. The salts of *o*-sulphamidocarboxylic acids give sulphimides on heating, as also the free acid and ethereal salts.
3. The alkaline salts yield, with haloid ethers, ethereal salts, in which the H of the imido group is replaced by the alcohol radical.
4. The ethereal salts give on saponification with alcoholic potash the ethereal salt of *o*-sulphamidocarboxylic acid, isomeric with the other ethereal salt of the same acid.
5. With HCl the ethers of the sulphimides yield alcohol bases and sulphonic acids.
6. The sulphimides are readily converted into the ethers of the *o*-sulphamidocarboxylic acid.—J. B. C.

By-products in the Manufacture of Thiophen. V. Meyer and K. Neure. Ber. **20**, 1756—1758.

THE higher boiling liquid remaining after distilling off the thiophen (prepared by Volhard and Erdmann's method), solidifies on cooling and consists of thiosuccinic anhydride and succinic anhydride. In addition to the solid constituents an oil remains which distils with steam and consists of a portion soluble in alkali and another insoluble in alkali. The soluble portion is thienylmercaptan $C_4SH_3.SH$. The solution of the mercaptan in concentrated alcoholic ammonia yields, on spontaneous evaporation, thienyldisulphide $C_4SH_2.S.S.C_4SH_2$. The portion insoluble in alkali was too small to be identified but contains probably thienylsulphide. —J. B. C.

Preparation of Anthranol and Dianthryl. C. Liebermann and A. Gimbel. Ber. **20**, 1854—1855.

Anthranol.—10grms. of anthraquinone in 4—500grms. of glacial acetic acid are boiled, and 25grms. of granulated tin added. The yellow liquid changes to brown, especially on addition of about 10cc. of concentrated HCl, but regains its original colour. Small quantities of HCl are added from time to time, as long as the solution darkens on addition of the acid. After about a quarter of an hour the process is complete. The end of the reaction may be recognised by the solution remaining clear on cooling. The anthranol is precipitated by pouring into water containing HCl and may be obtained pure by one recrystallisation from glacial acetic acid.

Dianthryl.—Anthraquinone is mixed into a thin paste with boiling glacial acetic acid, 40grms. of tin in 2—3 portions are added to every 10grms. of anthraquinone, and half the quantity of concentrated HCl to that of the acetic acid used. The latter is added in two portions. The mass is kept boiling for an hour. It becomes grey and is then decanted from unattacked tin on to a filter and washed with water. The substance is best crystallised from toluene.—J. B. C.

IV.—COLOURING MATTERS AND DYES.

Manufacture of the Ethylether of a New Acid. O. Imray, London. From the Society of Chemical Industry in Basle, Switzerland. Eng. Pat. 14,617, Nov. 11, 1886. 4d.

FOR the production of this new substance, which has the formula $C_{14}H_{24}N_2O_4$, 1·5 parts of ethylenediamine are heated on a water bath with 5 parts of acetylacetic ether. On cooling, a crystalline mass separates, which is collected on a filter and recrystallised from alcohol. The new compound is thus obtained in the form of needles or prisms, melting at 126° C. It is insoluble in water, sparingly soluble in petroleum spirit but dissolves readily in alcohol, ether, acetic ether, glacial acetic acid, chloroform, benzene, toluene and dilute acids.—D. B.

On the Production and Applications of Aniline Chromates. C. Girard and L. L'Hote. Compt. Rend. **105**, 284.

GRAWITZ, in a communication laid before the Academy (*Compt. Rend.*, 1887, 182) in reference to the authors' researches on a crystalline aniline chromate, pointed out that aniline chromates formed by double decomposition, had been crystallised by Persoz in 1872 (*Bull. Soc. Ind. Mul.*); that Zurcher in 1876 had obtained fine yellow crystals of the salt by the action of potassium bichromate on a slightly acid solution of aniline hydrochloride; and that he himself, in a patent dated Nov. 3, 1874, had recommended the use of this chromate in the manufacture of various dyes. To all this the authors reply that aniline chromates are constantly being produced, but that no one had previously isolated and examined the bichromate described by them, by the aid of which they had produced a whole series of dyes, and hoped also to obtain an aniline black. Contrary to Grawitz's assertions, it could be isolated in a pure condition only by working with an acid solution of an aniline salt.—W. G. M.

On Triphenylmethane Derivates. E. Kock. Ber. **20**, 1562—1566.

THE action of benzaldehyde on aromatic bases to form triphenylmethane derivatives have been studied by Ullmann and others. The author adopts the same method, employing substituted aldehydes and substituted bases. Thus he finds that although *m*-toluidine does not react readily with benzaldehyde, dimethyl-*m*-toluidine combines with *p*-nitrobenzaldehyde to form tetramethylditolylnitrophenylmethane $C_6H_4NO_2.CH.(C_6H_3.CH_3.N(CH_3)_2)_2$. Similar condensation products are produced with dimethyl-*m*-chloraniline and *p*-nitrobenzaldehyde and *m*-anisidine and *p*-nitrobenzaldehyde. It appears, therefore, that although the meta substituted aromatic bases form with difficulty triphenylmethane derivatives, the reaction proceeds readily on converting the base into a tertiary amine. It is also interesting to note that the leuco-bases with two meta-positions in one benzene nucleus do not yield colouring matters on oxidation, which is not the case with the ortho- and para-compounds. With anisidine, however, the meta-position does not produce this effect.—J. B. C.

Formation of Haloid substituted Amido-Compounds by the Reduction of Nitro-hydrocarbons. E. Kock. Ber. **20**, 1567.

THE author has prepared a chlorotoluidine by the action of tin and HCl upon *m*-nitrotoluene. This is identical with the compound prepared by Hönig and Goldschmidt, by nitrating *o*-chlorotoluene and then reducing the nitro compound thus obtained. The substance is therefore *o*-chloro-*m*-toluidine. It combines with phosgene to form di-*o*-chloro-*m*-tolylurea and gives a thio-urea of the formula $CS(NH.C_6H_3Cl.CH_3)_2$.—J. B. C.

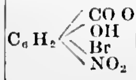
A Tabular Survey of the Artificial Organic Colouring Matters. G. Schultz and P. Julius. Chem. Ind. **10**, 295—305.

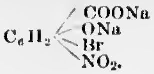
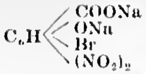
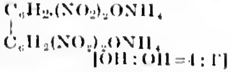
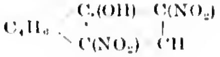
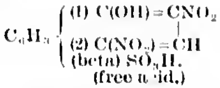
THE first column of the table contains the commercial names, and the letters in square brackets denote which firm uses the particular names :—[A] The Berlin Actiengesellschaft für Anilinfabrikation. [B] Badische Anilin- and Soda-Fabrik, Ludwigshafen a/Rh. [Bi] Actiengesellschaft für Chem. Industrie (late Bindschedler and Busch), Basel. [By] Farbenfabriken, formerly F. Bayer & Co., Elberfeld. [C] Leopold Cassella & Co., Frankfurt a/M. [D] Dahl & Co., Barmen. [DH] L. Durand & Huguenin, Basel. [K] Kalle & Co., Biebrich a/Rh. [L] A Leonhardt & Co., Mühlheim, Hesse. [M] Farbwerke, formerly Meister, Lucius & Brüning, Hoechst a/M. [Mo] P. Monnet & Cie, La Plaine, Geneva. [O] K. Oehler, Offenbach a/M. [P] Societé Anonyme des Matières Colorantes, et Produits Chimiques de St. Denis, Paris. [Sch] The Schöllkopf Aniline and Chemical Co., Buffalo, U.S.A. [V] Verein Chemische Fabriken, Mannheim. The second column contains the scientific names; the third, the constructional formulæ; the fourth, a concise notice of the methods of formation; the fifth, the years of discovery; the sixth, the names of the discoverers, number of the German patent and reference to the literature on the subject; and the last column contains the characteristic reactions. In the fourth column, under *β-naphthylaminemonosulphonic acid* Br, is understood the acid patented by Messrs. F. Brönner & Co., German patent No. 22,547; *β-naphthylaminemonosulphonic acid* D, that obtained by Dahl, German patents Nos. 29,084, 32,271, 32,276; *β-naphthylamine- δ -monosulphonic acid*, of F. Bayer & Co.'s German patent 39,925; *α-naphtholmonosulphonic acid* NW, that obtained by Nevile and Winther from naphthionic acid; *α-naphtholmonosulphonic acid* C, Cleve's acid; *α-naphtholdisulphonic acid* Sch, that patented by the Schöllkopf Aniline Co., No. 40,571; *β-naphtholmonosulphonic acid* B, patented by Bayer, No. 18,027; *β-naphtholmonosulphonic acid* S, Schaeffer's acid; and *β-naphtholdisulphonic acid* R and G, those of the German patent 3229.

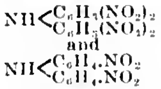
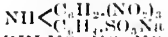
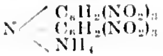
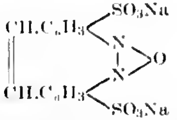
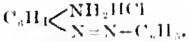
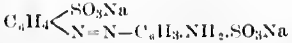
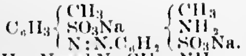
I.—NITROSO-COLOURS.

No.	Commercial Name.	Scientific Name.	Constitutional Formula.	Formation.	Date of Discovery.	Number of German Patents, References, etc.	Reactions, etc.
1	Dinitrosoresorcein. Solid green.	Dinitrosoresorcinol.	$C_6H_2\left\{\left(\begin{array}{c}O\\ \mid\\ NOH\end{array}\right)_2\right.$	Action of nitrous acid upon resorcinol.	1875	FITZ. *Ber.* **8**, 631.	A greyish brown powder, easily soluble in hot water, with difficulty in cold; soluble in dilute caustic soda. Deflagrates slightly when heated.
2	Naphthol green B. [C.]	Sodium-ferrous-salt of nitroso-beta-naphthol-monosulphonic acid.	$C_{10}H_5\left\{\begin{array}{lr}\multicolumn{2}{c}{SO_3NaNaO_3S}\\ O & O\\ \mid & \mid\\ \multicolumn{2}{c}{NO-Fe-ON}\end{array}\right\}C_{10}H_5$	Action of nitrous acid upon beta-naphtholmonosulphonic acid S and formation of the sodium-ferrous salt.	1883	OTTO HOFFMANN, *Ber.* **18**, 46. Frankfurter Anilinfarben-fabrik, GANS & Co. Patent 28,065, 19 Jan., 1884; 28,901, 16 March, 1884.	A dark green powder; leaves when ignited on platinum a residue of iron sulphide. Soluble in water with yellowish green colouration. HCl—no change. NaOH—colour becomes blue-green. Concentrated H_2SO_4 yellow-brown solution, becomes yellow on dilution with water and gives iron reaction with both ferri and ferro-cyanides.

II.—NITRO-COLOURS.

No.	Commercial Name.	Scientific Name.	Constitutional Formula.	Formation.	Date of Discovery.	Number of German Patents, References, etc.	Reactions, etc.
3	Picric acid, or Welter's bitter.	Symmetrical trinitrophenol.	$C_6H_2\begin{cases}(1)\ OH\\(2)\ NO_2\\(4)\ NO_2\\(6)\ NO_2\end{cases}$	Action of nitric acid on phenol or phenol sulphonic acid.	1771 1842 1869	WOULFE (from indigo). LAURENT (from phenol). *Annalen*, **43**, 208. R. SCHMITT and L. GLUTZ. *Ber.* **2**, 52.	Pale yellow crystals, soluble with difficulty in cold water, easily soluble in hot water, alcohol, benzene, etc.; melts at 122·5°. Tastes bitter. Boiled with potassium cyanide forms a brown solution.
4	Victoria yellow. Jaune Anglais. Victoria orange. Safron substitute. Aniline orange.	Mixture of the alkali salts of dinitro-ortho- and para-cresol.	$C_6H_2.OK.CH_3.(NO_2)_2.$ $[OK:CH_3=1:2$ or $1:4]$.	Action of nitric acid on a variable mixture of *o*- and *p*-cresolsulphonic acid.	1869	MITTENTZWEY.	A red-yellow powder; potash salt deflagrates; ammonia salt burns off. Soluble in water with orange-yellow colour. HCl—white precipitate of dinitro-cresol. NaOH—no change, but ammonia given off from the ammonia salt. Concentrated H_2SO_4—pale yellow solution.
5	Flavaurin.	Ammonia salt of di-nitrophenol-*p*-sulphonic acid.	$C_6H_2.ONH_4.(NO_2)_2SO_3NH_4.$ $[OH:NO_2:NO_2SO_3H=1:2:6:4]$.	Action of nitric acid on mononitrophenol-*p*-sulphonic acid.	1874	JUL. POST. *Ber.* **7**, 1323. Leipziger Anilin Fabrik. BEYER & KEGEL. Patent 27,271 (lapsed).	A yellowish-red powder; rises like a "Pharaoh's serpent" when heated. Yellow solution in water. HCl—wine-red coloration NaOH—ammonia given off and solution darkened, which zinc dust turns brown, and decolorises on boiling; air restores the brown colour. Concentrated H_2SO_4—wine-red solution, colourless on dilution.
6	Phenyl brown. Phénicienne. Phenicin. Rothein (No longer in use)			Action of nitric acid on crude phenol.	1863	J. ROTH. *Bull. Soc. Ind. Mulhouse*, **1864**, 499. *Wagner's Jahresber.* **10**, 510.	Yellowish brown powder; deflagrates on heating.
7	Salicylic yellow A. (No longer in use)	Monobromonitrosalicylic acid.	 $C_6H_2\left\langle\begin{array}{l}CO\,OH\\OH\\Br\\NO_2\end{array}\right.$ $[CO_2H:OH=1:2]$.	Action of dilute nitric acid on monobromosalicylic acid.	1880	CHEM. FABRIK AUF ACTIEN VORM. E. SCHERING. Patents 15,117 and 15,889 (both lapsed).	A pale yellow powder, which melts when heated on platinum and then burns quietly. Very difficultly soluble in hot water; soluble in alkalis.

8	Salicylic yellow II. (No longer in use)	Soda salt of salicylic yellow A.	 $C_6H_2 \begin{cases} COONa \\ ONa \\ Br \\ NO_2. \end{cases}$	Ditto, and formation of soda salt.	Ditto.	Ditto.	Orange-yellow powder; deflagrates on heating. Forms a yellow solution in water. HCl—precipitates the free acid. NaOH—precipitate of the soda salt, which re-dissolves on warming, giving a brown coloration with zinc dust.
9	Salicylic orange. (No longer in use)	Soda salt of mono-brom-dinitro-salicylic acid.	 $C_6H \begin{cases} COONa \\ ONa \\ Br \\ (NO_2)_2 \end{cases}$	Action of nitric acid on monobromosulphosalicylic acid.	Ditto.	Ditto.	Orange-yellow powder, smells of bromine and deflagrates. Yellow solution in water and alcohol. HCl—precipitates the free acid. NaOH—no change.
10	Zinalin. (No longer in use)	Probably nitrified rosolic acid.		Action of nitrous acid upon rosaniline in alcoholic solution.	1870	M. Vogel. *Die Entwicklung der Anilin Industrie.* 2nd edition. Leipzig. 1870, 100.	Orange-red powder, insoluble in cold water; soluble slightly at the boil; easily soluble in alkalis.
11	Palatine orange. (No longer in use)	Ammonia salt of tetranitro-gamma-diphenol.	 $C_6H_2.(NO_2)_2ONH_4$ $\vert$ $C_6H_2(NO_2)_2ONH_4$ [OH : OH = 4 : 1']	Action of nitric acid on benzidine.	1869	Caro. H. Schmidt & G. Schultz. *Annalen*, **207**, 335.	Brown powder soluble in water, acids precipitate brown flakes of tetranitro-gamma-diphenol, melting at 220°. Does not deflagrate on heating.
12	Martius yellow. Jaune d'or. Naphthalene yellow. Naphthylamine yellow. Manchester yellow. Gamahl yellow.	Ammonia, soda, or lime salt of dinitro-alpha-naphthol.	 $C_4H_4 \begin{cases} C.(OH) - C(NO_2) \\ \vert \\ C(NO_2) - CH \end{cases}$	Action of nitric acid on alpha-naphthylamine or alpha-naphtholsulphonic acid.	1864	Martius. *Zeitschrift f. Chemie*, *N. F.*, **4**, 80. Ballo. *Naphthalene*, 1870, 61. *Ber.* **3**, 288. Darmstaedter & Wichelhaus. *Ber.* **2**, 113.	Ammonia and soda salts, small glittering crystals, lime salt yellow-red crystals. Soluble in water, ammonia salt is soluble in alcohol. Soda salt deflagrates, ammonia salt burns off quietly. HCl precipitates dinitro-alpha-naphthol melting at 138°.
13	Sun gold. Heliochrysin. (No longer in use)	Soda salt of tetra-nitro-alpha-naphthol.	$C_{10}H_3.(NO_2)_4ONa$ (alpha)	Action of soda solution on tetranitro-alpha-bromonaphthalene.	1882	Merz & Weith. *Ber.* **15**, 2721. Farbwerke vorm Meister, Lucius & Brüning. Patent 14,951 (lapsed)	
14	Croceïn yellow. [By] (No longer in use)			Action of nitric acid on beta-naphtholmonosulphonic acid B.	1881	Farbenfabriken vorm F. Bayer & Co. Patent 18,027.	A yellow crystalline powder.
15	Naphthol yellow S. Naphthol yellow. Citronin. Acid yellow S.	Ammonia, soda, or lime salt of dinitro-alpha-naphthol-sulphonic acid.	 $C_6H_3 \begin{cases} (1)\ C(OH) = CNO_2 \\ \qquad\qquad\quad \vert \\ (2)\ C(NO_2) = CH \\ (beta)\ SO_3H. \end{cases}$ (free acid.)	Action of nitric acid on alpha-naphtholtrisulphonic acid.	1879	Caro. Bad. Anilin & Soda Fabrik. Patent 10,785. Lauterbach. *Ber.* **14**, 2028.	An orange-yellow powder, easily soluble in water, the solution being turned pale yellow by acids, but not precipitated. Emits sparks when burnt.
16	Brilliant yellow [Sch].	Soda salt of dinitro-alpha-naphthol-monosulphonic acid.		Action of nitric acid on alpha-naphtholdisulphonic acid, Sch.	1881	Mensching. The Schollkopf Aniline & Chemical Co. Patent 10,57	Egg-yellow powder, which bubbles up but does not deflagrate when heated. Dissolves with brown-yellow coloration in water, acids produce no precipitate but turn solution pale yellow. NaOH orange yellow precipitate, soluble on warming. H_2SO_4 pale yellow solution.

No.	Commercial Name.	Scientific Name.	Constitutional Formula.	Formation.	Date of Discovery.	Number of German Patents, References, etc.	Reactions, etc.
17	**Citronin.**	Tetranitro- (with a little dinitro-) diphenylamine.	 $NH<\begin{smallmatrix}C_6H_3(NO_2)_2\\C_6H_3(NO_2)_2\end{smallmatrix}$ and $NH<\begin{smallmatrix}C_6H_4.NO_2\\C_6H_4.NO_2\end{smallmatrix}$	Action of nitric acid on diphenylamine.	1877—8	BROOKE, SIMPSON & SPILLER.	
18	Pikryl brown. (No longer in use)	Soda salt of trinitrodiphenylamine sulphonic acid.	 $NH<\begin{smallmatrix}C_6H_2.(NO_2)_3\\C_6H_4.SO_3Na\end{smallmatrix}$ [NH:NO$_2$:NO$_2$:NO$_2$:SO$_3$H = 1:2:4:6:4′]	Action of trinitrochlorobenzene on sulphanilic acid.	1882	E. NOLTING & E. v. SALIS-MAYENFELD. Patent 22,268 (lapsed).	
19	Aurantia. Imperial yellow.	Ammonia salt of hexanitrodiphenylamine.	 $N\begin{smallmatrix}\diagup C_6H_2(NO_2)_3\\-C_6H_2(NO_2)_3\\\diagdown NH_4\end{smallmatrix}$	Action of nitric acid on diphenylamine.	1873	KOP. GNEHM. *Ber.* **7**, 1309.	Brown red crystals, soluble in water with orange yellow coloration. Acids precipitate hexanitrodiphenylamine melting at 238°. Decrepitates on heating, large quantities deflagrate.
20	Granite brown. Grenat soluble. (No longer used.)	Potash or ammonia salt of isopurpuric acid.		Action of potassic cyanide upon picric acid.	1859	HLASIWETZ. *Annalen*, **110**, 289.	Dark red powder or brown glittering crystals. Deflagrates on heating. Forms brown solution in hot water; soluble with difficulty in cold water. HCl—brown solution.
				III.—AZOXY-COLOURS.			
21	Sun yellow. Jaune soleil. Maize. Curcumin S.	Soda salt of azoxystilbene disulphonic acid.	 [CH : SO$_3$Na : N = 1 : 2 : 4]	Action of boiling caustic soda upon *p*-nitrotoluenesulphonic acid.	1883	J. WALTER at J. R. GEIGY'S. *Bull. Soc. Ind. Mulhouse*, **1887**, 99. G. SCHULTZ and F. BENDER. *Ber.* **19**. 3231.	Brown powder soluble with brown yellow coloration in water. Conc. H_2SO_4—violet solution, on diluting changes to yellow.
				IV.—AZO-COLOURS.			
22	Aniline yellow. Spirit yellow. Jaune d'aniline.	Hydrochloride of amidoazobenzene (amidodiphenylimid)	 $C_6H_4<\begin{smallmatrix}NH_2.HCl\\N=N-C_6H_5.\end{smallmatrix}$ [NH$_2$: N = N = 1 : 4]	Heating diazoamido-benzene with aniline hydrochloride in aniline solution.	1861 1863	MENÉ. *Jahresber.* **1861**, 196. *J. Prakt. Chem.* **82**, 462. SIMPSON MAULE & NICHOLSON (oxalate) *Zeitschrift. f. Chemie. N.F.* **2**, 132.	Steel blue crystals forming a yellow solution with water, which partly deposits the free base on heating. Conc. H_2SO_4 brown solution, turning red on dilution.
23	Acid yellow [A]. Echt Gelb G [K]. Acid yellow G. Echt Gelb extra [B]. Jaune acid. Fast yellow. New yellow L. [K]	Mixture of the soda salts of amidoazobenzene mono and disulphonic acid.	 $C_6H_4<\begin{smallmatrix}SO_3Na\\N=N-C_6H_3.NH_2.SO_3Na\end{smallmatrix}$ [SO$_3$: N and N : NH$_2$ = 4 : 1 and 1 : 4]	Action of fuming sulphuric acid on hydrochloride of amidoazobenzene.	1878	GRÄSSLER. Patent 4186, and additional Patent 7091. *Chem. Ind.* 2, 48—316.	A yellow powder. The yellow aqueous solution becomes orange on the addition of acids. NaOH produces no change. Conc. H_2SO_4 brownish yellow solution, orange yellow on dilution.
24	Echt Gelb R. [K]. Acid yellow R. [B]	Soda salt of amidoazotoluene disulphonic acid.	 $C_6H_3\begin{cases}CH_3\\SO_3Na\\N:N.C_6H_2\end{cases}\begin{cases}CH_3\\NH_2\\SO_3Na.\end{cases}$ [CH$_3$: N and N : CH$_3$: NH$_2$ = 2 : 1 and 1 : 2 : 4].	Action of fuming acid on hydrochloride of amidoazotoluene.	1878	GRÄSSLER. Patent 4186. *Chem. Ind.* 2, 48.	Brownish yellow powder. The yellow aqueous solution becomes magenta coloured on the addition of acids. NaOH—no change. Conc. H_2SO_4—brownish yellow solution; on dilution magenta red.

25	Bismarck brown. Manchester brown. Phenylene brown. Vesuvin. Anilin brown. Leather brown. Cinnamon brown. Canelle. English brown. Golden brown.	Hydrochloride of triamidoazobenzene (?).	$C_6H_4(NH_2)N_2C_6H_3(NH_2)_2(HCl)_2$. [$NH_2$:N and N:$NH_2$:$NH_2$=3:1 and 1:2:4]	Action of nitrous acid on *m*-phenylene-diamine.		1865	MARTIUS, CARO and P. GRIESS. *Zeitschrift. f Chemie. N.F.* **3**, 278.	Dark brown powder. The brown aqueous solution unchanged by HCl. NaOH produces a brown precipitate. Conc. H_2SO_4 brown solution, red on dilution.
26	Soudan G. [A].	*m*-Dihydroxyazobenzene. Aniline-azo-resorcinol.	$C_6H_5N=N.C_6H_3.(OH_2)$ [OH : OH = 1 : 3].	Diazo-compound of Aniline.	Combined with Resorcinol	1875	BAEYER & JAEGER. *Ber.* **8**, 151.	A brown powder, partly soluble in hot water, with yellow colour: HCl a bright brown precipitate. NaOH a brown solution. Conc. H_2SO_4 yellow brown solution, brown precipitate on dilution.
27	Soudan I. [A].	Aniline-azo-beta-naphthol.	$C_6H_5.N=N.C_{10}H_6.(OH.)$(beta)	Aniline.	Beta-naphthol.	1881	C. LIEBERMANN. *Ber.* **16**, 2860.	Brick-red powder, insoluble in water, soluble in alcohol with yellow colour. Conc. H_2SO_4 magenta red solution, on dilution precipitates orange yellow.
28	Tropæolin OOOO Azococcin G. (no longer in the market).	Soda salt of aniline-azo-alpha-naphtholmonosulphonic acid.	$C_6H_5.N_2.C_{10}H_5<^{OH\ (alpha)}_{SO_3Na\ (alpha)}$	Aniline.	Alpha-naphthol monosulphonic acid N.W.	1878	WITT, VEREIN CHEM. FABRIKEN MANNHEIM. Patent 26,012, 1883.	Red-brown powder, sparingly soluble in water to a red-yellow solution, which NaOH changes to orange yellow. HCl yellowish-red precipitate. Conc. H_2SO_4 magenta red solution, unchanged by dilution.
29	Cochineal. Scarlet G. [SCH].	Soda salt of aniline-azo-alpha-naphtholmonosulphonic acid.	$C_6H_5.N:N.C_{10}H_5<^{OH\ (alpha}_{SO_3Na}$	Aniline.	Alpha-naphthol-monosulphonic acid C.	1883	GAESS. *Monit. Scientif.* **1884**, 335	Brick-red powder, forms yellowish-red solution in water, which NaOH changes to orange yellow. HCl causes precipitation. Conc. H_2SO_4- cherry solution, brown red precipitate on dilution.
30	Ponceau 4 GB. [A]. Crocein orange. [K] [By].	Soda salt of aniline-azo-beta-naphthol-monosulphonic acid.	$C_6H_5.N=N.C_{10}H_5<^{OH\ beta)}_{SO_3Na.}$	Aniline.	Beta-naphthol monosulphonic acid S.	1878	GRIESS.	Fiery red powder. Solution in water is orange yellow, changed to brown yellow by NaOH. HCl—forms yellow-brown precipitate. Conc. H_2SO_4—orange-yellow solution, yellowish brown precipitate on dilution.
31	Orange G. [A] [M]. Orange yellow.	Soda salt of aniline-azo-beta-naphthol-disulphonic acid.	$C_6H_5.N=N.C_{10}H_4<^{OH\ (beta).}_{(SO_3Na)_2}$	Aniline.	Beta-naphthol disulphonic acid G.	1878	BAUM. MEISTER, LUCIUS & BRÜNING. Patent 3229. *Chem. Ind.* **1**, 110—111.	Yellowish red powder, the orange-yellow solution is not changed by HCl, turns brown on adding NaOH. Conc. H_2SO_4—orange yellow solution, unchanged on dilution.
32	Ponceau 2 G. [A] [M].	Soda salt of aniline-azo-beta-naphthol-disulphonic acid.	$C_6H_5N=N.C_{10}H_4<^{OH\ (beta)}_{(SO_3Na)_2.}$	Aniline.	Beta-naphthol disulphonic acid R.	1878	Ditto.	Fiery red powder, the red-yellow solution is scarcely altered by either HCl or NaOH. Conc. H_2SO_4—cherry red solution, on dilution yellowish red.
33	Butter yellow.	Aniline-azodimethyl-aniline.	$C_6H_5.N=N.C_6H_4N.(CH_3)_2$.	Aniline.	Dimethyl-aniline.	1877	P. GRIESS. *Ber.* **10**, 528.	Yellow leaflets, melting at 115°. Insoluble in water, soluble with red coloration in dilute HCl, precipitated by NaOH. Conc. H_2SO_4 yellow solution, red on dilution.
31	Chrysoidine.	Hydrochloride of di-amidoazobenzene, or anilino-azo-*m*-phenylenediamine.	$C_6H_5.N=N.C_6H_3.(NH_2)HCl$ [NH_2 : NH_2 = 1 : 3].	Aniline.	*m* phenylene-diamine.	1875 1876	CARO. WITT. A. W. HOFMANN. *Ber.* **10**, 213. O. N. WITT. *Ber.* **10**, 350—651. P. GRIESS. *Ber.* **10**, 388.	Red brown crystalline powder, soluble with brown coloration in water. HCl- precipitates brownish yellow flakes. NaOH- red-brown precipitate. Conc. H_2SO_4 yellowish brown solution, becomes cherry red on dilution.

No.	Commercial Name.	Scientific Name.	Constitutional Formula.	Formation.		Date of Discovery.	Number of German Patents, References, etc.	Reactions, etc.
				Diazo-compound of	Combined with			
35	Acid brown G. [A].	Soda salt of aniline-*m*-diamidoazobenzene - beta - sulphonic acid.	$C_6H_5.N:N.C_6H_2(NH_2)_2.N:N.C_6H_4.SO_3Na$. {$NH_2$:$NH_2$ and N:SO_3 1:3 and 1:4]	Aniline.	*m* - diamido-azo-benzene *p*-mono-sulphonic acid.	1882	*Actiengesellschaft fur Anilinfabrikation.* *Chem. Ind.* **6**, 207. Patent. Nov. 8, 1882.	Brown powder; the brown aqueous solution is unaltered by acids or alkalis. Conc. H_2SO_4—red brown solution, on dilution yellowish brown.
36	Orange III. Orange No. 3. [P].	Soda salt of *m*-nitr-anilineazo - beta - naphtholdisulphonic acid.	$C_6H_4 \left\{ \begin{matrix} NO_2 \\ N_2.C_{10}H_4(OH)(SO_3Na)_2 \end{matrix} \right.$	*m*-nitraniline.	Azo-beta-naphthol disulphonic acid R.	1878	Z. ROUSSIN and A. J. POIRRIER. Patent 6715. *Chem. Ind.* **2**. 292. H. STEBBINS. *Chem. News*, **43**. 58. *Chem. Ind.* **4**. 87.	Red-brown powder, forms a reddish yellow solution in water. HCl—orange yellow precipitate, soluble in much water. NaOH—solution becomes yellowish brown. Conc. H_2SO_4—orange yellow solution, on dilution first an orange yellow precipitate is formed, redissolving then to a clear yellow solution.
37	Orseille substitute. [A] [P]. Naphthionic red (antiquated name)	Soda salt of nitr-anilineazo - alpha-naphthylamine-sulphonic acid.	$C_6H_4 \left\{ \begin{matrix} NO_2 \\ N:N.C_{10}H_5.NH_2.SO_3Na. \end{matrix} \right.$ {NO_2 : N = 4 : 1].	*p*-nitraniline.	Naphthionic acid.	1878	Z. ROUSSIN and A. J. POIRRIER. Patent 6715. *Chem. Ind.* **2**, 292.	Brown paste, soluble in water. The red-brown solution is precipitated by HCl. NaOH—produces a precipitate soluble in water. Conc. H_2SO_4—magenta-red solution, brownish red precipitate on dilution.
38	Cochineal—Scarlet 2 R. [SCH].	Soda salt of toluidine - azo - alpha - naphthol - monosulphonic acid.	$C_6H_4(CH_3).N:N.C_{10}H_5 \left\{ \begin{matrix} (OH)\alpha \\ SO_3Na. \end{matrix} \right.$	Toluidine.	Alpha-naphthol-monosulphonic acid C.	1883	GAESS. *Monit. Scientif.* **1884**, 335.	Cinnabar red powder, sparingly soluble in cold, easily soluble with yellowish red coloration, in hot water. HCl precipitates red flakes. NaOH solution becomes orange. Conc. H_2SO_4—magenta-red solution; precipitates red flakes on dilution.
39	Scarlet G. T. [BY].	Soda salt of toluidine-azo-beta-naphthol-monosulphonic acid.	$C_6H_4(CH_3)N:N.C_{10}H_5 \left\{ \begin{matrix} OH\ (\beta). \\ SO_3Na. \end{matrix} \right.$	Toluidine.	Beta - naphthol-monosulphonic acid.	1879	LEVINSTEIN. *Ber.* **13**, 586.	Scarlet-red powder, orange-yellow solution in water. HCl—precipitates brown oily drops. NaOH—dark brown red solution. Conc. H_2SO_4—magenta-red solution; on dilution, oily drops.
40	Ponceau G. T. [B].	Soda salt of toluidine-azo-beta-naphthol-disulphonic acid.	$C_6H_4(CH_3)N:N.C_{10}H_4 \left\{ \begin{matrix} OH\ (\beta). \\ SO_3Na)_2. \end{matrix} \right.$	Toluidine.	Beta - naphthol - disulphonic acid G.	1878	BAUM. FARB. VORM MEISTER, LUCIUS & BRÜNING. Patent 3229, 1878.	
41	Ponceau R. T. [B].	Soda salt of toluidine - azo - beta - naphthol-disulphonic acid.	$C_6H_4(CH_3)N:N.C_{10}H_4 \left\{ \begin{matrix} OH\ (\beta). \\ SO_3Na)_2 \end{matrix} \right.$	Toluidine.	Beta - naphthol - disulphonic acid R.	1878	Ditto.	
42	Soudan II. [A].	Xylidine-azo-beta-naphthol.	$C^6H_3(CH_3)_2N:N.C_{10}H_6.(OH).(\beta)$.	Xylidine.	Beta - naphthol.	1883	FARB. VORM MEISTER, LUCIUS & BRÜNING. Patent 29,067.	Brownish red powder, insoluble in water. Conc. H_2SO_4—magenta-red solution; on dilution, straw-yellow precipitate.

43	Azococcin 2 R. [A].	Soda salt of xylidino-azo-alpha-naphthol-monosulphonic acid.	$C_6H_3(CH_3)_2N:N.C_{10}H_5\left\{\begin{matrix}OH\ (\alpha).\\SO_3Na.\end{matrix}\right.$	Xylidine.	Alpha-naphthol-monosulphonic acid N.W.	1882	WITT. VEREIN. CHEM. FABRIKEN MANNHEIM. Patent 26,012. *Chem. Ind.* **7**, 48.	Brown-red powder, with difficulty soluble in water. HCl—brownish red flakes. NaOH—solution brown-yellow. Conc. H_2SO_4—magenta-red solution; brown-red precipitate on dilution.
44	Cochineal-Scarlet 4 R. [SCH].	Soda salt of xylidine-azo-alpha-naphthol-monosulphonic acid.	$C_6H_3(CH_3)_2N:N.C_{10}H_5\left\{\begin{matrix}OH\ (\alpha).\\SO_3Na.\end{matrix}\right.$	Xylidine.	Alpha-naphthol-monosulphonic acid C.	1883	GAESS. *Monit. Scientif.* **1884**, 335.	Fiery red powder, soluble with difficulty in water. HCl—reddish brown precipitate. NaOH—solution yellowish red. Conc. H_2SO_4—magenta-red solution; precipitated on dilution.
45	Wool Scarlet R. [SCH].	Soda salt of xylidino-azo-alpha-naphthol-disulphonic acid.	$C_6H_3(CH_3)_2N:N.C_{10}H_4\left\{\begin{matrix}OH\ (\alpha),\\(SO_3Na)_2\end{matrix}\right.$	Xylidine.	Alpha-naphthol-di-sulphonic acid, SCH.	1881	MENSCHING. THE SCHOLLKOPF. ANILINE & CHEMICAL CO. Patent 10,571, Dec. 1885.	Brown-red powder, soluble in water with yellowish red coloration. HCl—solution changes to bluish red. NaOH—solution becomes yellowish red. Conc. H_2SO_4—cherry red solution; red on dilution.
46	Scarlet G. R. [A].	Soda salt of xylidino-azo-beta-naphthol-monosulphonic acid.	$C_6H_3(CH_3)_2N:N.C_{10}H_5\left\{\begin{matrix}OH\ (\beta).\\SO_3Na.\end{matrix}\right.$	Xylidine.	Beta-naphthol-monosulphonic acid S.	1879	LEVINSTEIN. *Ber.* **13**, 586.	Cinnabar-red powder, soluble with yellowish red coloration in water. HCl—brownish red precipitate. NaOH—solution unchanged. Conc. H_2SO_4—cherry red solution; on dilution, brown-red precipitate formed.

(To be Continued.)

—T. L. B.

Compound of Chromic Acid with Aniline. C. Girard and L. L'Hote. Compt. Rend. **104**, 1725.

IF saturated solutions of potassium bichromate and aniline hydrochloride be well cooled and then mixed together, yellow crystals of aniline bichromate $(C_6H_5.(NH_2)_2H_2Cr_2O_7)$ are readily formed. They crystallise in clino-rhombic prisms and are optically active; they are only slightly soluble in cold and are decomposed by boiling water. In alcohol they are only very slightly soluble, and gradually convert it into aldehyde: when gently heated they decompose, and when thrown on to mercury heated to 108 they burn away, leaving a residue of chromic oxide. With warm water a variety of violet colours is formed, while on addition of aniline hydrochloride and aniline, colours also result. Sodium, calcium and ammonium bichromates act similarly on aniline hydrochloride.—C. A. K.

The Colouring Matter of Lac-dye. R. E. Schmidt. Ber. **20**, 1285—1303.

LAC-DYE is obtained from the resin of certain trees in India, which are punctured by insects (coccus lacca). From these punctures the resin flows, which is known under the name of gum-, stick- and shel-lac. The colouring matter, or lac-dye, is obtained from the resin, probably by dissolving in water and precipitating the dye with lime and alum. The purification of the colouring matter is as follows:—Commercial lac-dye is treated with dilute H_2SO_4 at 90°, or HCl at the boiling point. The residue, which contains the larger portion of the colour and insoluble mineral substances, is washed and the colour dissolved in water and precipitated with lead acetate in the hot solution. The precipitate is washed, suspended in water, and the lead precipitated with H_2S. This solution is evaporated to dryness and extracted with alcohol. An insoluble powder—some of the colouring matter combined with iron, lead, and lime—remains. To the alcoholic solution 30 to 40 volumes of ether are added until no further precipitate forms. Some of the colouring matter and all the impurities are carried down. From the filtered solution the ether is distilled and the residue left to crystallise. An analysis of the crystallised product corresponds to the formula $C_{16}H_{12}O_8$. The author gives to the substance the name of laccaic acid. Caustic alkalis dissolve the colour and give a magenta solution. Baryta water forms a violet lake. Although laccaic acid resembles in many respects carminic acid (the colouring matter of cochineal), the two substances are apparently different in their properties, as well as in the shades which they give on wool and silk. A comparison of the absorption spectra of the two substances points to a close relationship between laccaic and carminic acids. Laccaic acids give a potassium salt of the formula $C_{16}H_9O_8K_3$, and a barium salt of the formula $C_{16}H_{10}O_8Ba$. With nitric acid it yields picric acid. Heated with concentrated HCl to 180°, a new crystalline body is formed and an inflammable gas, probably CH_3Cl or C_2H_5Cl, is given off. This new compound has the formula $C_{26}H_{14}O_{11}$. Laccaic acid is decomposed on fusing with potash. On dissolving the melt in water and steaming, part volatilises and part remains behind. The aqueous distillate contains acetic acid and a phenol. The non-volatile portion contains three substances. A body which is difficultly soluble in water and gives a red colour with Fe_2Cl_6; this the author finds to be oxyphthalic or oxyuvitic acid. The second compound, which gives no coloration with Fe_2Cl_6, gives on analysis numbers corresponding to oxytoluylic acid. The third substance has not been identified.—J. B. C.

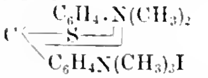
Formation of Oxyazo-compounds. B. Fischer and H. Wimmer. Ber. **20**, 1577.

OXYAZO-COMPOUNDS are formed by the action of phenols upon diazoamido compounds. The reaction proceeds best when the diazo-compound is added to the phenol, which should be heated a little above its melting point. Resorcinol and diazoamidobenzene yield dioxyazobenzene

$C_6H_5N_2C_6H_3(OH)_2$, resorcinol and diazoamido-*o*-toluene yield *o*-azotolueneresorcinol. Similar compounds are obtained with diazoamidoxylene and resorcinol, diazoamidobenzene and β-naphthol, diazoamido-*p*-toluene and β-naphthol, and diazoamido-*o*-toluene and β-naphthol. After heating the substances together for about half an-hour the product is poured into caustic soda solution and extracted with ether. The filtered alkaline solution is acidified with acetic acid and the new compound, which is precipitated, is recrystallised from alcohol.—J. B. C.

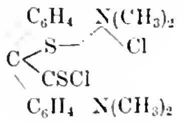
Tetramethyldiamidothiobenzophenone. O. Baither. Ber. **20**, 1731—1739.

This compound, which is manufactured commercially by the firm of Kern & Sandoz, has not yet been described. It melts at 202°, and occurs in the form of ruby red crystalline plates with a blue shimmer and also as a cantharides-green powder. The hydrochloride is prepared by passing HCl gas into the chloroform solution of the compound, and forms blue crystals. On heating the thiobenzophenone with HCl, tetramethyldiamidobenzophenone is formed, and H_2S is given off. A platinum double salt obtained by passing HCl into a solution of the thioketone was found to contain no sulphur, and gave, on analysis, numbers corresponding to one atom Pt, four atoms N, and seven atoms Cl. With concentrated nitric acid the thioketone gives trinitro-dimethylaniline. With hydroxylamine a reaction occurs in which H_2S is evolved, and an oxime is formed of the formula $C_6H_4N(CH_3)_2.CN.OH.C_6H_4N(CH_3)_2$. Methyl iodide combines with the thioketone to form a compound, which from its intense colouring power is not a ketone but has probably the following graphic formula :—



$$C\begin{cases} C_6H_4.N(CH_3)_2 \\ —S— \\ C_6H_4N(CH_3)_3I \end{cases}$$

Heated with zinc dust it is resolved into dimethylaniline and tetramethyldiamidodiphenylmethane, with thiophosgene in CS_2 solution it yields a colouring matter in the form of metallic golden green crusts, which dissolve in water. The colouring fades rapidly. This compound has probably the formula :—



$$C\begin{cases} C_6H_4\ N(CH_3)_2 \\ S—\ \ Cl \\ CSCl \\ C_6H_4\ N(CH_3)_2 \end{cases}$$

—J. B. C.

Carbazol Blue. E. Bamberger and R. Müller. Ber. **20**, 1903—1907.

Suida's compound is obtained by melting together carbazol and oxalic acid in the proportion of one of the former to 10—12 of the latter. The melt is extracted with hot water and benzene. The residue is dissolved in warm alcohol, filtered and evaporated. The alcoholic solution of carbazol blue when treated with glacial acetic acid, HCl, and zinc dust is decolorised. Filtered into caustic soda solution the leuco-base separates out as a white flocculent precipitate. On oxidation with any of the usual reagents the blue colouring matter is again formed. On the basis of this reaction and an analysis, which, however, is not entirely satisfactory, the authors consider the compound to be a triphenylmethane derivative of the formula :—

$$(HO).C \vdots (C_6H_3.NH.C_6H_4)_3.$$

—J. B. C.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

Improvements in the Preparation of Fuller's Earth for Use in Manufactures. F. Candy, Middlesex. Eng. Pat. 15,947, Dec. 28, 1885. 6d.

Fuller's earth in its natural state is ground in suitable apparatus, passed through a pug mill, formed into blocks, stacked, dried and pulverised, after which it is ready for use.—E. G. C.

Improvements in the Preparation of Fibre for Textile and other Purposes. T. Honywood, Horsham. Eng. Pat. 13,054, Oct. 13, 1886. 6d.

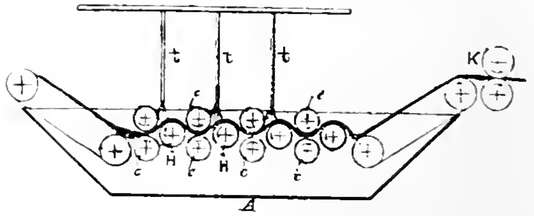
This invention relates to the treatment of the common nettle and allied species for the preparation of textile fibres. The bast and bark are separated from the wood and are then boiled in a solution containing soap jelly and either lime water, borax, soda or potash. This treatment may be preceded by a maceration in cold water.—E. J. B.

Improvements in the Method of and in Apparatus for Dressing or Sizing Textile Fibres. A. C. Henderson, London. From La Société Charles Vignet ses Fils et Cie., Lyon, France. Eng. Pat. 14,610, Nov. 11, 1886. 8d.

The method consists in producing immediate contact of the material to be sized with the sizing substance by means of rollers, a drawing of which accompanies the specification. The apparatus is specially adapted to light substances such as crape, net or tulle.—E. J. B.

New or Improved Process and Apparatus for Washing and Preparing Wool and other Fibrous Materials. W. H. Beck, London. From C. Delerue, Roubaix, France. Eng. Pat. 16,787, Dec. 21, 1886. 6d.

The wool or other material to be treated is drawn in between the rollers *c* placed in the washing vat A. The small "squirrel" rollers H prevent the fibres from lapping round the rollers c. Jets of water for washing are furnished by the pipes *t*. The washed fibre then passes through the squeezing rollers K. The object of the apparatus is to draw out the fibres while the material is being washed, thus rendering the subsequent carding operation unnecessary.—E. J. B.



Improvements in the Process of, and Apparatus for, Treating Ramie, Jute and other Fibres. C. C. Kauffman, New Orleans. Eng. Pat. 6464, May 3, 1887. 1s. 3d.

The process consists in drying the decorticated fibres by means of artificially-heated air, whereby the gummy matters in the fibre are solidified and rendered more easily removed by the subsequent mechanical treatment. The decorticated and dried fibres are then passed through the cleaning machine, the construction of which can only be understood by referring to the drawings and detailed description.—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING AND BLEACHING.

An Improved Method of Preparing Seaweeds and other Marine Objects for Ornamental Purposes. M. and C. L. Smout, Hastings. Eng. Pat. 9492, July 5, 1887. 4d.

The inventors claim the use of a solution of permanganate of potash, followed by treatment with a solution of acid oxalate of potash, for the purpose of bleaching the seaweed, sponges, etc. The bleached materials are then soaked in glycerine, or in a solution of a deliquescent salt, dried and finally shaken up in a box containing finely-powdered starch.—E. J. B.

VII.—ACIDS, ALKALIS AND SALTS.

Manufacture of Carbonate of Soda. Harrison Grey Dyar and John Hemming, London. Eng. Pat. 7713, Dec. 29, 1838. Second Edition, 6d.

This invention consists in the use of ammonium carbonate, sesquicarbonate or bicarbonate in the manufacture of sodium carbonate, by applying it to decompose common salt, and also in afterwards recovering the ammonia thus used in such a way as to allow of its being used again to convert fresh portions of salt into sodium carbonate. Successive portions of sodium carbonate are thus produced from the same portion of ammonia. As to the first part, common salt is dissolved in as much water as is barely sufficient to dissolve it, so as to constitute a fully saturated solution, and an equal weight of powdered ammonium carbonate is added to this solution. The mass is well mixed together and allowed to stand from ten to twenty hours, agitating from time to time to prevent the solid parts from settling before the reaction is complete. The liquid is then drained and pressed from the solid matters, which latter consist chiefly of sodium bicarbonate. To remove the excess of carbonic acid and to recover any ammonia contained therein, the mass is heated in a retort to 600° or 800° F. The vapours given off are condensed in a cooling chamber or refrigerating apparatus. The substance left in the retort is sodium carbonate. As to the second part, the liquid separated from the solid sodium bicarbonate contains ammonium chloride and carbonate, common salt and a small portion of the sodium carbonate formed. In order to recover the ammonium carbonate, the liquor is run into a still and heated, when water and ammonium carbonate distils over, which must be condensed. Or, instead of distilling over, a solution of calcium chloride is added to the mother-liquor, until the precipitate of calcium carbonate formed increases no longer. The latter is filtered, and the filtrate, now chiefly a solution of ammonium and sodium chloride, is evaporated to dryness and intimately mixed with powdered chalk. The mixture is heated in an iron retort until the ammonium carbonate, formed by this operation, is sublimed and separated. It is condensed in suitable chambers, into which the carbonic acid and ammonia vapours, given off on heating the sodium bicarbonate retorts, are also conveyed. The carbonic acid combines with the ammonia to ammonium bicarbonate, and if the amount of carbonic acid is not sufficient, more of it, obtained from any economic source, should be introduced. Furthermore, in order to complete the thorough recovery of the ammonia, a sufficient quantity of hydrochloric acid gas may be passed into the last of these condensing chambers, which acid gas will effectually retain the last traces of ammonia. The carbonate of ammonia thus reproduced or recovered is employed over again to convert fresh portions of common salt into sodium carbonate. It is essential for the success of the process to employ vessels or apparatus of such construction as to expose the ammonium carbonate as little as possible to the air, so that loss of ammonia may be prevented. The inventors claim as their invention: (1) the use of carbonate or bicarbonate of ammonia in converting common salt into carbonate of soda, and (2) the recovery of ammonia in combination with the first part of the process.—S. H.

A New or Improved Sodium Product and Method or Methods of Manufacturing the same. J. I. Watts and W. A. Richards, Sandbach. Eng. Pat. 13,001, Oct. 1886. 6d.

The new sodium compound is called "sesquicarbonate of soda," and is composed of one equivalent of sodium carbonate, one equivalent of sodium bicarbonate and two equivalents of water ($Na_2CO_3.NaHCO_3.2H_2O$). In manufacturing this compound, a solution containing three equivalents of soda to four equivalents of carbonic acid is prepared, and the solution is allowed to crystallise at a temperature not below 35° C. There are many ways of obtaining a solution of the right composition. The best appears to be to heat sodium bicarbonate so as to deprive it of about one-third of its carbonic acid and to dissolve the residue in hot water, or to add to a hot solution of 84 parts of sodium bicarbonate 106 parts of sodium carbonate. The solution, obtained by any of these methods, is clarified and slowly cooled, while it is kept agitated, when the sesquicarbonate crystallises out in distinct crystals, which are separated from the mother-liquor and dried.—S. H.

A New or Improved Continuous Furnace for the Production of Chlorine. E. Solvay, Brussels, Belgium. Eng. Pat. 13,389, Oct. 20, 1886. 8d.

This invention relates to a furnace for the continuous production of chlorine. In a mass of brickwork a series of hollow vertical columns is mounted, which receive the charge to be decomposed by heated air. These hollow columns are formed by placing one above the other a number of retorts made of fire-proof material, their diameter being very small in proportion to the total height of the columns, the heat having ready access to the material. The peculiar construction of the furnace has the further advantage of allowing all the parts to expand or contract freely in every direction, as the columns are really only a combination of separate segments. The whole series is heated from one gas-producer, the products of which are conducted by suitable flues to each column, round which they circulate. The temperature is regulated by opening or closing air-holes and the damper of the chimney. In carrying out the operation, the heated columns are filled from the top with the matter to be decomposed. A current of dried and heated air is admitted through the air-holes at the bottom of each column. The decomposed material is withdrawn continuously at the bottom, and the air, charged with chlorine, is conducted away from the top of the column.
—S. H.

The Manufacture of Hydrated Carbonate of Magnesia and other Products produced therein. W. Bramley and W. P. Cochrane, Middlesbrough. Eng. Pat. 13,762, Oct. 27, 1886. 4d.

To a solution of an alkaline bicarbonate or sesquicarbonate or ammonium carbonate magnesia is added, and the mixture is heated and agitated. Hydrated magnesium carbonate is formed, whereas the alkaline bicarbonate or sesquicarbonate is converted into carbonate. In the case of ammonium bicarbonate or sesquicarbonate the solution will, after treatment, contain ammonium carbonate or ammonia according to the amount of magnesia used. The operation should be performed in a closed vessel, to prevent loss of carbonic acid gas, and ensure more rapid mutual decomposition.—S. H.

Explosion of a Tube containing Crystals of Chromous Sulphate. J. M. van Bemmelen. Rec. d. Trav. Chem. des Pays Bas. 1887, **6**, 202.

The author prepared chromous sulphate, $CrSO_4.7H_2O$, as follows:—A solution of chromic chloride was reduced, precipitated by sodium acetate, the precipitate washed, dissolved in sulphuric acid, the solution crystallised, the crystals filtered, washed, dried and finally sealed in a tube, all the operations being conducted in an atmosphere of carbon dioxide. After being kept a year, protected from direct light, one of the tubes exploded violently. The crystals in this tube were not perfectly dry, their colour having changed from blue to green. The contents of the tube became liquid immediately after the explosion. No smell of acetic acid derivatives or of sulphurdioxide could be detected and only a trace of the latter appeared on distilling with dilute sulphuric acid. The author considers the explosion to be due to the water remaining with the imperfectly-dried crystals, which had gradually been decomposed, the oxygen going to oxidise the chromous salt, while the hydrogen was liberated and that the water of crystallisation of the salt, partially freed owing to the oxidation, had also been thus decomposed.—C. A. K.

Improvements in the Manufacture of Sulphuric Acid under High Pressure with Agitation, and in Apparatus for that Purpose. W. Burns, Leith. Eng. Pat. 14,441, Nov. 9, 1886. 8d.

The object of this invention is to form sulphuric acid of any required strength at one operation, by causing the chemical combination of sulphur and oxygen under high pressure. A is a cylindrical retort for burning sulphur, and C is a nitre pot. Both are placed horizontally in an oven with a fire-place F underneath them. The oven is heated, and as soon as the retorts are brought to the proper temperature, a blast of air from a blowing engine is injected into the retort A, to burn the sulphur. The sulphurous acid passes up the pipe D and down D′ into the vessel G, where it deposits any sublimed sulphur, and then up D″ into the mixer M. At the same time, the nitre in the pot C is decomposed by sulphuric acid from R and the liberated vapours pass up the pipe H into the mixer M. Atmospheric air from a blowing engine and high-pressure steam from a boiler are also blown into M. Here all the gases are thoroughly mixed, and on leaving the mixer, enter the large cylinder E, where they are deflected by the glass plate I down upon the surface of sulphuric acid contained in the basin L, whereby the vapours condense and form strong sulphuric acid, which overflows and falls to the bottom of the cylinder. The uncombined gases ascend and pass through the cup and ball agitators K, K, where the remainder of the sulphurous acid is converted into sulphuric acid and falls to the bottom. The remainder of the gases, consisting of nitrogen and nitrous acid, pass out by the pipe N into the cylinder O, which is filled with ammoniacal liquor or a solution of soda. Here they also meet a fresh supply of atmospheric air, which converts the nitrous acid into nitric acid, which in passing through the liquor forms a nitrate and, after boiling down, is used over again in the nitre-pot C. The remaining gases escape by the valve V, which can be weighed down to carry on the operation under any required pressure. Fig. 2 shows the construction of the ball and cup agitator. Z shows one of the balls forced up by the gas and the arrows show the direction the gases take in passing through the cups. The constant rising and falling of the balls keeps up a continuous agitation. In manufacturing on a large scale, three combining cylinders, E, are employed and in place of the sulphur retort, a vertical retort for burning iron pyrites is substituted. The specification contains illustrations of this and other modifications.—S. H.

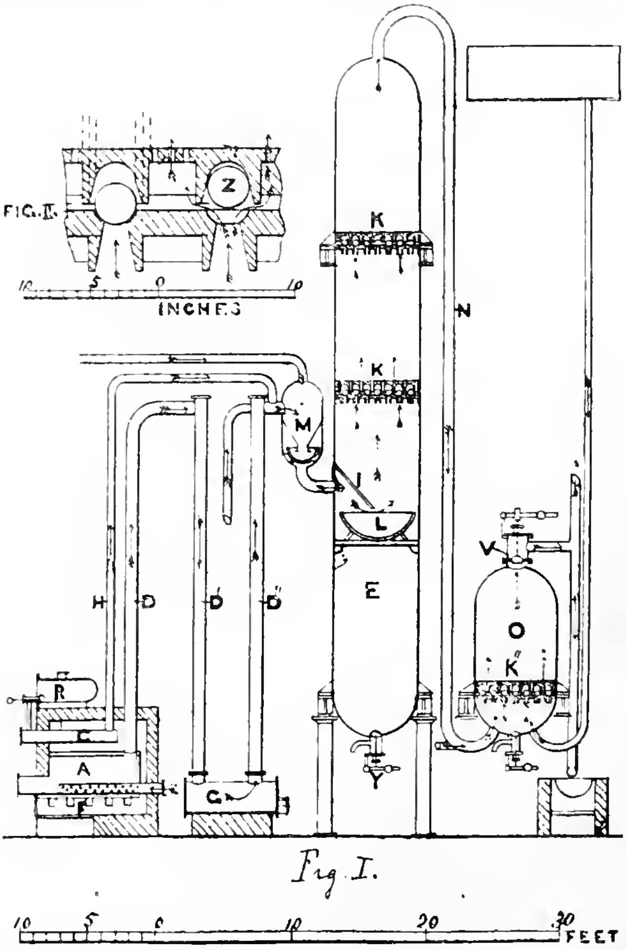


Fig. I.

Crystallisation of the Alkalis from Alcohol. C. Göttig. Ber. **20**, 1907—1908.

The author reserves the previous formulæ of his new hydrates of potassium and sodium hydroxide for further revision, as the substances were obtained from aqueous alcoholic solution and may contain alcohol of crystallisation.—J. B. C.

An Improved Apparatus for Using Liquid Carbonic Acid in Large Quantities. O. Brünler and C. G. Rommenhöller, Rotterdam, Holland. Eng. Pat. 9048, June 25, 1887. 6d.

In using liquid carbonic acid in large quantities out of the usual portable flasks, inconveniences occur owing to the supply of heat from outside being too small, as compared with the absorption of heat through the expansion of the liquid carbonic acid. In consequence, the gas inside the flask and passages in connection therewith, becomes "torpid," and causes obstacles in the working as well as danger. In order to do away with these drawbacks, the inventors fix a number of flasks in a frame and connect their outlet valves with a common gas-pipe, which lead to a small gas-holder.—S. H.

An Improved Apparatus for Impregnating Water with Carbonic Acid. T. R. Shillito, London. From C. G. Rommenhöller and O. Brünler, Rotterdam. Holland. Eng. Pat. 9994, July 16, 1887. 6d.

This invention is designed for application in conjunction with a "La Chapelle" apparatus for impregnating water with carbonic acid. Its object is to render unnecessary the mechanical power for driving the mixing machine by doing this with the driving force of the water to be impregnated. Carbonic acid from a gasholder and water from a well is drawn or forced by a pump into the mixing vessel. The latter usually contains an agitator driven from the main shaft, but according to this invention, a cylinder fitted with a small turbine, the shaft of which is provided with agitating blades, is placed underneath the mixing vessel, the turbine being driven by the partially-mixed carbonic acid and water passing to it through a pipe. When both are thoroughly mixed together, the water passes out into a collecting vessel.
—S. H.

The Present Position of the Leblanc and Ammonia-soda Industry. R. Hasenclever. Chem. Ind. **10**, 290.

In the last few years the consumption of sodium carbonate has steadily increased, but this increase has been exclusively supplied by alkali made by the ammonia soda process. In Germany 75 per cent., in France 60 per cent., in Austria 47 per cent., and in Great Britain 22 per cent. of the total production of alkali is made by this latter process. At the present time, 150,000 tons of 100 per cent. sodium carbonate are annually produced in Germany, compared with an output of 42,500 tons in 1878. Germany now produces more than its requirement, and although a small quantity has even been exported, the author thinks the export cannot be kept up permanently, as the raw materials for the manufacture of alkali are cheaper in Great Britain, which has also a better geographical situation for export. Since 1878, the price of alkali has decreased from £10 to £4 per ton. Previously 100kilos. of hydrochloric acid were calculated as costing 1 mark (1 shilling), but this price is too low at the present selling price of alkali. Consequently, certain branches of industry, which required a large amount of hydrochloric acid, as, for instance, Mond's or Schaffner's sulphur recovery process, had to be discontinued. The Rhenania Co. of Aix-la-Chapelle then tried to extract the sulphur from vat waste by Opl's process—viz., to drive out sulphuretted hydrogen by carbonic acid, and to use the former for the dissolution of more vat waste. Pure carbonic acid gas worked satisfactorily, but a mixture of 28 per cent. CO_2 and 0·5 per cent. to 1·3 per cent. O—gases from lime kilns—gave a bad result, as the oxygen proved troublesome, forming hyposulphites. It is the intention of the Rhenania Co. now to try H. v. Miller and Opl's modification, by which vat waste is first converted into calcium sulphhydrate, which latter is decomposed by steam into calcium hydrate and sulphuretted hydrogen, thus:

$$CaS + H_2S = CaS_2H_2.$$
$$CaS_2H_2 + 2H_2O = CaO_2H_2 + 2H_2S.$$

If this process could be cheaply carried out, a great advantage would result to Leblanc soda works. The competition between the two processes has lately become more acute, since the great depreciation of ammonia compounds, as well as improvements in apparatus, have been of the greatest benefit to the ammonia soda maker. In addition, the utilisation of the by-products of the ammonia soda industry is not lost sight of. Solvay has worked out his process of decomposing calcium chloride by silica so far, that the price of hydrochloric acid must not exceed a certain limit, whereas Mond experiments incessantly on the manufacture of chlorine from ammonium chloride. At present, nothing is known about the commercial value of these experiments.—S. H.

A Method of working up Stassfurt Potash-salt Liquors containing an excess of NaCl. H. Fischer. J. Prakt. Chem. **36**, 222—224.

It is well known the solubility of KCl and K_2SO_4 in water increases much more rapidly with temperature than that of NaCl; that the sulphates of potassium and sodium are less soluble in cold water than the chlorides; and lastly, that the solubility of all these salts, with the exception of KCl, is diminished by the presence of $MgCl_2$. Upon these facts is based the following method of working up liquors containing little potassium but much common salt; it has been found to work well in practice.

Mother-liquors rich in magnesium chloride are added until the quantity of $MgCl_2$ in solution is about one quarter the amount of NaCl. This produces immediately a partial precipitation of the common salt; and if the mixture is concentrated in a vacuum-pan below 100°, a further quantity of salt separates out, while the other chlorides and sulphates remain in solution. The salt thus obtained is fine-grained and contains 96—98 per cent. of NaCl. The liquor is boiled down to such a point that on cooling to the temperature of the air, all the potassium chloride remains in solution while the sulphates of potassium and magnesium crystallise out. The potassium chloride is recovered, partly as such and partly as artificial carnallite, by boiling down this and the successive mother-liquors in open pans. During this concentration the common salt still in solution separates out, together with a low percentage of sulphates: as soon as KCl begins to crystallise out the heating is stopped and the liquor transferred to the crystallising vats. The potassium chloride thus obtained is free from sulphuric acid.—D. E. J.

The Reaction between Sulphites and Nitrites. E. Divers and T. Haga. Ber. **20**, 1992—1996.

Claus and Fremy found that potassium sulphite gives with potassium nitrite, among other products, a salt $HON(SO_3K)_2$, which on heating yields $HONHSO_3K$ and $HKSO_4$. The authors have investigated the reaction with other nitrites and sulphites.

Silver and mercurous nitrite and SO_2 in excess yield sulphites, and NO and H_2SO_4 are formed; also after boiling, hydroxylamine may be detected. If, on the other hand, the solution is allowed to stand several hours without boiling, no hydroxylamine is formed.

Sodium nitrite and sulphurous acid yield NO and H_2SO_4, and also hydroxylamine. In the cold and with an amount of SO_2, just sufficient to decompose the nitrite, hydroxylamine is not formed but only after boiling. Sodium nitrite and sulphite solutions, when mixed, acidified and boiled, give hydroxylamine; with 1 molecule of $NaNO_2$ and 2 molecules of Na SO_3 almost the whole of the N present is converted into hydroxylamine. The solution of the two salts must be slowly acidified. Sodium metasulphite $Na_2S_2O_5$, when added to a solution of $NaNO_2$, acidified and boiled, yields hydroxylamine, and appears to be the best salt for the purpose.

Raschig has shown that potassium hydroxylamine sulphonate on boiling gives hydroxylamine. The authors recommend the use of the sodium salts in this reaction as being cheaper. These salts yield sodium hydroxylamine sulphonate, and also sodium amine sulphonate. On mixing the sulphite and nitrite the solution becomes alkaline, and absorbs CO_2 readily. In presence of CO_2 the reaction goes on with the formation of the amine-sulphonates, and after acidifying and boiling hydroxylamine may be detected in the solution.—J. B. C.

VIII.—GLASS, POTTERY AND EARTHENWARE.

Improvements in Machinery for Working Glass. E. H. Pearce, Birmingham, and H. Besson, London. Eng. Pat. 12,148, Sept. 24, 1886. 11d.

There are five claims in this patent, referring to machinery for grinding spectacle and similar glasses, to an arrangement for holding and manipulating large sheets of glass so that the edges may be "trued," bevelled, etc., and to other matters, detailed at considerable length in the specifications.—E. G. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS AND CEMENTS.

Blast Furnace Slag and Portland Cement. Knapp. Dingl. Polyt. J. **265**, 184–186.

THE author has recently observed a peculiar property possessed by blast furnace slag which he considers worthy of publication, seeing that the utilisation of slag for the production of hydraulic mortar is creating greater interest daily. In experimenting with Harzburg slag it was found that on digesting it with magnesium or ammonium chloride a considerable quantity of the lime was dissolved, whilst the silica remained unaltered. Portland cement exhibited the same property, magnesium chloride extracting from 14 to 18 per cent. of lime without absorbing even traces of silica. From these facts the author infers that both blast furnace slag and Portland cement contain free lime, which is taken up physically by the silica, thus forming a homogeneous mixture, the absorption in the case of cement taking place during the process of cementation, whilst with blast furnace slag the absorption is effected by solution during the operation of fusion.—D. B.

Sugar as a Cement. Herzfeld. Ztschr. f. Zucker-Ind. **37**, 499.

MORTAR containing sugar has been employed in building the new Natural History Museum in Berlin and has proved far superior to common mortar. It sets almost with the firmness of a good cement, while mortar made with molasses became soft and brittle after a time. In Madras a mortar is used with which either sugar, butter or buttermilk, shellac and eggs are mixed. It holds well and takes a marble-like polish—C. A. K.

Improvements in Making Portland Cement. A. Smith, J. Robertson and J. R. Andrew, Glasgow. Eng. Pat. 7539, May 25, 1887. 4d.

CLAY is taken as dug from the pit, without being dried, and mixed with the usual proportion of lime, a portion of which is used as limestone, the remainder as freshly-burnt lime. The burnt lime is first added in such proportion that the water in the clay exactly suffices to slake it and the heat given out effects the necessary drying. The limestone is then added and the mixture ground in a mill to the usual degree of fineness, made into bricks, calcined and the "clinker" reduced to a fine state of division as usual.—C. C. H.

Improvements in the Application of Various Inflammable Fluids and Substances to all kinds of Materials requiring High Temperatures in their Manufacture. R. Stone, London. Eng. Pat. 9458, July 21, 1886. 6d.

IN the manufacture of plastic and other materials, such as bricks, lime, gypsum, tiles, pottery, cement, etc., petroleum spirit, petroleum, tar or any other highly inflammable liquid, and vitriol are used, according to this invention, either together or separately as substitutes for ordinary fuel, such as coals or coke. Fibrous materials, as peat, sawdust, tow, hemp, old rope and refuse cotton waste, may be used for the absorption of the liquid fuels, which are sometimes also employed in the form of a spray thrown upon the incandescent mass. By the use of this invention, almost all kinds of refuse, including dust, coal dust, breeze cinders, ashes, clinkers, sewage and other materials, either ground or compressed, may be utilised.—E. G. C.

X.—METALLURGY, Etc.

Development of Ammonia in Working Iron. H. Wedding. Stahl and Eisen, **7**, 513.

G. W. GÖTZ, of the Otis Iron and Steel Company, Cleveland, Ohio, noticed that when a freshly-cast steel roller was broken, there was such a strong ammoniacal smell that it annoyed the workmen. The same thing occurred with an iron casting; this was only perceptible in great masses. It was specially perceptible when the steel contained 0·3 per cent. of carbon, 0·2—0·3 per cent. of silica and 0·9 per cent. of manganese.—W. E.

On Gautier's Investigations on Ferro-silicon and Iron Suitable for Foundry Purposes. H. Wedding. Stahl and Eisen, **8**, 562.

THE object of Gautier's investigations (this Journal, 1886, 606) was to dispense with the Scotch pig-iron, which was employed by French ironfounders as an addition to the different kinds of iron used for castings. The Scotch pig-iron was replaced by ferro-silicon, containing 10 per cent. of silicon, and it was shown that the favourable influence of the Scotch pig-iron on certain castings was due to the presence of silicon. A repeated heating and fusion of the iron oxidises the silicon and converts the graphite into amorphous carbon, and in order to maintain the chemical composition of the iron mixture, silicon must be added in some form. A mixture containing 2 per cent. of silicon is specially suitable for dense castings, as it prevents the formation of flaws. Owing to the application of ferro-silicon, the annual consumption of Scotch pig-iron in France has decreased from 200,000 tons to 20,000 tons. Wedding opposes Gautier's proposal on the point of economy. Since every iron mixture contains iron peroxide a portion of the silicon is used for the reduction of the peroxide, and this is evidently a waste of such an expensive article as silicon. Carbon is much cheaper as a reducing agent. Indeed, practical working has shown that the addition of the theoretical amount of silicon is insufficient; a larger or smaller excess, according to circumstances, is always required. As 10 per cent. ferro-silicon costs 97½ marks and 15 per cent. ferro-silicon costs 157½ marks, the author advises ironfounders to calculate carefully whether it is economical to replace pig-iron by ferro-silicium.—S. H.

Operating on Zinc Ore for Producing Chlorine, also Zinc, and the utilisation of said Zinc for Coating Metals Galvanically. J. Lea and H. R. Hammond, London. Eng. Pat. 10,868, August 25, 1886. 4d.

ZINC ORE (calamine) is treated with hydrochloric acid or an aqueous solution of chlorine and the solution of zinc chloride thus formed submitted to electrolysis. The zinc is deposited upon metals as a coating, or articles in zinc may be moulded by deposition, while the chlorine is used for operating upon fresh quantities of calamine.
—S. H.

Improvements in Machinery and Appliances for Treating, Dressing and Cleaning Tin and other Mineral Ores, and in Modes, Means and Processes connected therewith, and for other useful Purposes. G. M. Edwards, London. Eng. Pat. 12,729, Oct. 6, 1886. 11d.

THIS is a development of the sizing apparatus of Eng. Pat. 6347 of 1885 (see this Journal, 1886, 328). A series of vertical cylinders are so placed on an inclined plane or on steps, that the overflow from each cylinder is conducted into the bottom of that one next on the lower level. The first, or highest, of the series has a funnel connected with a large aperture at the lowest point on one side, and through this the slimes are introduced. It has also a telescopic cylinder, closed at its upper end, working within it at the upper part, the joint being rendered water-tight by an india-rubber ring; the object of this contrivance being the accumulation of water in the cylinder at will, to a level much higher than that in the next vessel. Each cylinder is supplied also with a four-arm radial agitator, working on the bottom; the agitator in the first being rotated, while those in the others are simply oscillated by an eccentric and crank movement, the motion imparted to each being less than that to the previous

one. Slimes are allowed to flow into the highest vessel to the full extent of the telescopic lining. The action of the beaters is suspended for a few seconds, and then a release of the inner cylinder causes a rapid overflow from the top of each pan to the bottom of the next throughout the whole series. The gradual diminution in rapidity of flow, coupled with the decreasing agitation in each successive cylinder, causes an efficient sizing of the ore. An automatic siphon arrangement may be substituted for the telescopic lining. After sufficient ore has collected in each vessel, it may be removed by any suitable sliding door, and may then be still further sized by passing alternately over and under partitions in a series of stepped chambers, in a continuous stream of water.
—W. G. M.

Improvements in Apparatus used for Coating Sheets of Iron and Steel, and Articles of Iron and Steel, with Zinc or Alloys of Zinc, or other Coating Metal or Alloy. R. Heathfield, Birmingham. Eng. Pat. 13,460, Oct. 21, 1886. 8d.

In addition to the brushes specified in Eng. Pat. 8390 of 1886 (this Journal, 1887, 512), a pair of revolving finishing brushes, preferably made of fine wire, similar to scratch brushes, is placed above the former for the purpose of surfacing the plate after coating. More than one pair of such brushes may be used and they may be employed in addition to, or in lieu of, the finishing rolls.
—W. G. M.

XI.—FATS, OILS AND SOAP MANUFACTURE.

Improvements relating to the Separation of Fat and Fatty Acids from Compounds containing the same. Wilhelm Graff, Bremen, Germany. Eng. Pat. 11,741, Sept. 15, 1886. 6d.

In treating water from wool-washing works, neutral calcium chloride is usually added, thereby precipitating large quantities of calcium carbonate. The inventor uses an acid solution of calcium chloride and to the precipitate obtained he adds caustic lime, in order to obtain calcium salts of the free fatty acids and of those combined with cholesterin or an alkali. This lime soap is dried on a steam bath, the non-saponifiable fats are extracted by benzine, etc. and the residue decomposed by hydrochloric acid.—W. L. C.

Improved Apparatus for Treating Waste Lubricating Oils. J. Stott, Bolton. Eng. Pat. 13,765, Oct. 27, 1886. 8d.

This is a description, with drawing, of an apparatus with cisterns, provided with sieves and water-gauges, through which the mixture of oil, water, metallic refuse, etc., is passed. The refuse is kept back by the sieves, the oil and water are separated by subsidence and the oil is used over again.—W. L. C.

XII.—PAINTS, PIGMENTS, VARNISHES AND RESINS.

On Cadmium Sulphide and the various Cadmium Colours of Commerce. G. Buchner. Chem. Zeit. **11**, 1087—1089, and 1107—1109.

Led by the great diversity of shades among the commercial cadmium colours, and the almost complete absence of reliable text-book information concerning them, the author has experimented with the different pigments and the methods employed in their production. When hydrogen sulphide is led into a neutral cadmium sulphate solution, the slight yellow cloudiness at first produced rapidly changes to a lemon-yellow precipitate; but when half of the metal has been thrown down, this precipitate darkens in colour until eventually it is of a dark Pomeranian or red-yellow shade; meanwhile about the period of half-precipitation a dark yellow scum forms on the surface, and there is a red ring around the margin and within the gas-tube; a small quantity of cinnabar-red, heavy, pseudo-crystalline powder collects also on the walls of the vessel. The precipitate after washing and drying may be separated by washing into a light and a dark coloured portion. But by filtering off the precipitate at half time, the collected portion darkens a little on drying, and the filtrate yields only the darker variety of sulphide. If the solution is warm or contains free acid before treatment (and Follenius has shown[*] that as much as 14% of 1·12 sp. gr. HCl may be present without hindrance to precipitation); the yellow stage is but evanescent, giving place immediately to one in which the colour is completely a full red. By using a different soluble salt of cadmium, a slight variation in shade will result; but an insoluble salt, treated while in suspension in water, always gives the dark product. The presence of neutral salts (NaCl, etc.) in the solution is without influence. But all these precipitates without exception are practically pure cadmium monosulphide (CdS): they contain no excess of sulphur, combined or otherwise, are similarly acted upon by reagents, are absolutely insoluble in water, and when suspended in the latter in pure condition are quite unaffected by air or hydrogen sulphide; they all, however, contain traces of the salt from which they were formed, which no amount of washing can remove and this is generally greater in the dark or red variety, in some cases amounting to even 4 per cent. of the sulphide. The chloride is the most obstinate in this respect, and may be removed only by prolonged heating in hydrogen sulphide; the small quantity of sulphur then deposited may be extracted by carbon bisulphide. Follenius suggested that this trace of undecomposed salt may effect the various colour alterations; but this is disproved by the fact that one finds similar shades with different percentages of impurity, and varying colours with the same quantity of foreign matter. The yellow is specifically much less dense than the dark variety, but in no sample has the author found any trace of structure or crystalline arrangement. He is convinced that there are two modifications only of the cadmium sulphide, one of a pure lemon yellow, the other of a full minium red colour; and that all the shades producible in the laboratory or obtainable in the market are mixtures of these two varieties in varying proportions. The alteration is simply molecular, the darker product being produced from the lighter by the condensation or aggregation of the molecules; so that to obtain a given modification, this aggregation must either be made as complete as possible or be prevented entirely. The yellow (or α-modification) is converted into the brown by the action of dilute acids or alkalis, and the more readily if it be *in statu nascendi*; hence, since by the action of hydrogen sulphide on a neutral cadmium salt a mineral acid is gradually generated in the solution, it is easy to comprehend why at a certain stage of the precipitation an aggregation of molecules is brought about. The red (or β-modification) becomes yellow for a moment immediately before solution in strong acids; and the interconvertible character of the two varieties may be observed by treating 1grm. of the red sulphide in a reagent glass with 1grm. of water and 3—5cc. HCl (1·124 sp. gr.) until it becomes yellow, and solution commences with evolution of SH_2; by then throwing the whole very rapidly into a large volume of cold water the β- will be found to have changed into the α-modification, and the reverse change will then gradually take place, owing to the presence of the diluted acid. The recorded formation of a CdS_5 described in Gmelin's hand-book as produced by the addition of potassium pentasulphide to neutral cadmium sulphate, is an error originated by Schiff (*Ann. d. Pharm.* **115**, 74). K_2S_3 and K_2S_5 produce respectively with $CdSO_4$ rapidly-subsiding sulphur-or-lemon-yellow precipitates, which become slightly red on complete precipitation, owing to the partial aggregation caused by a trifling excess of the potassium salt; a large excess causes re-solution of the cadmium compound. The pigment thus made is wanting in brilliancy; it consists of cadmium monosulphide with a variable excess of sulphur, extractable by carbon bisulphide and separable on treatment with hydrochloric acid. In regard to this

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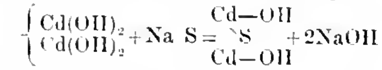
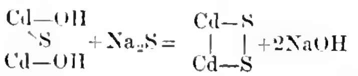
[*] "Contributions to the Knowledge of Cadmium, especially to the Quantitative Analysis of the same," Zeits Anal. Chem. 1874, Bd. 13.

precipitate, it is most important to note that, whilst the pure CdS, either in the α- or β-modification, is absolutely unaltered by light or air, all those products which contain free sulphur, finely divided by precipitation, become so completely oxidised when exposed to light, that the yellow colour passes in a short time into a dirty white, whether it be dry or moist, but most rapidly if rubbed down with linseed oil. This oxidation does not occur in the dark, nor can it be effected in any degree by mixing flour of sulphur with the monosulphide; it must be traced to the oxygen-carrying power of the precipitated sulphur, which is in this case so intimately mixed with the cadmium sulphide, and which is assisted greatly in its action by the oil—itself apparently not inactive as a carrier of oxygen. From these facts one may learn how great care should be expended in the choice of colours to ensure permanence, and how vast an influence may be possessed by an apparently insignificant impurity. The statement to be found in technological hand-books that the finest cadmium colours are made by the action of sodium monosulphide on the neutral sulphate, although apparently supported by theoretical considerations, since no free acid is formed in their production, is not borne out by the author's experience. Dilute cadmium solutions so treated give a bright yellow, concentrated solutions a dark yellow or red, and boiling solutions a brick-red precipitate. They are free from excess of sulphur, but will contain cadmium hydroxide or basic carbonate if sodium hydroxide or carbonate be present in the precipitant. The hydrosulphide behaves similarly. Cadmium hydroxide, like the sulphide, appears to exist in two modifications; and the action of hydrogen or sodium sulphide on these will produce a precipitate, coloured yellow or red according as the hydroxide is in the form of a bulky gelatinous precipitate (α-modification) or is heavy and finely flocculent (β-modification). The former of these may be produced by adding a solution of sodium hydroxide to one of a cadmium salt, the latter either by adding the cadmium solution to the caustic soda or by precipitating in boiling solutions. It would appear that the β-modification, with the red colour, is always the result of molecular aggregation; and this view is supported by the fact that an oxysulphide, $CdS.Cd(OH)_2$, which is formed when cadmium hydroxide is precipitated by sodium monosulphide (avoiding an excess of the latter), and which, of course, contains a double molecule, is of a red colour. This oxysulphide is regarded by the author as an intermediate stage in the production of the sulphide from the hydroxide, thus:—

$$(1.)\quad Cd(OH)_2 + Cd(OH)_2 = \left\{\begin{array}{l} Cd(OH) \\ Cd(OH)_2 \end{array}\right.$$

(2.) 

$$\left\{\begin{array}{l} Cd(OH)_2 \\ Cd(OH)_2 \end{array}\right. + Na\ S = \begin{array}{l} Cd-OH \\ \quad \diagdown S \\ Cd-OH \end{array} + 2NaOH$$

(3.) 

$$\begin{array}{l} Cd-OH \\ \quad \diagdown S \\ Cd-OH \end{array} + Na_2S = \begin{array}{l} Cd-S \\ \,|\quad\;\; | \\ Cd-S \end{array} + 2NaOH$$

It has a very fine red colour, of great brilliancy, but is less permanent than the sulphide when rubbed with oil; it dissolves completely in hydrochloric acid and gives up its oxide to acetic acid. The basic carbonate in its transformations resembles the hydroxide. The behaviour of cadmium sulphide at different temperatures is worthy of remark. It is quite non-sublimable, but maintained in air for some time at 135—140° C., it becomes superficially and only to a very slight extent, oxidised, losing at higher temperatures 2—3 per cent. of its weight partly by oxidation, partly by the loss of the acid of the trace of co-precipitated cadmium salt. As the temperature rises, the yellow modification gradually passes through dark yellow, orange and crimson to dark violet red, and on cooling returns through the same shades to its original colour; the red variety undergoes a similar play of colours, but on cooling becomes yellow, showing that the molecular aggregation has been dispersed. The final yellow is seldom a pure shade, but becomes tinged slightly with the brown of the oxide. There are a few varieties of the red sulphide which return to the original red except after long-continued or repeated heating; and a few α-modifications which become orange on cooling after protracted exposure to an even temperature without access of air.

Finally the author classifies cadmium pigments into three groups. (1.) *Pure Cadmium Colours.*—The best are those pure monosulphides produced, it may be in various physical modifications, by the action of hydrogen sulphide on cadmium solutions. They are unaffected by the media of the oil or water-colour artist, though less suitable for mixture with water-glass. Rubbed with linseed oil they undergo no appreciable alteration, even after a two years' exposure to light and air; even rancid oil of the worst description produced but a slight darkening. (2.) *Impure Cadmium Colours.*—Every trace of free acid or matter extractable by water, but above all of free precipitated sulphur, renders a sample unsuitable for use as a pigment. Impurities from the materials employed in manufacture, and cadmium hydroxide, carbonate, oxalate or phosphate must also be absent. (3.) *Adulterated Cadmium Colours.*—Flour of sulphur is believed never to be used for adulteration, nor has the author met with vermilion in the red pigments. The chief adulterants appear to be zinc oxide, sulphide and carbonate and cadmium oxide, carbonate, phosphate and oxalate; and these may amount to over 50 per cent. of the substance, A sample of colour for use as a pigment must satisfy the following tests, applied in each case to about 2grms. of colour:—(*a.*) HCl should effect complete solution, with evolution of SH_2, to a clear, or at most opalescent, liquid, which must give a yellow or orange precipitate with SH_2, and the filtrate from this must give no cloudiness with excess of NH_3 and $(NH_4)_2S$. An addition of ammonia in excess, and afterwards of calcium chloride, must produce no turbidity, nor must CS_2 extract more than the merest trace of sulphur. (*b.*) The moist CdS must be neutral to litmus, and digested with water, the solution must remain quite clear on the addition of $AgNO_3$ or $Ba(NO_3)_2$ (*c.*) The loss on heating must not exceed 3 per cent.; and after heating on platinum foil the residue must be red, yellow or orange-yellow, but never brown-tinged when cold. . The extract by acetic acid (1·06 sp. gr.) must not become turbid with KOH. (*d.*) After digestion with NH_3, the filtrate must be quite clear on the addition of an excess of HCl. (*e.*) They must be quite odourless, and if for use in oil-painting, absolutely dry—losing nothing at 100° C.

—W. G. M.

The Identity of Dambose and Inosite. Maquenne.

Compt. Rend. **104**, 1853.

In a series of researches on the composition of the juices of different plants yielding indiarubber, M. A. Girard has distinguished three new principles, "Dambonite," "Bornesite," and "Matezite," which he extracted from the gums of Gaboon, Borneo and Madagascar (*Compt. Rend.* **67**, 820; **73**, 426; and **77**, 995). These bodies behave as the methyl ethers of *dambose*, *Borneo-dambose and matezdambose*, a special variety of saccharine substances, non-reducible, non-fermentable, and which Girard has isolated by decomposing their methylic derivatives with hydriodic acid. Thus methylic iodide was disengaged. Having occasion to study a remarkable sample of pure *dambonite*, furnished him by the firm Billault and prepared according to Girard's prescription used for the caoutchouc of Gaboon, the author now finds a complete identity between *dambose* and *inosite* (*Compt. Rend.* **104**, 225). *Dambonite* may, perhaps, be considered as the dimethyl ether of inosite. Hence, there is no longer any need of retaining the name "dambose," since it is absolutely identical with the *inosite* contained alike in the vegetable and animal economies.—C. A. K.

Caoutchouc Yielding Plants. T. T. P. B. Warren.

Jour. Soc. Arts. **35**, 787—788.

After some brief remarks on the sources of the rubbers known as "Ceara," "Pernambuco," and "Mangaubeira," a description is given from the *Moniteur Officiel* (Feb. 1887) of the method for extracting caoutchouc from the *Sonchus oleraceus.* The plant is exhausted with carbon bisulphide and the residue obtained on evaporation treated with boiling alcohol. The insoluble matter, which is crude caoutchouc, is purified by warming with alcoholic potash and washing well with warm diluted alcohol. The yield is 4·13 per cent. of extractive matter, 0·41 per cent. of crude caoutchouc, which gives 0·16 when purified. An alternative process is to treat the plant with alcohol and then with benzene. After evaporating the solution, the residue (92 per cent. by weight of the whole plant) yields 0·27 per cent. of nearly pure caoutchouc on treatment with alcohol.—E. E. B.

XIII.—TANNING, LEATHER, GLUE AND SIZE.

Improvements in the Manufacture of Liquid Cement or Gum. E. M. Knight and A. H. Hobson, London. Eng. Pat. 13,168, Oct. 15, 1886. 6d.

To make one gallon of the gum about one and a half gallons of water, 3lb. of glue, 4oz. of borax and 2oz. of carbonate of soda, or an equivalent of any other alkali, are taken. The glue and alkaline salts are dissolved in the water by heat, and the solution is kept at a temperature a few degrees below boiling point for 5 or 6 hours. The continued application of heat renders the gum permanently liquid at the ordinary temperature. After allowing the sediment to settle, the clear liquid is evaporated to the required consistency.—B. H.

Improvements in Purifying and Graining or Bating Hides and other Skins, and in Apparatus Employed therein. T. Palmer, Bermondsey. Eng. Pat. 13,636, Oct. 25, 1886. 8d.

The patentee first describes the ordinary process of "bating" or "graining" hides, by means of a solution of pigeon or other birds' dung in water, and the use of the "new grainer," "mended grainer" and "old grainer." He then describes his improvements, by which he claims that a much larger number of hides can be "grained" in proportion to the amount of dung employed. Before submitting the hides to the action of the grainers, they are placed in a revolving drum and rinsed with water (preferably soft), at a temperature of about 70° F. The drum is rotated for about an hour. This rinsing removes a large proportion of the lime, so that the subsequent action of the grainers is to soften the hides. The hides are next stocked for 20—30 minutes, and are then submitted for about 45 minutes to the action of an old grainer. The hides, after draining, are then placed in a new or mended grainer. To make a new grainer, instead of placing the dung in the pit itself, the patentee places about 3 bushels of dung in a separate vessel and mixes it with about 130 gallons of water. The strong solution, after straining through a suitable sieve, is run into a grainer pit containing 900—1000 gallons of water. "A further improvement and economy" is effected by covering in the grainer pit, instead of leaving it open. For this purpose it is provided with a roof having one or more doors, for the introduction or removal of the hides. Drawings are given showing a grainer pit and drum, the pit provided with a roof as described.—B. H.

XIV.—AGRICULTURE, MANURES, Etc.

Examination of Beetroot Seeds. Pagnoul. Sucr. Indigène, 30, 68.

The quantities of phosphoric acid contained in sixteen varieties of seeds were determined and compared with the amount of sugar in the beets grown from them, with the result that no relationship between the two was evident.—C. A. K.

Agricultural Experiments on the Behaviour of Certain Plants towards the addition of Nitrogen as Saltpetre. G. Wolf and Kreuzhage. Landw. Jahrb. 1887, 16, 659.

From a series of experiments the authors conclude that cereals only grow well when the soil offers a sufficient quantity of nitrogenous nourishment, partly in the form of saltpetre. This also applies to potatoes, which need a considerable amount of nitrogenous matter, and in both cases the addition of manure containing nitre proved advantageous. Leguminous plants, on the other hand, did not appear to be influenced by the use of saltpetre manure, but they were found to have assimilated a large amount of nitrogen even after five months' growth in a soil containing little or no nitrogenous food. This assimilation of nitrogen by leguminous plants in cases where it is not supplied by the soil, appears extraordinary, and the authors suggest that it may be absorbed as ammonia from the air by the leaves or indirectly from the soil, which has itself absorbed the ammonia from the air; or, as may be possible in the case of a dry soil, the plants, owing to the presence of limestone, assimilate the free nitrogen of the air.—C. A. K.

Effect of the Manure used for Beetroot. Hellriegel. Ztschr. f. Zucker Ind. 37, 543.

The author finds that beetroot is more liable to decay on keeping when a phosphoric acid manure has been used, than when one containing Chili saltpetre has been employed and that this is especially the case when the beet is preserved under conditions of great heat and continued dryness.—C. A. K.

Action of Phosphoric Acid in Various Forms. Pommer. Ztschr. f. Zucker Ind. 37, 547.

The author compares the relative efficiency of superphosphate and Thomas slag as manures, and considers that while for the present superphosphate is of greater use, still further experiments should be made with Thomas slag, which appears to have the advantage that its effect is more lasting. When used the slag should be finely ground and evenly spread as early in the year as possible. It is specially good for moist and marshy land.—C. A. K.

On the Behaviour of Thomas Slag under Treatment with an Aqueous Solution of Carbon Dioxide. M. A. von Reis. Chem. Zeit. 11, 933—934 and 981—982.

These experiments are a continuation of others (see this Journal, 1886, 381), and are in reply to v. Maltzahn, who discredits the previous experiments in affirming the relative insolubility of phosphates in slags which have undergone igneous fusion. Eighteen phosphates have been treated and the results are recorded in tabular form. 10grms. of the finely powdered sample were exposed in a funnel to a flow of the carbonic acid water, at the rate of $\frac{1}{3}$ litre per hour. Tests made at regular intervals with one slag showed that the ratio of silicates to phosphates passing into solution corresponded fairly well with that in the original sample; that comparatively little silica or phosphoric acid are removed after 25 litres have passed; but that a somewhat greater proportion of lime was extracted even up to 50 litres. The decompositions are stated respectively as follows:—

$$Ca_4P_2O_9 + 6H_2CO_3 = CaH_4(PO_4)_2 + 3CaH_2(CO_3)_2 + H_2O.$$

$$Ca_2SiO_4 + 2H_2CO_3 = CaSiO_3 + CaH_2(CO_3)_2 + H_2O.$$

The remaining slags and compounds were examined only after passing two successive quantities of 5 litres each. Considerable differences appear in the relative solubilities of the phosphates—*i.e.*, the amount of phosphate dissolved as compared with that in the fresh sample—which are explained as arising from different combinations of the phosphoric acid. Thus, it was found that 42·1 per cent. of the phosphoric acid in calcium tetraphosphate were dissolved, while only 12·5 per cent. were extracted from the tri- and 16·8 per cent. from the diphosphate; bones (containing organic matter) yielded 28·5 per cent., bone ash, 5·5 per cent., and apatite, 3·1 per cent., the slags giving from 23 to 48 per cent. in the 10 litres. The silica thus extracted (relatively) from the slags varied from 50 to 85 per cent., the total lime from 40 to 57 per cent. The bulk of the magnesia appeared to be left in the undissolved residue. The experiments tend to confirm the accepted theory that the phosphorus in "Thomas" slags is present actually as tetraphosphate, and not as a mixture of triphosphate with free lime. The first action of aqueous carbon dioxide on tetraphosphate is to dissolve out any excess of CaO (if pre-existing) and then, after about 5 litres have passed, to extract the CaO and P_2O_5 in the constant ratio of 4 : 1, whereas the above mentioned mixture would continue to yield the lime in great excess up to the point of practical exhaustion. This research has an important bearing on the manurial value of the slags in question.—W. G. M.

The Phosphatic Deposits of Santa Maria di Leuca in Southern Italy. H. Spiodler. Chem. Zeit. **11**, 989.

THESE deposits occur between Gallipoli and Otranto, and consist of coprolites, bones, etc., embedded in a porous tertiary limestone. There are two beds, having a thickness of 19½ to 31½in. and extending for a distance of 160 yards along the shore. A phosphoric acid determination in numerous samples obtained from various parts of the bed and ground up together gave 7·4 per cent. P_2O_5 and the coprolites alone 8·7 per cent. P_2O_5. The phosphatic nodules contain a considerable amount of iron but no fluorine. How far these deposits extend inland has not yet been determined.—C. A. K.

Value of Different Varieties of Winter and Summer Wheat. A. Beseler and M. Märcker. Bied. Centr. **16**, 460—467.

IN these experiments twenty-one varieties of winter wheat and five of summer wheat were cultivated, as nearly as possible under exactly similar conditions; the yields, quality, etc., were noted, and other properties of the products were investigated. Tables of the results in detail are given, from which the following conclusions are drawn:—Large grain wheat generally contains a lower proportion of gluten than small grain. The swelling power of gluten is greatest in those cases where the amount of the gluten-nitrogen is in the greatest excess above that of the non-gluten nitrogen. It does not follow that flour richest in gluten is necessarily that containing the largest proportion of its total nitrogen in form of gluten-nitrogen. As regards baking qualities, on the average, summer wheat as compared with winter wheat contains more gluten; the swelling power of its gluten, both relative and absolute, is greater and the paste made from it is lighter, although there are varieties of winter wheat which produce lighter paste than some summer wheats. Bearded rivetts yielded the worst baking flour, although some non-bearded coarse white wheat proved good in the bakery. There is no regular relationship between baking qualities and either the quantity of gluten or the swelling power of the gluten contained in a flour; hence these factors alone are insufficient to determine the bread-making value of flour. The behaviour of these flours when mixed was not investigated.—D. A. L.

Agricultural Value of Different Varieties of Oats. O. Beseler and M. Märcker. Bied. Centr. **16**, 467—484.

SIXTEEN varieties of oats were cultivated, under similar conditions, on a warm humus loamy soil; their various valuable qualities were compared and estimated, and from the data obtained the following conclusions are drawn, which, of course, apply in main to the particular varieties and conditions of the experiments:—The best yielding varieties were Beseler's oats and oats of Swedish origin. Early maturing varieties yielded smaller crops than those varieties maturing later; the Duppauer variety was an exception, but it far exceeded all other early varieties in yield of grain. The amount of yield from the same variety in different years does not depend directly on the length of the period of vegetation. The best yielding varieties have not only the largest grains, but also the greatest number of grains to the ear. The weight per hectolitre varied from 40·8 to 56·1 kilos. in the different varieties, the smallest grained having, as a rule, the smallest weight per hectolitre. The amount of husks in the different sorts of oats varied from 22·8 to 29·9 per cent: the richest in albuminoids having the largest proportion of husk; whereas the grain poor in albuminoids had a larger proportion of its protein in the husk than grain rich in albuminoids. Only 4·5 per cent. of the nitrogen of the oats was contained in the husk, and on an average only 5·3 per cent. of the total nitrogen was non-albuminoid. The absolute germinating power was about the same in all the varieties, but the energy of germination differed considerably, generally being least in those grains containing most albuminoids; these were frequently the smaller grains which were generally richer in albuminoids than the larger grained varieties of oats, but all small grain oats are not rich in albuminoids. In the varieties cultivated, richness in albuminoids did not accompany abundance in crop-yield, in fact, the varieties yielding the smaller crops were in many cases characterised by a high percentage of albuminoids. The early varieties had a higher percentage of albuminoids than the late varieties, but the latter yielded the larger quantity of albuminoids per acre. In many cases richness in albuminoids was associated with a low percentage of fat, but there were several exceptions to this. During the season 1886 seeds poor in albuminoids also yielded crops poor in albuminoids. By Stutzer's method, 94 per cent. of the nitrogenous matter of the oats was found digestible, an amount greatly in excess of any results obtained by direct experiments with animals. The amount of nutritive matter produced per acre differs very greatly in the various kinds of oats; and from a financial point of view for every £5 value of nutritious matter obtained from the lowest yielding variety, a value of £6 10s. was got from the highest yielding variety. Hence showing the importance, in farming, of selecting a variety of oat suitable to the surrounding conditions.—D. A. L.

XV.—SUGAR, GUMS, STARCHES, Etc.

Decomposition of Cane Sugar by Boiling with Lime. W. Niedslag. Deutsche Zucker Ind. 1887, 159—160.

IN reference to the so-called "undeterminable loss" of sugar during its extraction from sugar-beet, the author shows experimentally the decomposition of sugar by boiling with lime. On boiling with lime, 250grms. of cane sugar were almost entirely decomposed at the end of twenty-one days, forming an amorphous calcium salt. Heating cane sugar for seventy-two hours with lime, strontia and baryta, respectively, caused a loss of sugar and more especially of the crystallisable portions; the baryta was most energetic in its action.—D. A. L.

A Carbohydrate contained in Acorns. C. Vincent and Delachanal. Compt. Rend. **104**, 1855.

AFTER isolating quercite from acorns by further concentrating the extract after the removal of the potassium and calcium salts as sulphates by concentration and addition of alcohol, the author found that after a good yield of quercite had been obtained, the mother liquor yielded a small quantity of large transparent crystals. These formed hexagonal prisms, contained water of crystallisation and effloresced in the air. The substance is a hexatomic alcohol and has the formula $C_6H\ (OH)$, isomeric therefore with inosite, from which however it is distinguished by its crystalline form and physical properties. It melts at 342° (inosite at 217°), its hexacetyl derivative at 301° (that of inosite at 212°) and dissolves in 66 parts of water at 15°. The author suggests the name *Quercin* for this new body.

—C. A. K.

On the Storage of Diffusion Residues of the Sugar Works, and Experiments on the Loss resulting from the same. K. Müller. Hildesheim. land-u-forstw. Vereinsbl. 1887, 1.

SATISFACTORY results have accrued from the application of Fry's sweet ensilage system to the residues of the diffusion process: these should be mixed with thin milk of lime, pressed in a Klusemann press and packed closely (now containing 20—30 per cent. of dry substance) in the silo. The silo consists of a deep pit with steep, cement-covered walls, covered airtight with roofing felt or similar material and so weighted with bricks that the ensilage matter is subjected to a pressure of 50kilos. per square foot. The pit may be opened after five months and the contents used as fodder. In an experiment recently made, 90 kilos of the shavings had lost but 1 kilo. in five months and were then eagerly eaten by the cattle.

—W. G. M.

Direct Extraction of Sugar by means of Alcohol. Zeits. f. Zucker Ind. 1887, 371.

HERZFELD has tested Trobach's patented method (see this Journal, 1884, 376), and finds it to possess the following advantages:—The direct production of refinable sugar, the concentration of nearly all the nitrogen in the molasses and the use of the shavings as a fodder. But the consumption and loss of alcohol by distillation and frequent rectification are so great as to utterly preclude the practical use of the process. Moreover, the purity of the alcoholic product is but little higher (3 per cent.) than that resulting from the use of water.

—W. G. M.

Improvement of the Press Method. Bull. Soc. Chim. 1887, 203.

BOYER has found that the impurities carried into the sap. when beet pulp is heated to 70—80° before pressing, could be retained in the pulp, not by calcium bisulphite, but by a small addition of lime (0·2 litres of milk of lime of 20° per 100 litres of water).—W. G. M.

The Quantity of Juice and Marc in abnormal Sugar Beet. G. v. Lippmann. Bied. Centr. **16**, 449.

IT is frequently asserted that sugar-beets are poor in juice when they yield their juice and diffuse with difficulty. The author, however, in common with some other investigators, finds these abnormal beets contain the ordinary amount of juice, 94—95 per cent. (see this Journal, 1887, 445). The difficulty in diffusing them (due to the peculiar swelling of the pulp-portions) may be removed by using slightly alkaline water for the extraction or by treating the sections with milk of lime.

It is shown, moreover, that the mode of extraction influences results in analysis; thus by the use of hot or cold water, of weak or strong alcohol or methyl alcohol, etc., a difference of over 1 per cent. in the quantity of marc was obtained.—D. A. L.

Estimation of Raffinose. R. Creydt and C. Scheibler. Bied. Centr. **16**, 487—488.

CREYDT is perfecting a method for the estimation of raffinose. Scheibler, taking advantage of the solubility of raffinose in methyl alcohol, has the following method for estimating it in spike sugar:—The sugar under examination is digested with a saturated solution of sugar in methyl alcohol in which the polarisation has been previously determined. If the sugar is pure no change is observed; on the other hand, raffinose, if present, dissolves and increases the polarisation of the solution. Inversion methods are, however, of greatest importance and wherever in question should be set right. Clerget found when cane sugar is polarised, then inverted by heating with acid and again polarised, that for every 100° of original right-handed rotation at 20° C., 34° of left-handed appeared; this was confirmed by Tuchschmidt. Creydt, and also Wolff, working with 3·024grms. of sugar in 50cc., with 5cc. concentrated hydrochloric acid and heating ten minutes at 68° C., then diluting to 100cc., found 32° instead of 34°, but on using the same quantities as employed by Clerget they also were able to confirm his number.—D. A. L.

Extraction of Saltpetre from the Salts from Sugar-beet Molasses in France. Bied. Centr. **16**, 485—486.

WHEN sugar-beets are heavily dressed with nitrogenous manures, nitrates are found in abundance, both in their juice and in the molasses obtained from such juice. Some molasses of this description on dialysing yielded a dialysate, which on evaporation deposited a crystalline mass of the following composition:—KNO_3, 48·90; KCl, 34·70; K_2SO_4, 1·87; sugar and organic matter, 7·96; insoluble, 0·92; water, 5·95 per cent. resp. By dissolving this mixture in hot water and cooling to 70° C., when the gravity equals 38° B., the potassium chloride crystallises and the liquid is easily removed. On further cooling the nitre is deposited and by simple digestion in a solution of nitre and whizzing, may be purified to a fineness of 90 to 98 per cent.—D. A. L.

XVI.—BREWING, WINES, SPIRITS, Etc.

Improvements in or appertaining to Compounds applicable for the Manufacture therefrom of Ale, Stout, Porter, Lager and other like Liquors; and in Apparatus for making said Compounds. E. Manbré, Garston. Eng. Pat. 12,291, Sept. 28, 1886. 8d.

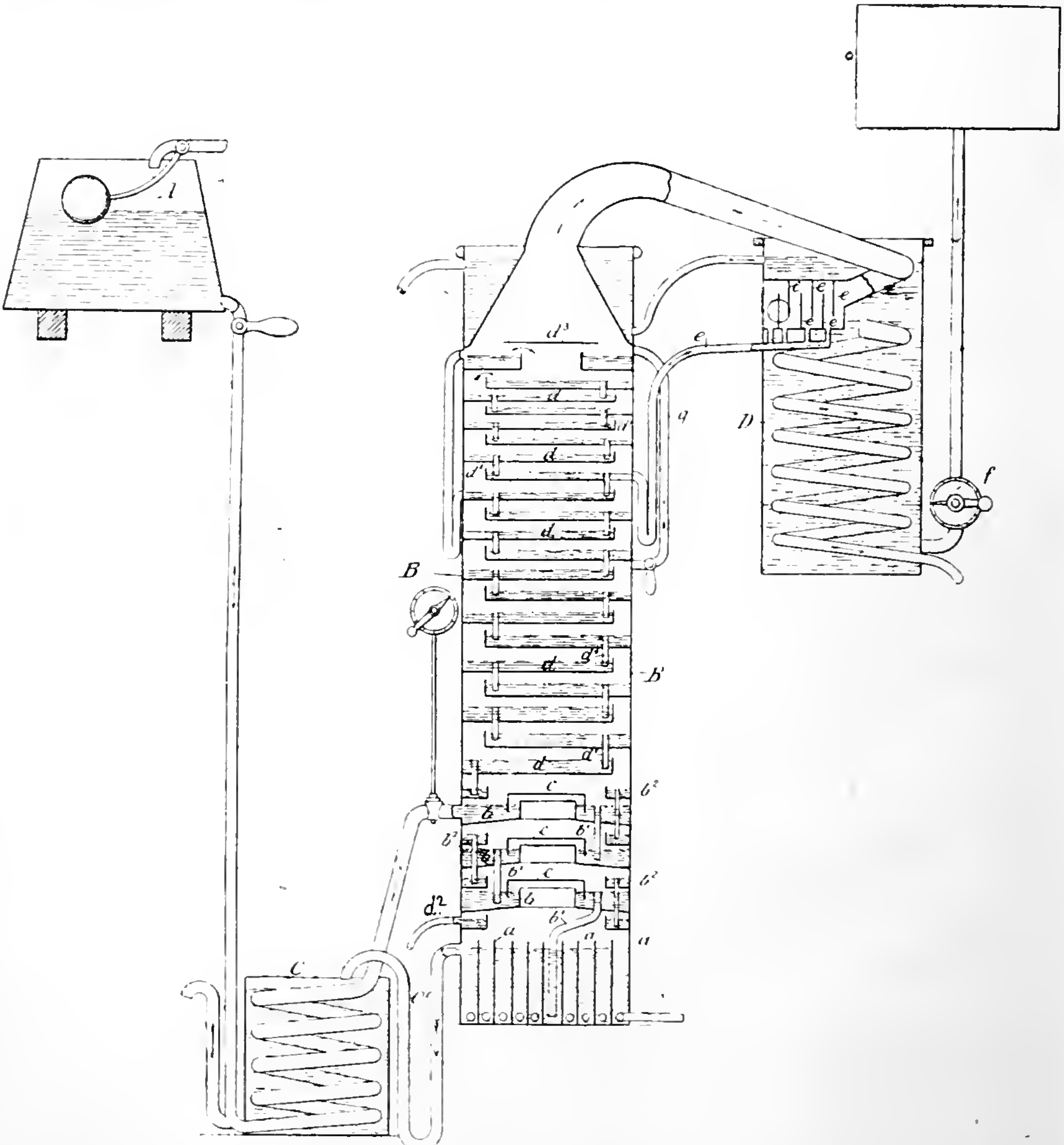
A WORT is prepared in the usual manner and when all the starch has been converted, it is heated under a pressure of 60lb. to 90lb. with a small quantity of alkali in order to free it from oil, nitrogenous matters and easily volatilised salts and acids. An extract of hops is then prepared by boiling hops in distilled water under a high pressure and temperature. The two solutions are then mixed, concentrated and used for the above purposes in this state. A drawing of the apparatus employed accompanies the specification.—G. H. M.

Improvements in or applicable to the Manufacture of Grape Wines. W. Wild, London. Eng. Pat. 10,108, July 19, 1887. 4d.

THIS embraces the preparation of a pure grape-must by the concentration in vacuo of fresh grapes. Unfermented and fermented still and sparkling grape wines can be prepared from this concentrated must by dilution with water and aëration with carbonic acid gas or by fermentation, as the case may be.—G. H. M.

An Improved Mode of, and Apparatus for, Distilling and Maturing Alcohols. J. Wallace, London. Eng. Pat. 7190, May 17, 1887. 8d.

THE object of the apparatus described in this specification is the production of alcohol free from fusel oil and acetic acid, the absence of which is the characteristic of spirit which has been "aged," and an increased yield from a given quantity of grain, which the patentee states amounts to about 10 per cent. A is the wash charger feeding the wash continuously through the heater C, kept full of spent wash, to the still column B. The lower part of the still column is formed into a boiler *a*, heated by a steam coil lying between the convolute partitions. *b*, *b*, *b*, are the distilling trays, each consisting of an annular space connected to the next tray lower by overflow pipes *b*¹; C is a baffle preventing the steam and vapour from passing through the centre of the still without passing through the wash on the trays *b*. *d*, *d*, *d*, are the rectifiers charged at the beginning of an operation with cold water; they communicate with each other by an overflow pipe, and compel the vapours to follow a circuitous path. The fusel oil condensing on the rectifiers finds its way to the rings b^2 at the lower part of the still and out by the pipe d^2. D is the condenser in which the rectified and pure spirit is finally condensed, after passing through a baffle plate-box e, e, e, which removes the last traces of fusel oil. The condensing water is supplied to D from an overhead cistern, through a regulating valve *f*; the quantity of water supplied to this vessel regulates the purity or "age" of the finished spirit.—C. C. H.



XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(*A*) CHEMISTRY OF FOODS.

New Method of Preserving Butter. Board of Trade Journal, Sept. 1887.

THE French *Moniteur Industriel* states that M. Pierre Grosfils, of Vervier, has communicated to the "Société d'Encouragement de Vervier" a note on his process for preserving butter. After having enumerated the causes which led last year to the lowering of the prices of dairy produce, and especially of butter, he dwells upon the unfortunate results of the over-production of this article, and on its falsification by means of oleomargarine. He has discovered a way of preserving butter, without alteration, for a long period, so that it can be imported into countries the climate of which does not permit it to be made there. The process has been subjected to practical experiments for more than six months. M. Grosfils describes the various phases of his research as follows:—He first mingled 1grm. of salicylic acid with 1 kilo. of butter, but after some weeks the product had altered. He thought that the cessation of the antiseptic action of the acid was due to its crystallisation in the non-liquid substances which were mingled with it. After numerous experiments, he found that lactic acid prevents this crystallisation. This acid is, in fact, a good solvent for salicylic acid; it has the advantage of being hygroscopic, of possessing antiseptic power, and, finally, of being uninjurious in food.

The first result of the discovery of M. Grosfils was to be able to diminish the amount of salicylic acid used to preserve the butter. Instead of mixing 1grm. of acid per kilo., he put the butter in a liquid containing ·05 per cent. of salicylic acid and 3 per cent. of lactic acid. He successively divided the salicylic acid into still smaller doses, until at last he had the proportion of 1grm. of acid to 5000 parts of water. The final composition consisted then of 98 parts water, two parts lactic acid, and 0·0002 of salicylic acid. This composition allows of the indefinite preservation of butter of good quality, even at a high temperature and in hot countries. If the butter has already undergone some alteration, a stronger dose must be used.

But the author points to the following fact:—The lactic acid contained in the antiseptic liquid in doses stronger than 2 per cent. gives the product a taste which, without being offensive, is a little too sour to leave the article saleable. In such case the butter should be washed with water, or better still with scalded milk, to which a little carbonate of soda has been added to prevent any coagulation of the casein. This washing will not only remove the lactic acid and its taste, but also the salicylic acid in solution, to such a degree that what remains will be imperceptible.

The process is stated to be most economical, as the antiseptic liquid will serve indefinitely, being unalterable. Care must be taken each time to use the same quantity of butter.

The preparation of a kilo. of butter by means of this process, it is stated, will not cost more than one or two centimes.—C. G. C.

Examination of Milk. R. Frühling. Rep. Anal. Chem. **7**, 517—523.

This paper contains a detailed description of the methods adopted for testing once a month, both morning and evening, an average sample of the milk yielded by about 17 cows at a dairy for "nursery milk." In order that the quality of the milk might be as uniform as possible throughout the year, dry food only was used, the nature and quantity of which is also fully described.

The average composition of the milk, tested monthly from January to December, 1886, was:—

	Evening.	Morning.
Fat	3·00	2·84
Proteïds	3·96	3·92
Ash	0·72	0·72
Milk-sugar	4·43	4·39
Water	87·89	88·13
	100·00	100·00
Sp. gr. at 17·5°	1·0325	1·0307

All the monthly analyses are published in full. The milk and cream obtained were quite white, but experiments showed that these became yellow again if green food was provided.—E. E. B.

New Researches on the Behaviour of Proteïds when treated with Digestive Ferments. A. Stutzer. Zeits. f. Physiol. Chemie, 1887, 529.

From the newer researches of the author (*Chem. Zeit. Rep.* **11**, 56) it appears that peptic digestion is best effected by warming 1grm. of the substance under examination for 12 hours with a pepsin solution containing 0·2 per cent. of hydrochloric acid. The quantity of the latter solution to be employed will depend upon the percentage of total nitrogen in the proteid—viz., 100cc. for bodies with less than 5 per cent. of N, 200cc. for those with 5—10 per cent., and 400cc. for those holding more than 10 per cent. When more than 1grm. of substance is used, the amount of pepsin is proportionately increased. A solution with 1 per cent. of HCl will dissolve a somewhat greater quantity of nitrogen than one with 0·2 per cent. By successive treatment with acid pepsin solution and alkaline pancreatic fluid, the amount of undigested nitrogen remained almost identical, whether the former contained 0·2 per cent. or 1 per cent. of HCl. The pancreatic fluid, made according to the author's directions, acts more readily in dilute alkaline solution than when neutral; but a slightly greater or less quantity of sodium carbonate is a matter of indifference. The dried pancreatic preparations of commerce simply dissolved in water are able to dissolve more protein than when 0·25 per cent. of sodium carbonate is present.—W. G. M.

Improvements in or applicable to Packages for Canning or Preserving Articles used as Food, or in Plates applicable for the Manufacture of the same. W. Powell, Liverpool. Eng. Pat. 9932, Aug. 21, 1885. 6d. Amended specification.

The title and body of this specification were amended July 2, 1887. Tin plate, sheet-iron, steel or other thin metallic sheet, is coated with mucilage or cement, rendered antiseptic by salicylic acid; a sheet of *papier mâché* or paper is applied thereto, passed through rolls and dried. The paper prevents injury to the contents of "tinned" packages by contact with the metal.

—C. C. H.

(*B*) SANITARY CHEMISTRY.

Notes on Crude Carbolic Acid and its Substitutes. Alfred H. Allen. A paper read before the British Association. Brit. and Col. Drug. 1887, 364.

A variety of substances has been employed and patented as bases for the manufacture of carbolic powders. Thus, the oldest preparation of this kind is made by adding a certain proportion of crude carbolic acid to a crude sulphite of calcium, prepared by passing sulphurous acid gas over ignited limestone. Sulphurous acid is introduced into other powders by the direct addition of a solution of calcium bisulphite, and the use of other sulphites has also been patented. Carbolic and other powders are made by adding carbolic acid to silica in various forms, to peat, spent gas lime, etc. A mixture of bleaching powder and carbolic acid has also been employed. Soluble salts have been used as absorbents of carbolic acid, the resultant powder being more readily removed and less likely to choke up drain pipes than the preparations commonly employed. "Borophenol," a similar preparation, is made by absorbing carbolic acid in dried borax.

Although the term carbolic acid has been extended commercially so as to include products consisting chiefly of cresylic acid and still higher homologues of phenol, it appears a straining of its legitimate signification to apply it to products from which the real carbolic acid has been previously extracted. This, however, is sometimes done, but the matter becomes more serious when the article is purposely mixed with neutral tar-oils or other hydrocarbons of little direct value as antiseptics; and this has been done to the extent of fully 50 per cent.

Another practice which is increasing is the complete or partial replacement of carbolic or cresylic acid from coal-tar by the mixture of crude phenoloid bodies obtained from the tar or oil produced by condensing the waste gases from coke-ovens or blast furnaces burning bituminous coal. "Blast-furnace creosote oil" is now produced in enormous quantities in Scotland, and has already found an extensive application for creosoting timber, for producing the "lucigen" light, and as a liquid fuel. It contains from 20 to 35 per cent. of phenoloid bodies soluble in caustic soda, as against 5 to 10 per cent. in coal-tar creosote oil of London make (Newcastle coal).

Here there is a cheap and abundant source of phenoloid bodies, but it is evident that the unacknowledged substitution of them for coal-tar acids is objectionable, even assuming them to be comparable to the latter in antiseptic value.

Our knowledge of the phenoloid bodies extracted by caustic soda from blast-furnace creosote oil is chiefly due to the researches made by Watson Smith. He found a sample of phenoloids, extracted from Gartsherrie tar, to contain only 1·33 per cent. of real phenol boiling at 182° C., whereas the tar acids from Lancashire coal-tars yield about 65 per cent. of crystallisable carbolic acid. The fraction which would contain the *cresols* (cresylic acid), amounted to 4·5 per cent. of total phenoloids. The larger fraction (19·4 per cent.), distilling between 210° and 230°, he regarded as probably consisting mainly of a mixture of the xylenols, $C_8H_9.OH$. A large proportion of the phenoloids distilled at a temperature above 230°, but its nature requires further study. The fraction distilling above 360° gave, on treatment with soda and exposure to air, unstable colouring matters, which are probably allied to the eupitonic acid obtained from wood-tar. The tars obtained by condensing the gases from gas-producers and Jameson's coke-ovens contain phenoloid bodies not unlike those of blast-furnace tar. Similarly, the crude oil or tar produced in Scotland by the distillation of bituminous shale yields to soda phenoloid bodies to the extent of 1 or 2 per cent. Creosol seems to be wholly absent, but on the other hand, *phlorol* is present, as also a *cymenol* ($C_{10}H_{13}.OH$), boiling at 237° and two phenols isomeric therewith. The pyrogallic ethers, boiling respectively at 253°, 265° and 285°, found by Hoffmann in wood-tar creosote, have also been isolated from the shale product, together with other bodies of very high boiling point which have not yet been fully examined.

These results show that a similarity exists between the phenoloids of low temperature tars, whether they be obtained by the distillation of wood or shale, or by the condensation of the gases from blast-furnaces, coke-ovens or gas-producers. In minor though important points, differences exist, but they seem to present a greater resemblance to each other than they do to the coal-tar phenols.

A well-known firm is now preparing an antiseptic from these phenoloids of blast furnace tar. At the author's suggestion they have adopted for their product the name "Neosote," a word which signifies "new preserver," or "new preservative," and may serve to suggest its similarity to creosote. The crude mixture of phenoloid bodies obtained by treating blast-furnace tar with alkalis is subjected to a process of further purification, which greatly improves it. Thus, the strong disagreeable odour of the crude product is destroyed and the highly irritating and acrid bodies are also removed. These objectionable constituents are probably identical with or closely allied to the *cærulignone* of wood-tar creosote, a single drop of which causes bleeding when placed on the tongue.

"Neosote," freshly prepared from blast-furnace tar, is almost as colourless as water but it acquires a sherry colour by keeping. Experiments made to test its antiseptic value indicate that it is fully able to compare with crude carbolic acid, while its caustic properties (when applied in a concentrated condition to the skin) are very much less marked than those of the coal-tar product. In short, when properly purified, neosote presents a considerable resemblance to wood-tar creosote.

The Antiseptic Properties of some of the Fluorine Compounds. Wm. Thomson. Chem. News, **56**, 132.

THE author finds that the compounds of fluorine, hydrofluoric acid, the acid and neutral fluorides of the alkalis, and also their fluosilicates are powerful antiseptics, and possess besides the advantages of being non-volatile and not destroyed by oxidation. Of these compounds the sodium fluosilicate seemed the best suited for the general purposes of an antiseptic. This salt is not poisonous, possesses no smell, and is sparingly soluble in water. Possessing only a slight saline taste, it may be employed for preserving articles of food without communicating any taste to them. As regards uses in surgery, it may be remarked that a saturated aqueous solution containing 0·61 per cent. of the salt is, it is stated, not irritating to wounds, while it possesses greater antiseptic power for animal tissues than one part of mercuric chloride in 1000 of water.—W. S.

Purification of Water. Ztschr. f. Zucker Ind. **37**, 498 and 599.

COMMUNICATIONS on the purification of the waste water from sugar factories by Sickel, Handtmann, Schattmann, Herzfeld and Stammer point out that no method yet known is generally applicable, and that methods of purification by chemical means are objectionable, since, although they clear the water, they do not serve to remove the injurious impurities (sugar, gum, etc.), for as the alkalinity of the water gradually disappears, decomposition and fermentation again set in. Further, it is stated the fish are often not killed by the organic impurities of the water, but by the ingredients introduced in the purification, especially the large amount of alkali, though the results of the experiments on this point are not concordant. Nevertheless, purification by chemical means is recommended where the neighbourhood is annoyed by rapid decay and fermentation taking place in the polluted water. The authors consider such purification sufficient.—C. A. K.

Manufacture of a Composition for Softening and Purifying Water. H. R. Lipscombe, London. Eng. Pat. 12,061, Sept. 22, 1886. 4d.

DRY slaked lime, 40 parts, is mixed with sodium carbonate, 50 to 60 parts, or an equivalent quantity of potassium carbonate, phosphate of sodium 2 parts and one part each of potassium permanganate, oxide of manganese and ammonium carbonate. The compound is added to the water to be softened. "Generally 1lb. of the composition will suffice for softening 200 gallons of water."
—C. C. H.

Improvements in Furnaces for the Desiccation, Deodorisation and Combustion of Animal and Vegetable Matters, or Town's Refuse. T. Ogden, Burnley. Eng. Pat. 12,248, Sept. 27, 1886. 11d.

THE refuse or matter to be desiccated is placed in an oven underneath the bars of a furnace constructed in the ordinary manner. The products of combustion from the furnace divide at the farther end of the furnace and are carried by flues, circulating in opposite directions, round the sides and underneath the floor of the oven, passing from thence to a shaft. The gaseous products of dessication rise from the oven and pass through the furnace, mingling with the products of combustion; they are thus completely destroyed. The dried matter may be afterwards fed into the furnace itself and consumed.—C. C. H.

Improvements in the Preparation of Materials for use in the Treatment of Sewage and Other Foul Liquids, in order to Purify them, and in the Method of Treating them, and in Apparatus for Use in their Treatment. W. B. Hallett, Goring. Eng. Pat. 12,382, Sept. 29, 1886. 8d.

THE sewage is first rendered alkaline and then treated with from 4 to 20grs. per gallon of the improved compound. This is prepared by grinding and mixing three parts by weight of commercial sulphate of alumina or iron, or both, with two parts of spent oil-shale, or other carbonaceous matter, or a carbonised mixture of clay, shale and tar. The sludge is settled out in tanks or in the improved apparatus described. This apparatus consists of a tall rectangular tank slightly larger at the bottom than at the top; a centre diaphragm divides one side from the other reaching nearly to the bottom, so that the treated sewage passes down to the bottom and rises again before flowing off at the upper part. The sludge collects at the bottom and is removed by lifting two large valves admitting it into an outlet chamber provided with a stop valve.—C. C. H.

Combining Disinfectants with Soda Crystals. R. L. Hickes, London. Eng. Pat. 6209, April 28, 1887. 4d.

A SATURATED solution of soda crystals is made in water at the boiling point. At the moment of crystallisation, on cooling, a mixture of diamylene, camphene, menthene, terebene, cymol and thymol, and sometimes phenol, is added.—C. C. H.

XVIII.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Porous Cells of Cork. M. Stein. Electrician, **19**, 245.

THE author succeeded in making porous cells of cork, which are very light and not easily broken. Finely powdered cork is made to a paste with water and a small quantity of naphthalene added, moulds are filled with this mixture and dried at a low temperature. The presence of naphthalene is said to prevent the formation of salt-crusts on the sides of the cells.—S. H.

The Electrolytic Reduction of Antimony with Recovery of the Sulphur in both Ore and Solvent. W. Borchers. Chem. Zeit. **11**, 1021—1022.

THE process is based on the electrolytic separation of the antimony from its solution in a liquid containing sodium sulphide, and is really an application on the large scale of the analytical method of Classen and Ludwig. Any antimony compound which is thus soluble may be employed, the presence of hydro- or poly-sulphides being immaterial. But the ratio of sodium to sulphur should be maintained at 1 : 1 ; for above this, any excess of the former causes an increase in electrical resistance, of the latter a separation of sulphur. A preponderance of Na S is advisable, as, although such a mixture as $Sb_2S_3+Na_2S+2NaHO$ contains the correct relation of sodium to sulphur, it is too unstable to be of practical use. Antimonite is most suitable for the process, very poor ores being available, owing to the ready solubility of the Sb_2S_3 in even dilute solutions of sodium sulphide. After extracting by Na_2S solution to a gravity of 12° B., about three per cent. (on the whole solution) of sodium chloride should be added to increase the conductivity of the liquid. The decomposing tanks may be of iron, and are thus available as cathodes, to increase the surface of which a concentric lining in metallic connection with them may be used, the anodes being inserted between, but insulated from them.

The anodes are of lead, the presence of the sulphur compounds in the electrolyte tending both to hinder the solution of the metal and to prevent the formation of dioxide. An intensity of 2 to 2½ volts per cell is required. The deposited antimony is either pulverulent or in shining scales. It is collected (the portion clinging to the anode being detached by steel brushes), washed first with water containing a little Na_2S, NaOH or NH_3, then with pure water, next in water slightly acidulated with HCl, and finally again with pure water; it may then be dried and fused with glass of antimony. The depositing solution may afterwards be made to yield the sodium chloride added, and also sodium thiosulphate. In an experiment with 9·62 kilos. of sodium sulphantimoniate, with 0·8 of sodium hydroxide, 2·437 out of a possible 2·440kilos. of antimony were recovered, the mother-liquor consisting of 2·4kilos. of NaHS, 1·2kilos. of Na_2S_2 and 1·5kilos. of $Na_2S_2O_3.5H_2O$. In another trial with 3·4kilos. of Sb_2S_3 and 7·2kilos. of Na_2S (crystallised) a loss of 5grms. of antimony on 2·4kilos. occurred, the residual liquid containing 1·3kilos. of NaHS, 1·2kilos. of Na_2S_2 and 1·6kilos. of $Na_2S_2O_3.5H_2O$. The explanation of the reactions at the anode and cathode respectively are :—

$$Sb_2S_3+3Na_2S+6H = Sb_2+6NaHS$$
$$6NaHS+3O = 3H_2O+3Na_2S_2.$$

The difference between this statement and the actual numbers obtained from the second experiment is to be ascribed to the imperfect circulation of the liquid in the cell, whence a higher degree of oxidation of one portion occurs before the hydrosulphide formed at the anode can reach the opposite pole. In the first experiment the reaction at the anode is supposed to be :—$2Na_3SbS_4+2NaOH+6H=Sb_2+2Na_2S_2+4NaHS+2H_2O$. These reactions are fully borne out by the experimental numbers and it would thus appear that the decomposition occurs through the electrolysis of 3 molecules of water for every 2 atoms of antimony in each case.

—W. G. M.

The Change Produced in the Retort Carbon when used as the Positive Electrode in the Electrolysis of Acids. H. Debray and Péchard. Compt. Rend. **105**, 27.

WHEN retort carbon is used in the electrolysis of acids the positive electrode is always more or less rapidly destroyed with the formation of a black, finely divided powder. The authors found the powder to contain 9—10 per cent. of oxygen, 8—10 per cent. of water and when nitric acid was electrolysed, nitrogen also. They regard this as a chemical rather than a mechanical action.—C. A. K.

Improvements in Secondary Batteries. W. J. S. Barber-Starkey, Bridgnorth. Eng. Pat. 8693, July 2, 1876. 4d.

IN those cells in which plates of lead and peroxide of lead in dilute sulphuric acid are usually employed a new electrolyte is used consisting of a solution of bisulphate of sodium or a mixture of bisulphate of sodium and dilute sulphuric acid. If the plates are coated with a white insoluble compound, carbonate or bicarbonate of soda, or a mixture of both, is added to the dilute acid. A solution of sulphate of sodium may be used.—B. T.

Improvements in Secondary Batteries. E. Andreoli, London. Eng. Pat. 12,595, Oct. 4, 1886. 6d.

TO increase the conductivity of the peroxide plates formed according to Eng. Pat. 8842, of 1886, the inventor employs thin metallic conductors of any suitable shape either in the mass or on the surface. These do not serve as supports, but to increase the discharge per plate and to utilise more fully the active material by collecting the current from all parts of it, thereby lessening the resistance. The conductors may be of any material that will not be acted on by the acid or cause local action with the peroxide.—E. T.

Improvements in Secondary Batteries. W. W. Beaumont, London. Eng. Pat. 12,818, Oct. 8, 1886. 8d.

PIECES of active material moulded into regular forms and preferably composed of Fitzgerald's "Lithanode," are arranged in regular or irregular order in moulds of suitable form for the electrodes and lead or lead alloy is either poured or forced into the interstices. This operation is performed under pressure to prevent blow holes forming and also to force the lead into every interstice. The active material may consist of a mixture of oxides of lead or partly of sulphates, or sulphites and water, sulphuric acid, steam, sulphate of ammonia or similar suitable materials.—B. T.

An Improvement in the Manufacture of Carbons for Electrical and Other Purposes. W. R. Johnston, Clanchattan, N.B. Eng. Pat. 13,648, Oct. 25, 1886. 4d.

PAPER pulp, which may be that made from textile or other fibre, or from straw, wood or other vegetable material, is moulded into the desired shape, subjected to pressure and carbonised in the usual way. To give greater cohesion the pulp is sometimes mixed with materials such as starch, sugar or tar.—B. T

Improvements in Obtaining Gold from Refractory Ores or other Substances. J. B. Hannay, Loch Long. Eng. Pat. 14,061, Nov. 2, 1886. 6d.

THE crushed ore is chlorinated either by electrolytic means or by the injection of liquefied chlorine; but in any case the premature precipitation of the gold by ferrous salts, produced *in situ*, is prevented by a solution of a soluble cyanide or sulphocyanide contained in an inner porous compartment, in which is placed the cathode of a comparatively feeble electric current: the anode being placed in the external chamber. The solution should be slightly alkaline and therefore commercial potassium cyanide may be employed.—W. G. M.

Improvements in Galvanic Batteries. T. Goodman, London. From C. Gassner, jun., Mainz, Germany. Eng. Pat. 16,810, Dec. 22, 1886. 4d.

Protoxide of zinc is thoroughly mixed with the exciting salts and plaster powder of a dry cell before water is added. The otherwise heavy and hard mass becomes porous and so facilitates the exchange of gas and lessens the polarisation and resistance of the cell. The inventor uses two parts of plaster to one of protoxide.—E. T.

Improvements in the Production of Aluminium and of Alloys of Aluminium and Copper by Electro Deposition. C. A. Burghardt and W. J. Twining, Manchester. Eng. Pat. 2602, Feb. 19, 1887. 6d.

To a solution containing copper and aluminium chlorides, from which excess of acid has been evaporated, sodium hydroxide is added to complete precipitation of copper hydroxide and re-solution of alumina. 16oz. of potassium cyanide per ounce of metal in solution is now added, and the liquid heated until the copper is dissolved. Half that quantity (8oz.) of potassium bicarbonate is added and the mixture boiled for about 24 hours. After filtration, if necessary, a small quantity of hydrocyanic acid is added, when the bath is ready for depositing a bright alloy of copper and aluminium at a temperature of 180° F. and with a platinum or aluminium bronze anode.—W. G. M.

Improvements in Primary Batteries. C. L. Tweedale, Crawshawbooth. Eng. Pat. 4648, March 29, 1887. 8d.

In this two-fluid battery the positive element consists of either lead, tin, copper, or alloys composed of these metals, and is immersed in any suitable acid or solution of an acid salt; when lead is employed the best results are obtained from a mixture of nitric and hydrochloric acids. The negative element consists of platinum or carbon and is immersed preferably in dilute nitro-sulphuric acid, but nitric alone or nitro-hydrochloric acid may be used. Arrangements are made for withdrawing the liquids from the two cells independently of one another.—B. T.

Improvements in Galvanic Batteries. J. Serson and J. O. Whitten, Boston, U.S.A. Eng. Pat. 10,217, July 21, 1887. 8d.

A cylindrical zinc rests in a circular channel in the bottom of the outer cell containing mercury. The porous cell contains a cylindrical carbon, within which are three small porous cells resting in sockets formed in the base of the large porous cell. The latter contains water, sulphuric acid, nitric acid, chromic acid and bichromate of potash, and of the small porous cells the first contains bichromate of potash, the second nitric acid, and the third sulphuric acid to reinforce the compound solution. The outer cell contains a solution (1:6) of sulphuric acid. The lid, which is held on by a cam, may have india-rubber rings on it to prevent spilling and mixing of the liquids.—B. T.

XIX.—PAPER, PASTEBOARD, Etc.

Improvements in the Manufacture of Paper to render same Antiseptic and Germ Proof. R. D. Sinclair and J. B. Brown, Glasgow. Eng. Pat. 12,217, Sept. 25, 1886. 4d.

Resorcinol, prepared by fusing galbanum resin with potassium hydrate, or from coal tar, is incorporated with the paper pulp in the proportion of one to two thousand; oil of Eucalyptus is sometimes added.—C. C. H.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Occurrence of Methyl Alcohol in the Vegetable Kingdom. H. Gutzeit. Annalen, **240**, 243—244.

It has been shown by Maquenne (this Journal, 1886, 317) that on distilling fresh plants with water the distillate contains methyl alcohol. The latter may already exist in the plant or it may be produced as a decomposition product during the process of distillation. The author states that the occurrence of alcohol in plants is no novelty. In 1875 he discovered its presence in the distillates from the fruits of the following plants:—*Heracleum giganteum*, *Pastinaca sativa L.* and *Anthriscus cerefolium Hoffm.*, whilst in 1879 he extracted ethyl compounds from heracleum fruits by means of pure ether. Having recently isolated methyl alcohol from *Acorus calamus L.*, in the course of an investigation on the constituents of the rhizome of this plant, the author concludes that methyl and ethyl alcohol exist in a free state in plants.—D. B.

Medico-chemical Notes. V. Meyer. Ber. **20**, 1725—1731.

1. *The Stability of Sublimate Solutions.*—Professor Angerer of Munich recommends the addition of common salt as a preventive against precipitation of sublimate solutions made without distilled water. The author finds that common salt, even in the proportion of 1 to 4, has not this property in tightly closed vessels and in corked vessels it has but a slight preservative action. On the other hand it has a considerable preservative action in open or loosely closed vessels.

2. *Physiological Action of Chlorinated Ethyl Sulphides.*—As the author has already shown, thiodiglycolchloride $CH_2Cl.CH_2.S.CH_2.CH_2Cl$ is a powerful poison and produces terrible blisters and ultimately necrosis when in contact with the skin. The effect of the monochlorinated compound has been tried with the following result:—A small quantity placed on a rabbit's ear produced inflammation but not so violent as the dichloride; after 48 hours the inflammation had gone down. No inflammation below the epidermis occurred. Rabbits in a confined space and subject to the vapours of the monochloride, died on the fourth day. The action of the non-chlorinated product is not poisonous. The poisonous action is therefore directly due to the presence of chlorine.—J. B. C.

Localisation and Recognition of Alkaloids in the Plants containing them. B. Errera. Bull. de la Soc. Roy. de Pharm. de Brux. **31**, 217.

Aconitine is contained in all parts of the *Aconitum napellus*, though not uniformly diffused. The greatest amount is found in the ovaries and in the extremity of the root—the so-called vegetation point. Considerable quantities are also contained in the other parts of the root, the blossom, and the seeds. The reaction with sulphuric acid and sugar can also be obtained in the case of the dry plant, provided the latter has been previously softened by soaking in luke-warm water.—W. S.

Notes on the Chemistry of Strophanthin. T. R. Fraser. Pharm. J. 1887, 69.

The active principle obtained by the author from strophanthus seeds, some years ago, by treating the alcoholic extract with ether, is found to be resolvable by acetate of lead into at least two bodies, one of which is an extremely active glucoside and the other an acid for which the name *Kombic acid* is suggested. The following is an outline of the process now recommended for the preparation of strophanthin:—The product obtained in the earlier process is dissolved in water, tannic acid added and the tannate digested with recently precipitated oxide of lead. This is extracted with rectified and proof spirit, the extract obtained dissolved in a small quantity of rectified spirit and the solution precipitated by ether. The precipitate is finally dissolved in weak alcohol and carbonic anhydride passed through this solution for several hours, by which means lead is completely got rid of. After filtration, the solution is evaporated at a low temperature and dried *in vacuo* over sulphuric acid. Strophanthin thus obtained, is imperfectly crystallised, neutral in reaction, intensely bitter, freely soluble in water, less so in rectified spirit and nearly insoluble in ether and chloroform. All the mineral and many organic acids resolve strophanthin, even in the cold, into glucose and a body which the author names strophanthidin.—W. E.

Tests for some Pharmaceutical Preparations recommended by the Committee of the German Pharmaceutical Society. Arch. Pharm. **25**, 653.

Tartaric Acid.—The aqueous solution (1 : 10) must not be altered by calcium sulphate, sulphuretted hydrogen or ammonium sulphide. Barium nitrate and ammonium oxalate must not produce an immediate turbidity *Lard.*—It should be white and nearly without smell. A boiled mixture of 2 parts of lard, 3 parts of caustic potash and 2 parts of water, should remain almost clear on the addition of 50 parts of water and 10 parts of alcohol. *Sulphuric Ether.*—Mixed with fifteen times its volume of water, it should remain clear. It should be kept protected from light, as the influence of the latter may conduce to the formation of aldehyde or hydrogen peroxide. *Acetic Ether.*—It frequently contains butyric ether and amyl-compounds, which are detected by steeping filter paper in the ether to be tested and allowing the latter to evaporate. The paper must not have the characteristic smell of the foreign ethers towards the end of the evaporation. *Codeïne.*—Dried at 100°C. it should lose 6 per cent. of its weight and should burn without residue. A solution of potassium ferricyanide, to which one drop of iron perchloride has been added, must not immediately turn blue on the addition of an aqueous codeïne solution acidified with 1cc. of hydrochloric acid. This test detects very small quantities of morphia. *Collodium.*—It is to be prepared by moistening one part of collodium wool with 7 parts of alcohol, adding 42 parts of ether and shaking repeatedly. The solution is allowed to subside and the supernatant liquor is drawn off. *Iron Lactate.*—On igniting, it should leave 27 per cent. of iron peroxide. Sugar is detected by boiling 30cc. of the solution (1 : 50), to which 3cc. of dilute sulphuric acid has been added, for some minutes and adding caustic soda solution in excess. The mass is filtered and the filtrate heated with 0·1grm. of potassium-sodium tartrate and some drops of copper sulphate solution should not give a precipitate of red cuprous oxide. *Iodoform.*—It is sometimes adulterated with picric acid, which is easily detected by shaking the crystals with water and filtering. The filtrate should be colourless.—S. H.

Antipyrine as a Substitute for Morphine for Subcutaneous Injections. Germain Seé. Compt. Rend. **105**, 103.

The dose for subcutaneous injections is 0·5grm. of antipyrine dissolved in an equal weight of water. The injection, which is effected just as in the case of morphine, produces a diminution of pain after first causing a pain which lasts for a few moments, and is unattended by the unpleasant secondary actions due to morphine. Antipyrin possesses a further healing power which morphine does not, and this in addition to its antiseptic action. The author has not met with any cases in which antipyrin cannot be substituted for morphine.—C. A. K.

Synthesis of Pilocarpine. Hardy and Calmels. Compt. Rend. **105**, 68.

Starting from β-pyridine ethylidene lactic acid, the authors prepared β-pyridine α-bromopropionic acid by treatment with PBr_3 dissolved in carbon bisulphide. The bromine substitution product was separated as the gold double salt $C_8H_8BrNO_2.AuBr_4H$ and this, when decomposed in presence of alcohol by sulphuretted hydrogen, yielded the free acid in a syrupy form. On dissolving the latter in a solution of trimethylamine and heating the whole in a closed tube to 150°, a product resulted from which a few drops of the alkaloid *pilocarpidine* were extracted by ether-alcohol. The methyliodide addition product of pilocarpidine was next prepared and this, on oxidisation with silver permanganate until all the iodine in the methyliodide had been precipitated, yielded pilocarpine, which remained in solution and which possessed all the physiological properties of the natural alkaloid.—C. A. K.

On the Secretion of the Araucaria. E. Heckel and F. Schlagdenhauffen. Compt. Rend. **105**, 359.

It is usually supposed that the secretions of the coniferæ consist of an essential oil and a resinous substance. The authors' experience shows that this is not the case for a large number of coniferæ, especially the araucaria group. Their secretion consists of resin, essential oil and a pure gum, which turns the plane of polarisation to the left, is oxidised by nitric acid to a mixture of mucic and oxalic acids and contains traces of glucose.—S. H.

Phenol-Cocaine. Viau. Nouv. Remèd. **87**, 192.

The author recommends phenol-cocaïne as a very efficient local anæsthetic in surgical dentistry. It is prepared by heating for a short time, two parts of cocaïne with one part of phenol.—S. H.

The Alkaloids of the Coca Leaves, O. Hesse. Pharm. Zeit. **32**, 407.

Stockmann supposes the amorphous cocaïne to be a solution of cocaïne in hygrin. The author's results do not support this, although he finds that hygrin may be formed during the decomposition of one or other of the coca-bases. The blue fluorescence of a dilute hydrochloric acid solution of hygrin was the test adopted for detecting its presence. The leaves were treated with ammonia, shaken with ether and the ethereal extract shaken with dilute hydrochloric acid, and it was found that with fresh, unbruised leaves, the acid solution did not show any fluorescence at first, but on standing the characteristic blue fluorescence gradually appeared, showing that hygrin is a decomposition product. Hygrin is precipitated from its acid solution by ammonia or caustic soda as a basic oil with a characteristic smell.

The author also separated an amorphous base, having the same empirical formula as cocaïne ($C_{17}H_{21}NO_4$) from a small leaved coca plant, to which he gives the name *Cocamin*. It is readily soluble in alcohol, ether, and chloroform, melts at 80° and is decomposed above 100°.—C. A. K.

Coriander Oil. R. Eck. Pharm. Zeit. **32**, 423.

Fifty kilos. of the dried seed extracted with direct steam yield on an average 550grms. of rectified oil. The oil gives a brown-red colouration when mixed with a drop of sulphuric acid on a watch glass; a bright red with nitric acid, which passes into lilac and blue on warming; and with a drop of tincture of iodine a green to dark green colour. All these colorations are destroyed on adding alcohol.—C. A. K.

The Alkaloid of Indian Hemp. E. Jahns. Arch. Pharm. **25**, 479.

The alkaloid supposed to exist in Indian hemp is, according to the author, simply choline. It exists in varying amounts from 0·05—0·1 per cent. Five kilos. of hemp were worked up, but there was not the least indication of the presence of any other alkaloid.

—C. A. K.

The Ethereal Oil of Black Pepper. L. A. Eberhardt. Arch. Pharm. **25**, 515.

The oil has the characteristic smell of pepper, is of a green colour, and at 15° has a sp. gr. of 0·8735. It is not miscible with alcohol (sp. gr. 0·830), but mixes readily

on addition of ether. Subjected to fractional distillation it yields a levro-rotatory terpene boiling at 169·5—171°, and having the sp. gr. 0·858 at 20°, together with higher boiling isomers. The fractions up to 180° are colourless, but above this temperature they are greenish to blue-green; above 310° a thick brown residue remains in which the presence of a phenol could not be proved.
—C. A. K.

Ueuhuba, the Seeds of Myristica Surinamensis. A. Tschirch. Arch. Pharm. **25**, 619.

THESE seeds contain 72·5 per cent. of fat, which is solid, of a yellow colour and melts at 36°. The fat fills the inside of the seeds, is in part amorphous and in part crystalline. The seeds, which morphologically resemble the ordinary musk seed, contain no starch but are specially characterised by the presence of large, regular and well-formed albumen crystalloids.—C. A. K.

Arbutin. W. Stoeder. Nieuw. Tijdsch. Pharm. Nederl. 1887, 176.

THE author obtained 1·6 per cent. of arbutin from the leaves of the strawberry tree (arbutus). He confirms the formula, $C_{25}H_{34}O_{14}$ and finds that on gentle warming with dilute sulphuric acid, it is decomposed into sugar, quinol (hydroquinone) and methyl quinol.—C. A. K.

A New American Vaselin. R. Gerstenberger. Pharm. Post. **20**, 462.

"SALVO PETROLIA" is the name given to a new vaselin which is sold in two forms—white and light coloured. The former possesses no smell at the ordinary temperature, melts at 35° and after melting has a slight smell of petroleum. Treated with sulphuric acid, it soon becomes brown and after ten minutes' standing, black. When melted and poured into a test tube it assumes a dirty white colour with a tinge of yellow on cooling. Its sp. gr. is 0·833.—C. A. K.

The Fatty Oil of Strophanthus Seeds. O. W. Fischer. Pharm. Post. **20**, 489.

IN thin layers the oil is of a greenish-yellow colour, and in thicker layers dark green with a red fluorescence by reflected light: it is a thick liquid at the ordinary temperature and possesses a narcotic smell due to the presence of a small quantity of an ethereal oil. This latter is removed by distillation with steam and may be extracted from the aqueous distillate by means of ether, which when distilled off leaves it behind as a colourless oil. The fatty oil has a sp. gr. of 0·9247 at 21°; it is only slightly soluble in boiling alcohol but dissolves readily in ether and chloroform. Nitric acid does not dissolve it but colours it emerald green and on warming the colour passes first to brown and then to yellow. The oil is readily saponified by caustic potash, and contains 92 per cent. of total fatty acids. Köttstorfer's test gave as a mean of two determinations 179·5, and Hübl's iodine test in two experiments, 95·3 and 95·9. The green colour of the oil is due to its containing chlorophyll.—C. A. K.

Acetphenetidine as an Antipyretic. E. Ghillany. Ztschr. österr Apoth. Ver. **25**, 339.

ACETPHENETIDINE, prepared by Hinsberg, has the formula $C_2H_5O.O.C_6H_4.NH.C_2H_3O$. It reduces the temperature gradually for 4—6 hours, when the maximum reduction of 2° is reached. In none of 50 cases in which it was employed were any unpleasant after-symptoms observed.—C. A. K.

Occurrence of Methyl Alcohol in the Calamus-Root. A. Geuther. Annalen, **240**, 109.

IN the course of an investigation of this substance, undertaken as a review of H. Thom's work (*Arch. Pharm.* **24**, 465; also this Journal, 1887, 560), the results of which are in the present publication shown to be erroneous, the author succeeded in isolating a quantity of a liquid sufficient for identification as methyl alcohol.
—C. F. C.

The Ethereal Oils of Allium Ursinum. F. W. Semmler. Annalen **241**, 149.

THE author summarises the results of his investigation as follows: (1) The oil consists chiefly of vinyl sulphide, containing, in addition, but in small proportion, a polysulphide of this radicle, a mercaptan, and an aldehyde. (2) The crude oil treated with metallic potassium yields directly pure vinyl sulphide of sp. gr. 0·9125 and boiling point 101°, the odour of which is similar to and yet distinct from that of allyl sulphide. (3) The corresponding oxide $(C_2H_3)_2O$ boils at 39°; it is obtained from the sulphide by treatment with dry silver oxide. (4) Moist silver oxide, on the other hand, determines oxidation, vinyl alcohol is the first product, and passing into the isomeric acetaldehyde, the oxidation to acetic acid is completed. (5) Vinyl sulphide is oxidised by nitric acid, permanganates and chromic acid, to carbonic, oxalic and sulphuric acids, no sulphones being formed. (6) The sulphide forms crystalline compounds with $HgCl_2$, $PtCl_4$ and $AgNO_3$, according to the following equations respectively:—

$$(7)\ 2(C_2H_3)_2S + 2HgCl_2 = 2C_2H_3Cl.HgCl_2(C_2H_3)_2SHgS.$$

$$(8)\ 3(C_2H_3)_2S + 2PtCl_4 = 4C_2H_3Cl.Pt.Cl_4(C_2H_3)_2S.PtS_2.$$

$$(9)\ (C_2H_3)_2S + 2AgNO_3 = (C_2H_3)_2S.2AgNO_3.$$

(10) The sulphide absorbs the halogens and the halogen hydracids. With bromine it combines to form the compound $(C_2H_3Br_2)_2SBr_2$. (11) By the action of potassium sulphocyanide upon the mercury compound (7) vinyl mustard oil is formed C_2H NCS.—C. F. C.

Andromedotoxin, the Poisonous Principle of the Ericaceæ. H. G. de Zaayer. Archiv. f. Pbysiol. **40**, 480.

PLUGGE has shown that andromedotoxin is not only the poisonous principle of *Andromedas*, but very probably also of all the poisonous ericaceæ. The author has extracted this poison in considerable quantity from *Rhododendron ponticum*. Pure andromedotoxin forms small white crystalline needles, which melt and begin to decompose at 228°—229°. It is not altered by continued heating at 100°. It dissolves in alcohol, chloroform, ether and benzene, and is three times more soluble in cold than in boiling water. When dissolved in water or alcohol the solution is levro-rotatory, while the chloroform solution turns the plane of polarisation to the right. It belongs to the indifferent, non-nitrogenous bodies; its solutions in indifferent liquids have an alkaline reaction and are not precipitated by any of the general precipitants for alkaloids. It is fairly stable, is not decomposed by acetic acid on boiling and only decomposed by strong solutions of oxalic or tartaric acid after boiling for a long time. It is not precipitated from its solutions by metallic salts, nor does it reduce Fehling's solution. Concentrated sulphuric acid dissolves it with a dark red-brown colour. When evaporated with dilute sulphuric, hydrochloric or phosphoric acids, colorations varying from rose-red to violet-red are obtained; these reactions are all very delicate. The author assigns the formula $C_{31}H_{51}O_{10}$ to the pure substance.—C. A. K.

Improvements in Means for the Manufacture or Production of Ozone. A. Brin, London, and L. Q. Brin, Paris. Eng. Pat. 11,846, Sept. 17, 1886. 8d.

THE patentees produce ozone commercially from air or oxygen by causing electric sparks to pass between layers or masses of conducting material so disposed as to present a large surface. The conducting material may consist of granular plumbago, iron, zinc or copper filings, or dust shot. Drawings of the apparatus employed accompany the specification.—E. J. B.

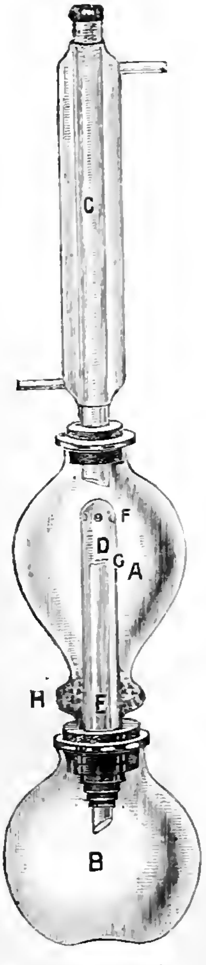
A Dental Anodyne or Local Anæsthetic. C. T. Arnold, London. From C. W. Arnold, Florida, U.S.A. Eng. Pat. 7061, May 18, 1887.

CHEMICALLY-PURE acetic acid is neutralised with ammonium carbonate and the mixture saturated with salicylic acid. The whole is then filtered and treated with "cocoaine hydrochloride." This compound is used for preventing or relieving the pain in sensitive dentine during the process of preparing the cavity of the tooth for the purpose of filling it. It also acts as disinfectant and deodoriser for preventing septic action and lessening the liability to trouble usually following a dental operation.—D. B.

XXII.—ANALYTICAL CHEMISTRY.

A New Extractor, especially suitable for Experimental Researches. Dr. R. Rempel. Chem. Zeit. **11**, 936.

THE author, finding Soxhlet's and Drechsel's apparatus unsatisfactory for the purposes for which he required them, has devised an extractor which may be made of size sufficient to treat 100grms. or more of material at one operation. In the subjoined figure, A is the extractor with a lower bulb H; it is connected by corks with an upright condenser C above and with a flask B, to contain the solvent, beneath. Within A and maintained in place by an air-tight cork on which it rests, is the tube D, which has openings F above into A and also openings into the bulb H of the extractor; through the cork is passed the tube E. This innermost tube is cut off at an angle beneath and has a notch G at the top of the longest side. The mouth of the condenser is closed by a plug of cotton wool. When in use the bulb H is filled with cotton wool or other filtering medium and the matter to be treated is placed above. The vapour of the solvent passes from B, through the tube E and the holes F, into the extractor A and thence into the condenser, where it becomes liquefied. The liquid percolating through the substance under extraction becomes more or less saturated and finds its way through the lower perforations in D; and as more liquid condenses, it gradually rises between the two tubes until the notch G is reached, whence it finally trickles down the walls of the tube E into the flask. The height of the solution in the extractor may be regulated by adjusting the sliding tube E; or, if the material treated permits only a very slow filtration, this tube may even be removed without fear. The extraction ended, the vessel A is emptied, the tube E then raised as high as possible and the liquid still left in B distilled into A, whence it is subsequently removed. The greater part of the solvent is thus recovered without the aid of any special distilling arrangement.—W. G. M.

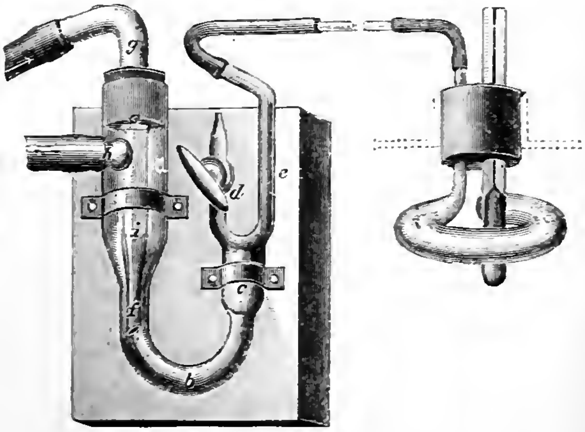


Orsat's Apparatus. Chem. Zeit. **11**. 989—990.

IN order to allow the copper spirals and capillary tubes in this apparatus to be readily removed when required, as well as to facilitate the washing out of the apparatus, C. Heintz has fitted the vessel A with a well-ground and air-tight stopper, thus avoiding the renewal of the vessel due to the spirals getting burned or to the breaking of the capillary tubes.—C. A. K.

A Practical Thermostat. L. Rügheimer. Ber. **20**. 1280—1284.

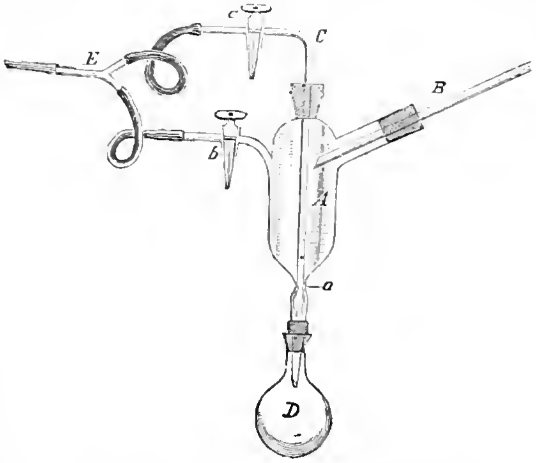
THE apparatus consists of a glass tube *a* with thick walls (see figure) to which a side tube *h* is attached and also a narrower U-tube *b* opening into a wider tube *c*. The latter terminates on one side in a tube and simple glass stop-cock *d*, on the other side in a narrow thick-walled tube *e* with a knee-shaped bend. The tube *g* is fixed in *a* by means of a cork and is drawn out towards *f* and cut off at an angle. The tube *g* is also perforated at *i*. The mercury placed in *b* is just in contact with the open end of *f*. When the gas tap is open, gas passes through *g* and *f* and then through *h* to the heating apparatus. If the tap *d* is now closed and the temperature



of the air bath raised, the mercury will rise and partly close the aperture at *f*. The total extinction of the flame is prevented by the hole at *i*, which supplies a constant stream of gas to the flame. The apparatus used in connection with an air-bath for 8 sealed tubes has the following dimensions: *f* has a diameter of 5mm. and walls 0 75mm. thick, and *b* a diameter of 8½mm. The mode in which the apparatus is regulated requires no detailed description. The tap *d* is gradually closed as the required temperature is reached; or better still the tap is closed completely several degrees below the point required, the temperature allowed to become constant, the tap again opened and quickly closed and this operation repeated once or twice.—J. B. C.

Apparatus for Fractional Distillation under reduced Pressure. L. Meyer. Ber. **20**, 1834—1836.

THE vessel A is attached to the end of the condenser B. In the upper end of A, which is 16mm. wide, a glass tube is fitted through a cork. The lower end of this tube is cut off at an angle, and is well ground into the narrow part of A at *a*. Below *a*, the lower end of A again widens and is then drawn out conically and cut off at an angle. To this conical piece the receiver D is attached by a well-fitting cork. The tube C is bent above A at right angles and on the horizontal portion a three-way glass cock *c* is fitted. A similar cock *b* is attached to the side of A. A simple tap may be substituted for the latter; a three-way tap is preferable in case the liquid should froth over. In order to use the apparatus, the two taps *b* and *c* are attached by strong narrow indiarubber tubing (1—2mm. inside diameter, 3—4mm. thick) to a T piece E, and this is connected with a manometer and water-jet aspirator. It is convenient, in case the liquid should run back, to insert a large empty wash bottle between E and the pump. The tube C is raised by a gentle upward turn so that A and D are in connection, and both taps turned, as in the figure, so that both are in connection with the pump. If a fraction of the distillate is to be separated, the tube C is pressed down, which shuts off D from A. In order to remove D the tap *c* is so turned that air enters through the tail of the tap and enters D through C. When D has been emptied or filled, *c* is slowly turned through 90° so that it is again in connection with the pump. The small quantity of air introduced produces a very slight change of pressure. When D has been again evacuated, by raising *c* the liquid in A is allowed to flow into D. The author recommends cork and not indiarubber stoppers.—J. B. C.



Laboratory Apparatus for Fractional Distillation. P. Monnet. Monit. Scient. 4 Sér. **1**, 335.

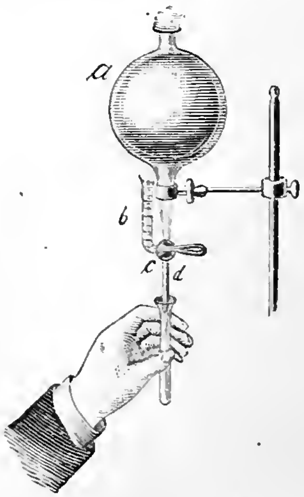
THE tube D, which serves as the dephlegmator, is 0·35—0·4m. high and has an internal diameter of 28—35mm., narrowed to 5mm. at the bottom to allow of its being fitted into the stopper of the flask B. It is filled with lead shot or, if acids are distilled, with pieces of glass or flint. For ordinary use lead shot No. 4 is used for the lower half and No. 6 for the upper half, the two being separated by a piece of copper gauze. In the case of very volatile substances, finer shot is employed and the length of the tube increased. A funnel with an upturned edge is inserted above the narrowed portion of the tube to support the shot. I is the tubulure leading to the condenser and H the thermometer which is fixed just above the top of the lead shot.

300cc. of a mixture of equal parts of water and alcohol yielded the greater part of the alcohol, on distilling, of a strength of 95%, and with a mixture of aniline and toluidine the author obtained nearly two-thirds of the aniline in a pure state after three distillations.

—C. A. K.

Apparatus for Measuring out Definite Quantities of Nutritive Solutions in Bacteriological Investigations. H. Treskow. Rep. Anal. Chem. **7**, 505—506.

THE construction of this apparatus, which is made of glass, will be readily understood from the accompanying diagram. *a* is the vessel containing the nutritive solution, *b* a graduated cylinder, *c* a cock with a right angled aperture drilled in it so that there may be either a passage from *b* to *a* or from *b* to *d*, which is the outlet tube; *a* and *b* are preferably closed by plugs of cotton wool. Any desired quantity of the solution can thus be rapidly measured into a test tube without any risk of introducing micro-organisms as would be the case if a pipette were used.—E. E. B.



Purification of Sulphuretted Hydrogen from Arseniuretted Hydrogen. O. Jacobsen. Ber. **20**, 1999—2001.

THE author passes H_2S gas, which has been completely dried, over solid iodine. This process is based upon the fact that AsH_3 readily combines with iodine to form AsI_3 and HI, whereas H_2S is not acted upon by the solid iodine. 2—3grms. of iodine suffice, and should be spread in layers between plugs of glass wool in a tube 30—40cm. long. The gas is then passed into water, when any iodine vapour remains dissolved in the water as hydriodic acid.—J. B. C.

Detection of Nitrogen Compounds in Seleniferous Sulphuric Acid. G. Lunge. Ber. **20**, 2031—2033.

SULPHURIC ACID containing selenium gives no reaction with diphenylamine, but on the addition of a layer of water the blue colouration is formed just as in the case of the nitrogen acids. With sulphate of iron solution the brown ring is also obtained, but this is only intensified on warming, due to the reduction of the selenium. From the above it follows that neither diphenylamine nor ferrous salts can be used for the detection of nitric acid in sulphuric acid containing selenium. Neither can indigo be used. Brucine gives, however, no reaction with selenious acid and can therefore be used in detecting nitrogen acids in concentrated sulphuric acid.
—J. B. C.

Notes on the Logwood Test for Alum in Bread, etc. W. C. Young. Analyst **12**, 145—147.

FURTHER experiments have led the author to modify the opinions expressed in a former paper. He finds, however, that aluminium phosphate is *slightly* soluble in cold acetic acid, although it is reprecipitated on boiling. The alumina naturally present in flour is *combined* with the gluten. Alumina would be detected in bread by the logwood test if present either as hydrate or phosphate, and the author now considers that this test is invariably efficient in detecting alum added to bread.—E. E. B.

Thomas Slag. J. H. Vogel. Rep. Anal. Chem. **7**, 469—477.

IN connection with the valuation of basic slag according to the fineness of the ground product (see this Journal, 1887, 46), it has been suggested that those portions which pulverise with facility contain phosphoric acid in a more useful form than the phosphoric acid of the remaining portions. The author has investigated this subject and finds, as many others do, that the percentage of phosphoric acid is higher in the fine than in the coarser portions of the ground slag and intermediate in the commercial product. Collateral experiments with these three forms of the slag indicate that on digestion with hydrochloric acid or with ammonium citrate they always yield phosphoric acid in the following order:—Most from the fine, least from the coarse, with the original commercial ground slag intermediate. With hydrochloric acid of different dilutions up to 1 : 8, the quantity of phosphoric acid dissolved increases with the dilution. The author is perfecting a method of analysis based on this fact. Taking all things into consideration, the author concludes that the phosphoric acid exists in the same forms in both the fine and coarse portions of the ground slag; and that the low percentage in the coarse stuff is due to the higher percentage of iron it contains.

The author recommends the following method of decomposing the slag in preference to Brunnemann's (see this Journal, 1887, 304); it is quicker and yields results within less than 0·1 per cent. from Brunnemann's. Five grams of slag are digested in a half-litre flask, with 100cc. of strong hydrochloric acid and 20cc. of concentrated nitric acid for half-an-hour on a water-bath; when cool the flask is filled up to the mark and the phosphoric acid determined in 50cc. by the molybdate method.

By fusing the slag with potash, extracting with hot water and digesting with ammonium carbonate, a constant quantity of phosphoric acid is always found in the solution, which invariably coincides with the quantity extracted by ammonium citrate.—D. A. L.

Determination of Titanic Acid. L. Levy. Pharm. Chim. **16**, 56.

To determine titanic acid in presence of alkalis or the oxides of magnesium, zinc, aluminium or copper, the substance is fused with five times its weight of potassium bisulphate, the melt extracted with water (if necessary with addition of sulphuric acid) and the liquid neutralised with caustic potash or ammonia. Sulphuric acid is then added to the extent of 0·5 per cent. by volume of the total solution and the whole boiled for six hours, water being added from time to time. The precipitated acid is ignited and weighed.—C. A. K.

The Reactions of Vanadium and their Application to Chemical Analysis. A. Carnot. Compt. Rend. **104**, 1850.

URANIUM SALTS precipitate vanadic acid, both from an ammoniacal solution and from a solution slightly acidified with acetic acid, and this reaction can be employed for its determination. The solution of vanadic acid is, if acid, very nearly neutralised with ammonia, a few grammes of ammonium acetate added, then an excess of uranium acetate and the whole heated to boiling, when a yellow precipitate is formed. To ensure the presence of an excess of uranium acetate a drop of the solution is tested with potassium ferrocyanide. The precipitate is filtered, washed and dried. Its composition is $V_2O_5.2UO_3(NH_4)_2O.H_2O$. This is heated to redness, together with the filter ash, and the resulting compound, $V_2O_5.2UO_3$ weighed. Vanadic acid can be determined by this method in presence of the alkalis, alkaline earths and of most of the metallic oxides whose acetates are not decomposed by boiling. The method is especially useful in separating vanadic acid from manganese, zinc and copper, but cannot be employed to separate it from the acids of arsenic or phosphorus.

A second method of determining vanadic acid depends upon the formation of an insoluble compound with manganese monoxide. A slight excess of ammonium chloride and ammonia is first added to the vanadium solution. The solution is then heated to boiling in a strong flask, when the manganese chloride or sulphate is added, mixed with ammonium chloride. The boiling is continued for 2—3 minutes, the flask corked and placed in cold water until the precipitate settles, after which the latter is filtered off and washed. It should be yellow brown in colour and become lighter on drying. It is finally ignited and weighed as $V_2O_5.2MnO$, which has a red-brown colour. By this reaction vanadic acid can be completely separated from molybdic acid. The filtrate from the above precipitate is treated with ammonium sulphide to remove the manganese and then molybdenum (if present) is precipitated as sulphide on the addition of hydrochloric acid. Phosphoric, arsenic and tungstic acids cannot be separated from vanadic acid by this method. The formation of the above precipitate also serves as a convenient means for isolating vanadium from alkaline or ammoniacal solutions. The manganese vanadate is heated with sulphur in a slow current of sulphuretted hydrogen and then treated with dilute hydrochloric acid (1 : 20), when the manganese sulphide is readily dissolved, while the sulphide of vanadium remains behind.—C. A. K.

Nitrates and Nitrites (II.). A Percy Smith. Analyst, **12**, 152—153.

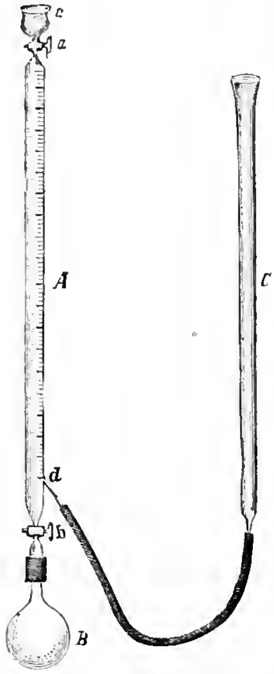
IN using the naphthylamine test, water must be prepared quite nitrogen-free by treating it with a copper-zinc couple for *at least* a week, rendering alkaline and distilling, rejecting any portion containing ammonia. The naphthylamine hydrochloride must be almost colourless, so it is advisable to keep animal charcoal in the bottle with it. It is best to perform the test by evaporating 100cc. *just* to dryness, adding ten drops of phenolsulphonic acid, then 1cc. of water, three drops of strong sulphuric acid, diluting, adding excess of ammonia and finally making up to 100cc. This reagent is better than *m*-phenylene diamine for ascertaining when all nitrites have been reduced by the copper-zinc couple, and the author prefers to use a surface of at least 8 sq. in. of zinc for 100cc. of water.—E. E. B.

Paraffin as a Preventive against Frothing during Distillation. H. Kunz. Arch. Pharm. **25**, 632.

Paraffin acts very effectually in preventing the frothing that generally occurs in decomposing ammonium salts by lime or magnesia. Two to three grms. are sufficient for an Erlenmeyer flask of 800cc. capacity, and containing 200—300cc. of solution.—C. A. K.

Estimation of Metallic Iron in Slag. G. Neumann. Zeits. Anal. Chem. **26**, 530—534.

The two methods at present in use for the estimation of metallic iron, mixed with iron compounds, are:—(*a*) Digestion with $HgCl_2$, and titration of the ferrous chloride produced, with $KMnO_4$; (*b*) Digestion with $CuSO_4$, weighing the separated copper or titration of the residual $CuSO_4$. The first method is liable to give too high results, the second, though very exact, cannot be employed when other bodies which decompose $CuSO_4$ are present; both methods require a great expenditure of time. The method employed by the author, whilst quite as exact as the above, has the advantage of being more rapid and generally applicable. The process consists in measuring the hydrogen evolved when the slag is treated with acid; this can be effected in a Lunge's nitrometer, but more conveniently with the apparatus figured. The flask B of 50—100cc. capacity, containing the material and nearly filled with water, is connected by indiarubber tubing to the graduated tube A of about 80cc. capacity and 1cm. wide. Water is poured through the tube C into B till the cock *b* is filled. The latter is now closed, and the cock *a* being open, the tube A is filled with acid through C. After closing *a*, *b* is opened and the acid allowed to mix with the water in the flask. On warming the hydrogen is given off, collects in A, and after the apparatus has cooled, it is measured and its volume corrected for temperature and pressure. If the hydrogen evolved contains CO_2 or H_2S, they can be removed by allowing some caustic potash to run in from the funnel *c*. The apparatus is also very serviceable for the estimation of metallic zinc in zinc dust or of CO_2 in carbonates.
—A. G. G.



On the Estimation of Phosphoric Acid in Thomas Slag. Dr. G. Kennepohl. Chem. Zeit. **11**, 1089.

The ready solubility of slag phosphates in moderately concentrated hydrochloric acid would have long since caused this method of extraction to become general in analysis, but that it was not clear whether it would be advisable thus to leave out of account the phosphorus existing in the slag as phosphide. Jensch, it is true, has shown (this Journal, 1886, 451) that iron phosphide is rapidly oxidised in garden soils, but this does not prove an equality between the phosphorus present as phosphide and that as phosphate. However, the author confirms the experiments of Jensch and Klein (this Journal, 1886, 451 and 502) as to the practical non-occurrence of iron phosphide in normal slags, and recommends the digestion of the phosphates for half-an-hour with strong hydrochloric acid, in which time the extraction should be absolutely complete. He has used the following method in the Darmstadt laboratory during the last two years:—10grms. of slag are introduced into a 500cc. flask, moistened with alcohol to prevent adhesion and heated in a water-bath for at least half-an-hour with 40cc. of HCl (1·12 sp. gr.) and 40cc. of water. After cooling, the flask is filled to the graduation mark and the solution filtered; 25cc. of the filtrate are then, after an addition of ammonium nitrate, precipitated directly with molybdate solution (without previous separation of silica), heated to 80° for 15 minutes, cooled, filtered, the precipitate washed with water containing 3 per cent. of nitric acid, dissolved in a 2½ per cent. ammonia solution and finally precipitated with magnesia mixture. The presence of the nitric acid in the wash-water for the phospho-molybdate precipitate is especially necessary in the presence of much iron, since a portion of the latter will otherwise remain and will contaminate the magnesium phosphate. In all the analyses made to test this process the magnesium precipitate after ignition was examined carefully, but in no case was any silica found, although no special precautions had been taken to ensure its exclusion. This is owing to the ready solubility of ammonium silicomolybdate. Where, however, a portion of the silica has become converted into the silicon-molybdenum salt, it may be readily removed by washing, the yellow colour of the wash-water being an indication of its presence. If the presence of ferrous salts should tend to cause the separation of molybdic oxide, which dissolves but slowly in ammonia, an addition of nitric acid or bromine, before introducing the molybdate solution, will ensure the production of a precipitate instantaneously soluble in the ammonia.—W. G. M.

Abnormal Ether Explosion. Ed. Schär. Arch. Pharm. **25**, 623.

The ether used was from a stock bottle which had been kept for many years; it was used for the estimation of fat in "coprah" and exploded while being evaporated in a platinum dish on an iron plate. It also did so with fats other than coprah. Analysis showed that the ether in question contained an extremely high percentage of H_2O_2 (over 5 per cent.), to which the author attributes the violent decomposition, it being favoured by the presence of the acids which are formed—viz., acetic and formic.—W. E.

A Note on Pettenkofer's Gallic Acid Reaction. F. Mylius. Zeits. f. Physiol. Chem. **11**, 492.

The author points out that this greatly depends upon the action of furfurol. If one drop of furfurol be dissolved in 10cc. of water, one drop of the solution is sufficient to colour a mixture of cholic acid, water and sulphuric acid blood-red. The substance which gives rise to the reaction is of itself apparently colourless and acid in property. It can be extracted by ether from the acid solution; 0·000,025grm. of furfurol can be detected by this cholic acid reaction. There are other substances which give a similar reaction with furfurol and sulphuric acid—viz., isopropylalcohol, isobutylalcohol, allylalcohol, trimethylcarbinol, dimethylethylcarbinol, amylalcohol, oleic acid, petroleum; the following do not give the reaction: ethylalcohol, propylalcohol, caprylalcohol, acetic acid, acrolein, benzene. Probably the alcohols do not in themselves enter into combination with furfurol, but the decomposition products by the action of the sulphuric acid.—W. E.

A Test for Linseed Oil and Linseed-oil Varnish. Ed. Hahn. Pharm. Zeit. **32**, 449.

THE readiest means of distinguishing these is by the action of lime water which, when mixed in equal proportions, gives a yellow permanent emulsion with linseed oil but not with linseed-oil varnish. Bleached linseed-oil varnish does not react like the unbleached but gives a pure white emulsion.—W. E.

Examination of Raw Sugar for Sulphurous Acid. Deutsche Zuckerind. **12**, 939.

ACCORDING to Davidson, 1·5—2cc. of cold, very dilute starch solution is poured over 1—1·5grm. of the sugar and as soon as the greater part of the sugar is dissolved a few drops of iodic acid are cautiously allowed to flow over the surface of the sugar solution. In the presence of sulphurous or hyposulphurous acid there immediately appears at the point of contact a blue ring. Second-rate products, as molasses, do not give this reaction, owing to the presence of reducing agents. To estimate the amount of SO_2, 10grms. of sugar are dissolved in cold water free from air, neutralised with H_2SO_4, a few drops of starch solution added and titrated with a centi-normal iodine solution until the blue colour no longer disappears. Ordinary sugars mostly require 0·3cc. of iodine solution, while some sugars as much as 9·8cc. equivalent to 0·03 per cent. of SO_2.—W. E.

Detection of "Fahlberg's Saccharin." C. Schmitt. Rep. Anal. Chem. **7**, 437—441.

THE tests for Fahlberg's saccharin (orthosulphaminebenzoic acid) depending on the formation of ammonia or the alkaline sulphides, are scarcely of sufficient delicacy or convenience for the detection of minute quantities, as, for instance, in wine. The following, based on the formation of salicylic acid during the fusion of saccharin with alkalis, is recommended where salicylic acid is not already present in quantities sufficient to impair the delicacy of the reaction. The wine is rendered strongly acid and 100cc. are shaken three times successively with 50cc. of a mixture of equal volumes of ether and light petroleum. The united extracts are evaporated after the addition of some caustic soda and the residue is heated at 250° for half-an-hour with 0·5 or 1grm. of solid caustic soda. The fused mass is dissolved in water and the salicylic acid separated and detected in the usual manner. In this manner 0·005 per cent. of saccharin, or even less, may be detected. The mixture of equal volumes of ether and light petroleum, an excellent solvent for saccharin, does not dissolve tannin and such like substances, which also form salicylic acid when fused with alkalis and would interfere with the test if they were extracted. Potash cannot be used for the fusion in place of soda.

—D. A. L.

Colour Reaction for Chloral Camphor. Haarst. Nieuw. Tijdsch. Pharm. Nederl. 1887, 179.

BY adding a trace of hydrochloric acid and a few drops of peppermint oil to chloral camphor, a red coloration results, which on warming, gradually passes into blue-violet. On diluting with alcohol or ether the liquid first becomes dark-blue, then blue-green and finally chlorophyll green with a blood-red fluorescence.—C. A. K.

The Carbamides and their Reaction with Nitric Acid. P. N. Franchimont. Rec. des. Trav. Chim. des Pays-Bas, 1887, 213.

THE author has already shown that carbamide and its methyl derivatives are readily decomposed at ordinary temperatures by nitric acid, with evolution of nitrous oxide. He has now examined other urea derivatives, especially those in which hydrogen is replaced by an acid residue and is led to the conclusion that, if the urea residue forms a closed chain with the residue of a mono or dibasic acid, it no longer behaves as an amide towards nitric acid, with a decomposition similar to that quoted above. A further study of these reactions showed that if carbamide forms a closed chain with a chain of two or three carbon atoms linked to hydrogen or oxygen, whether saturated or not, the resulting urea derivative is not decomposed by nitric acid at normal temperatures; if carbamide forms a closed ring with one carbon atom, nitric acid produces an unstable nitro-derivative which decomposes into a nitro-hydrocarbon and urea, the latter of which then suffers decomposition as explained. Uric acid is so broken up by nitric acid at common temperatures into carbon dioxide and nitrous oxide, as to show that one molecule of urea corresponds to one molecule of uric acid, though this does not, at first sight, agree with Medicus' formula for uric acid.—W. G. M.

The Determination of Certain Salts in Soap. F. M. Horn. Zeits. f. d. Chem. Ind. **16**, 85.

THE usual process of estimating the sulphate, chloride and carbonate of sodium or potassium in soap by extracting the soap with absolute alcohol and testing the residue, leads to wrong results, as absolute alcohol of commerce dissolves not inconsiderable quantities of those salts. Furthermore, the high percentage of water in soaps dilutes the alcohol, whereby salts go into solution in the alcoholic extract, which amount is always neglected. The author recommends to dissolve soap in water, separate the fat with nitric acid and determine the chlorine in the filtrate with silver nitrate. For estimating sodium or potassium carbonate and sulphate, the soap must be dried for a long time at 30° to 40° C. and afterwards at 110° to 120° C. The dry soap is then treated with absolute alcohol, filtered, washed, and the residue on the filter taken up with boiling water; one portion is titrated with standard acid, while another portion is retained for the estimation of sodium or potassium sulphate. Better still is a direct determination of the carbonic acid. Below are the results of two analyses, performed by the old (I.) and the author's (II.) process:—

	H_2O	NaCl	Na_2CO_3	Na_2SO_4	
Glycerine Soap	35·7	3·86	2·01	0·73	I.
Cocoa-nut-oil Soap	55·4	4·58	1·66	0·61	
Glycerine Soap	35·7	5·06	3·96	1·25	II.
Cocoa-nut-oil Soap	55·4	9·50	3·35	1·23	

—S. H.

Examination of Cane Sugar mixed with other Optically Active Substances by the Polarimeter, both before and after Inversion, and employing Clerget's Formula. W. Gautenberg. Chem. Zeit. **11**, 953.

DARK-COLOURED syrups and molasses may be decolorised by lead acetate without any prejudicial effect in the resulting measurements by the polarimeter. The product must be decolorised before inversion, then the lead precipitated by hydrochloric acid and an excess of acid added to effect the inversion. The weighed quantity of molasses is dissolved in water, decolorised with acetate of lead (if necessary with tannin), the solution made up to 100cc., filtered and examined in the polarimeter. 50cc. of the filtrate are next placed in a 100cc. flask, an excess of hydrochloric acid added and the flask warmed in the water-bath for not more than 15 minutes to 66—68° C. It is important not to exceed either the time of warming or the temperature and the flask should be placed inside the water-bath, not on a metal ring. After heating, the flask is cooled as quickly as possible to the temperature of the room, filled up to the 100cc. mark with water, allowed to stand at least 10 minutes and then the levro-rotatory power of the solution determined. This factor multiplied by two and corrected for temperature is introduced into Clerget's formula as the value for the inverted solution.—C. A. K.

Estimation of Rosin in Beeswax. F. M. Horn. Rep. Anal. Chem. **7**, 503—504.

A SAMPLE of bees-wax known to be impure was examined by determining the amount of alkali required to combine with the free fatty acid, the total alkali to effect complete saponification, the amount of matter extracted by ether and lastly, the ratio of the ether extract to the amount of alkali required to combine with the free fatty acid. Compared with the figures obtained with genuine beeswax, these results showed that stearic acid, tallow and rosin might be present. A glycerin test by Benedikt and Zsigmondy's process proved tallow, etc., to be absent and then from the ether extract no stearic acid could have been present. Rosin was found by Donath's test, which consists in boiling with nitric acid and adding first water and afterwards ammonia, when a blood-red colour is produced. The percentage of rosin (R) could then be calculated from the formula—

$R = \frac{100\ (A - a)}{(r - a)}$ where A, a and r were the amounts of alkali required to combine with the free acid in the mixture, in pure beeswax (20) and in pure rosin (146) respectively.—E. E. B.

Estimation of Extract of Conium. A. Kremel. Pharm. Post. **20**, 521.

To estimate the amount of coniine, 7·5grms. of extract are dissolved in 10—15cc. of water and the solution gradually brought up to 150cc. with 95 per cent. alcohol. To the solution placed in a cylinder 10grms. of freshly-slaked lime are added, the cylinder corked, the whole shaken and set aside twenty-four hours, then filtered. To the filtrate 1grm. of tartaric acid is added and the precipitated tartrate of lime filtered off: 100cc. of the filtrate (= 5grms. extract) are freed from alcohol by heating on a water-bath after the addition of 25cc. of water. After cooling, the aqueous solution is filtered, washed and the acid liquid exhausted with ether. After the removal of the ether the residue is rendered alkaline with KHO and then shaken with ether, which removes the conine. To the ethereal extract an equal volume of absolute alcohol and 25cc. of centi-normal HCl are added and the solution is titrated back with centi-normal NaHO, litmus being used as the indicator.

—W. E.

Determination of Sugar in Beet. Burkhard. Neue Ztschr. Zuckerind, **19**, 30.

THE author states that accurate and concordant results are obtained by the Siekel-Soxhlet apparatus, by that of Scheibler (both the old and new form) and by the Rapp-Degener method, provided the necessary conditions are carefully fulfilled. It is best to digest 51·2grms. of the beet with alcohol in the usual form of flask, with a capacity of 201·2cc., add 10—15 drops of acetate of lead and heat on the water-bath to 75° for three-quarters of an hour. In using Scheibler's apparatus A the time for extraction should be extended to one hour. Scheibler's apparatus B (capacity of flask 200cc.) is specially recommended.—C. A. K.

New Books.

THE EXTRA PHARMACOPŒIA, with the Additions introduced into the British Pharmacopœia, 1885. By WILLIAM MARTINDALE, F.C.S., etc. Medical References and a Therapeutic Index of Diseases and Symptoms, by W. WYNN WESTCOTT, M.B. Fourth Edition. London: H. K. Lewis, 136, Gower Street, W.C. 1885.

SMALL 8VO VOLUME, bound in morocco leather to serve as a pocket-book, containing list of references to current literature, a review of the British Pharmacopœia of 1885—its additions, omissions, changes in nomenclature, and principal alterations, and 386 pages of text, including from page 337 onwards a Secondary List of Drugs, of some of which little or no experience has been had, and of others which are old remedies recently resuscitated. An Appendix is devoted to Antiseptic Applications and Surgical Dressings, to Histological Preparations for Staining, Hardening and Mounting Microscopic Objects, Index and Posological Table, and a Therapeutic Index of Diseases and Symptoms. The most interesting part of this little work to manufacturers of Fine Chemicals and others connected with such branch, as well as to the Research Chemist of Organic Chemistry, will be the portion devoted to the rarer alkaloids, vegetable extracts, and other organic compounds.

Obituary.

MR. CHARLES MOSELEY.

A MEMBER OF THE SOCIETY OF CHEMICAL INDUSTRY.

IN the sudden death of Mr. Charles Moseley, on Saturday, 8th October, Manchester has lost one of her most public-spirited, far-sighted, and energetic citizens. Besides having the practical management of the extensive indiarubber factory of which he shared the proprietorship with his brother, Mr. Joseph Moseley, he was Chairman of the Lancashire and Cheshire Telephone Company, one of the most active of the Directors of the Manchester Ship Canal, and the Chairman of the No. 7 Section of the Royal Jubilee Exhibition in Manchester, a Section having charge of the electric lighting of the building and of the gardens, of the music and of the catering. But even these duties, sufficiently heavy for any ordinary individual, only represent a fraction of all the engagements to which he so zealously, so untiringly devoted his full energies. It is well known in Manchester how much we owe to that indefatigable energy and persistent attack, which, in the contest with the Post Office—that strove under the Telegraphs Act to prevent the establishment of telephonic communication between adjoining towns—gave Mr. Charles Moseley at length the victory over that short-sighted opposition, and to his fellow-countrymen the inestimable boon of telephonic communication between towns. Thus, the present "trunk-line" system has been developed, by which it is possible for most of the Lancashire towns to hold telephonic communication with each other. When the Edison Electric Light Company was organised, his interest in electricity induced him to take a leading position, and as a Director he has always taken an active part in fostering its development and welfare.

One of the most surprising things in connection with Mr. Moseley was his quick perception. For example, it was his voice that was first raised to propose the abolition of technical juries and medal awards in connection with the Manchester Exhibition, a proposition unanimously received by the Executive Council, and adopted with the greatest benefit to the Exhibition. This fact is borne ample testimony to by the determination of the Executive of the Glasgow Exhibition of 1888 to follow in this respect the example of Manchester, and leave reward to the natural and unbiassed voice and verdict of public opinion.

Mr. Charles Moseley was born in the year 1840, and in his death he leaves a widow and three young children to mourn his loss.

Trade Report.

(From the Board of Trade and other Journals.)

GENERAL MEETING OF THE SOCIETY FOR THE PROTECTION OF THE INTERESTS OF THE GERMAN CHEMICAL INDUSTRIES.

FRANKFORT, *Sept 1th.*

The secretary of the Society submitted his business report. The result of a retrospect of the last year, 1886, is relatively favourable. In spite of a not unimportant augmentation in production, which occurred in all branches of chemical industry, the increased supply was taken up by the consumers without difficulty, so that no great accumulation of stocks has taken place. This favourable development of trade was, however, in part compensated for by a fall in the prices of many of the articles produced. In the course of the year it has been possible, chiefly through conventions, not only to put a stop to this movement, but in many instances to cause an improvement in prices. It is unfortunately not yet possible to make a statistical comparison of the activity developed during the year 1886 in the productions of the chemical industries with former years; however, in future years the statistics of the associations will furnish the suitable materials for this purpose. During the year 1886 there were in the chemical industries 23,528,498 working days, for which 61,797,490 marks were paid as wages. It is seen from the published statistics of the companies that as a matter of fact an increase in the profits occurred in almost all branches of chemical industry. In the year 1886 82 limited companies, with a paid-up capital of 162,540,842 marks, returned as dividend 11,659,895 marks, being 7·17 per cent.

This increase of profits has not taken place in all instances, but principally only in the older-established works, where large amounts have already been written off. In order to render a comparison with former years possible only those factories may be considered which have existed at least since 1881. In that case there is an average dividend of 9·25 per cent. In comparison with former years it is seen that the average dividend, which since 1882 steadily decreased, in the last year again moved in an upward direction. The average dividend of these manufactories amounted to—

For the year 1882	13·07 per cent.
,, ,, 1883	11·04 ,,
,, ,, 1884	8·42 ,,
,, ,, 1885	7·92 ,,
,, ,, 1886	9·25 ,,

If the principal branches of chemical industry be considered which paid dividends, the following results are obtained. The dividends paid in the soda and potash industries were—

In the year 1882	9·89 per cent.
,, ,, 1883	9·27 ,,
,, ,, 1884	6·54 ,,
,, ,, 1885	5·58 ,,
,, ,, 1886	5·68 ,,

It results from this, that if the turn for the better in this branch of chemical industry has not been very important, still it shows that a step has been taken in an upward direction. No branch of chemical industry within the last ten years has had such rapid development as the soda industry. While the production in the whole of Germany during 1878 only amounted to 42,500 tons, there are at present in 24 works (Getriebsstatten) 150,000 tons manufactured. This increase is almost wholly due to the introduction of the ammonia-soda process. Ten years ago the imports of soda amounted to only 27,000 tons, signifying that 40 per cent. of our requirements had to be covered from abroad. Now we are able, in spite of the immense increase in consumption, not only to supply home requirements, but we have already commenced to export. The price of the 98 per cent. calcined soda in the same time has gone down from 20 to 8 marks in spite of the increased duty.

In the Stassfurt industry (potash salts) the business in chloride of potash has been developed steadily, with unchanged prices and increased sales. The production is increased so that at the beginning of this year the daily output of carnallit has risen from 45,000 to 55,000cwt. The sales to the different countries have been fluctuating. This was particularly seen with America, which did import considerably less than in former years on account of a commercial crisis. This deficiency has been abundantly compensated for by larger home consumption, so that at the close of the year only the necessary stocks were in hand. The sales of potash salts for manure which are obtained from kainit were less favourable, as America, the chief purchasing country, took considerably smaller quantities. Still, the total sales are not much behind those of former years.

In the tar colour trade the average dividends declared by the German "Aktien Fabriken" were—

In the year 1882	20·53 per cent.
,, ,, 1883	14·06 ,,
,, ,, 1884	10·49 ,,
,, ,, 1885	6·70 ,,
,, ,, 1886	9·45 ,,

In this branch of chemical industry, likewise, reduction in prices took place, which, however, was kept within moderate limits, whilst the sales at the same time, particularly for export, rose considerably. The exports in the year 1885 were 4,645,000kilos., and in 1886 5,700,000kilos.

Respecting the manufacture of explosive materials, the following are the results. The average dividends paid were—

In the year 1882	9·39 per cent.
,, ,, 1883	10·51 ,,
,, ,, 1881	8·09 ,,
,, ,, 1885	10·01 ,,
,, ,, 1886	15·46 ,,

This favourable development of business during the last years has principally been of good to the old and large establishments, which through conventions were able to secure high export prices, and utilise suitably the fluctuations in the raw material market; while some of the more recently established factories, as the Cologne and Siegener dynamite works, have not yet, for instance, been in a position to declare any dividend to their shareholders, and lately the prospects of profits of these companies have got worse on account of the price of glycerine, which has risen from 54—60 marks, paid last year, to 106—110 marks.

The manufacturers of artificial manures (superphosphates) have again worked most unsatisfactorily. They paid as dividends—

In the year 1882	6·74 per cent.
,, ,, 1883	5·79 ,,
,, ,, 1884	4·16 ,,
,, ,, 1885	3·30 ,,
,, ,, 1886	3·52 ,,

The fault of this unfavourable result lies not so much in the small consumption as in this, that the manufacturers have been injuring themselves through constantly lowering their prices on account of the unfounded fear that the very much increasing consumption of Thomas basic slag might influence the demand for superphosphates. The efforts to form conventions remain without result. Only in some districts (Hamburg, Hanover) have the manufacturers succeeded in coming to an agreement among themselves, and here it has worked with somewhat better results, to which principally the increase in the average dividend of this year is to be ascribed.

In the production of technical, pharmaceutical, and photographic preparations the average dividends stand as follows:—

In the year 1882	11·88 per cent.
,, ,, 1883	11·05 ,,
,, ,, 1881	15·50 ,,
,, ,, 1885	15·01 ,,
,, ,, 1886	16·83 ,,

This satisfactory average is not found to occur in all branches of this industry; it is rather due to the prosperous condition of one of the most important manufactories (Schering). In this industry, also, important reduction in prices has taken place, particularly so with the alkaloids quinine, caffeine, atropine, cocaine, and veratrine. The acknowledged superiority of the German preparations, especially abroad, has also here insured an increase of sales.

Among the other important branches of chemical industry, the manufacturers of mineral colours have done satisfactory business both at home and abroad. Only the export to Austria was somewhat limited owing to the disproportionately high duty, and to Scandinavia on account of the rigorous arsenic law. Owing to strong competition, prices were only, with much difficulty, able to maintain themselves.

The condition of ultramarine has been very unsatisfactory. The cause of this is to be sought, not perhaps in over-production, but in diminished consumption, occasioned partly through the influence of fashion and partly because ultramarine is being replaced by other colouring materials. Export for inferior sorts has become impossible on account of the high duties, and can only be effected for the best varieties and for specialities. Only old and very substantial firms have been able to defy these unfavourable circumstances, and there are, as a matter of fact, in Germany scarcely two or three firms which work without loss.

The secretary reported as to the internal activity of the Society, and the work which has been carried out by the various committees.

In connection with the secretary's report, the meeting resolved to direct their efforts so that German manufactures should only be exported with German labels and German designation, and called upon the members to use their influence in their Chambers of Commerce, etc., to prevent the credit of the good products of German manufacture being given to foreign countries.

The revision of the Patent law was next the order of the day. The Imperial Enquiry Commission has rendered a report, on the basis of the enquiry discussion, to the Imperial Government, in which definite proposals are made concerning the alterations in the existing Patent Law. The Patent Law Committee of the Society has given definite counsel in these discussions concerning the position of the chemical industries; these discussions will soon be brought to a conclusion.

With respect to the original project of the Imperial Government for making provision for invalid and aged workmen, there being many alterations necessary before bringing about a discussion in the Society, the subject was adjourned.

The meeting then considered the question of insurance against fire of chemical factories. Statistics concerning the fire insurance of chemical works during the last 10 years, with a collective insurance amount of over 200 million marks, were laid before the meeting. This showed that during the stated time, on the whole 23·2 per cent. of the paid premiums have been paid back in making good losses. On the basis of these statistics, and regarding the little consideration which the insurance companies have hitherto shown to the wishes of the chemical manufacturers, the Society resolved by a large majority to instruct the committee concerning the plan of the formation of an insurance of chemical works, based on reciprocity, to take the matter into consideration, and to take in hand the necessary preliminary steps. The necessary sum for this purpose (amounting to 5000 marks) was placed at the disposal of the committee.

Respecting the reform of the Trade Marks law, a petition will be forwarded from the Society to the Imperial Chancellor, who will be requested so to frame the law, that in the intended reorganisation of the Patent Law Commission, steps be taken at the same time for the consideration of the reorganisation of the Trade Marks law. The petition included also that there might be, for the carrying out of the Trade Marks law, a distinct trade marks office established, affiliated to the patent office itself.

This official should at the same time take in hand the task of examining the already registered marks, as well as the more recent, and to publish periodically the authorised and recognised marks.

Unfortunately, for Frankfort especially, the next order of the day had to be set aside, as the work of the committees had not sufficiently advanced. It related to the pollution of public watercourses by manufacturers' waste liquors.

The work of the special committee to which has been entrusted the question of the preparatory education of chemists continues. For the present it has been decided that the real schools for the preparatory education of technical chemists shall be considered equal to that obtained in the colleges. The conclusion of academic study should not in future (as up till now) form the doctor degree, but an examination before a Government Commission, and which shall comprise certain subjects (general chemistry, chemical technology, physics, and various other allied subjects). Concerning the fixing of the proper course at the technical high schools or at the universities, the consideration shall be continued. Eventually prizes should be granted for the best papers dealing with this subject.

Two resolutions were moved by members. The first concerned the transport of mineral acids by rail; the second the needful facilities for the use of alcohol in chemical industries for general and manufacturing purposes. The meeting resolved regarding the first proposition to petition the proper quarter, and appointed a special committee (consisting of nine members) for its consideration.

MISCELLANEOUS TRADE NOTICES.

THE NEW GERMAN SPIRIT LAW.

By order of the Prussian Finance Minister alcohol for medicinal and scientific purposes has been provisionally declared exempt from the principal clauses of the new German spirit law. It is also provided that all alcohol for such purposes at present existing in Germany will remain free from the increased duty if used within three months from October 1. The authorities charged with the execution of the law have measured the quantity of alcohol in stock in Prussian pharmacies and chemical works on the 1st of this month, and nothing may be taken from the supply thus found except in the presence of the Customs officers, who will satisfy themselves that it is used for pharmaceutical or scientific purposes, a control which appears to be of a rather complicated character.—*Chemist and Druggist*, October 22, 1887.

EXHIBITION OF ILLUMINATING APPARATUS AND NAPHTHA INDUSTRY AT ST. PETERSBURG.

A report, dated the 2nd September last, has been received from Mr. J. Michell, her Majesty's Consul at St. Petersburg, enclosing copies of notices relating to an exhibition of illuminating apparatus and naphtha industry which is to be opened at St. Petersburg in November next, with the sanction of the Russian Government and under the auspices of the Imperial Russian Technical Society.

[The notices in question, containing particulars as to the exhibition, may be seen on application at the Commercial Department, Board of Trade, S.W.]

RAMIE CULTIVATION IN SAXONY.

The Italian *Bollettino di Notizie Commerciali* for the 4th September last, quoting from the *Moniteur Industriel*, states that the first German manufactory of ramie was established at Zittau. The thread produced in these looms has the brilliancy of silk, and is used largely for the upholstering of furniture. After some initial delay and disappointment, the manufacture began to flourish, and since 1883 has been in a very satisfactory state. The cultivation of the ramie is carried on in the Oberkunewalde, with the following species of plants, the *Urtica dioica* or common nettle of Germany, the *Laportia Canadensis* or North American nettle, the *Urtica nirca*, which is known as "China grass," and is a native of China, and the *Urtica tenacissima* or "ramie" proper, which was originally discovered in Siberia, then cultivated in Algeria, and afterwards introduced into central France, and lately into Hungary. The two last-mentioned species have borne the winter in Oberkunewalde with perfect success.

COMMERCIAL MUSEUM AT TREBIZOND.

According to the *Bulletin du Musée Commercial* for the 17th September last, a Commercial Museum is about to be opened at Trebizond, under the auspices of the Belgian Consulate in that city.

COMMERCIAL MUSEUM AT AVIGNON.

According to the *Moniteur Officiel du Commerce* for the 15th of September, the French Minister of Commerce and Industry has approved, by a decree of the 6th of September, the establishment of a Commercial Museum by the Chamber of Commerce of Avignon.

COMMERCIAL MUSEUM AT TOKIO.

The *Bulletin du Musée Commercial* for the 27th September last states that the Japanese Government has attached to the School of Commerce in Tokio a Commercial Museum, for the purpose of exhibiting to Japanese importers foreign articles of trade which are likely to interest them. The School of Commerce at Tokio, according to the *Bulletin*, is an important institution, containing no less than 500 students, who are being trained with a view to their spreading the latest principles of commercial science through the length and breadth of Japan. The *Bulletin* remarks that it is, therefore, of importance to European merchants to contribute to the new museum, and adds that specimens may be sent, addressed to Mr. Takashi Masuda, Hitotsubashidori, Tokio, Japan.

COMMERCIAL MUSEUM AT ANTWERP.

The *Bollettino di Notizie Commerciali* for the 4th of September states that a Commercial Museum was opened at Antwerp on the 21st of August last.

CANDLE TRADE IN CHINA.

The *Bulletin du Musée Commercial* for the 10th of September last, quoting from the *Exporteur*, states that the trade in candles with China is important, and capable of great development. The candles most in demand in China are those which are of the colour of red sealing-wax. Blue candles are used in funeral ceremonies, and there might well be made a large supply of these. At present none but white candles are imported into China, and they are surface-coloured very cheaply before being re-sold. It should be remembered in preparing candles for the China market that the Chinese prefer them with a bamboo wick projecting at the bottom, so as to be easily fixed into a hole in the candlestick.

BEET SUGAR CULTIVATION IN THE UNITED STATES.

It is stated in *Bradstreet's* of the 3rd September last that a large sugar refiner is reported to be contemplating the experiment of growing beet-root sugar in the United States, in one of the central Western States. The climate is said to be similar to that in Germany and Austria, where beet-root cultivation is a most important industry. Whether, says *Bradstreet*, under present conditions of low sugar prices it is possible to successfully make this sugar in the United States, is an interesting question. In 1886 the total consumption of sugar of all kinds in the United States was 1,389,125 tons, of which only one-tenth was produced in that country.

FILTERS WANTED FOR THE STATES.

There is a good opening in the States, says the *Medical Press*, for an enterprising manufacturer of filters. They have no filters, or if they have they do not use them. Nor is it on account of the extreme purity of their water supply, for out of many specimens examined during the past few weeks, scarcely one fulfilled the primary conditions of freedom from colours and sediment. It was to this, indeed, apart from what was mixed with the water, that the foreign delegates to the Medical Congress attributed the choleraic diarrhœa from which nearly all of them suffered during their visit.

PROBABLE ADVANCE IN THE PRICE OF PETROLEUM.

We have reason to believe, says the *Financial News*, that there is likely to be a substantial and sustained advance in the price of petroleum. We understand that, at the instance of the Standard Oil Company, steps have been taken to limit the production for a long period, and the effect of this upon values, both here and in the United States, is already beginning to be felt.

THE CHLORIDE OF POTASSIUM INDUSTRY.

According to the report of the general representative of the syndicate, the chloride of potassium business in the first half of the current year entirely fulfilled the expectations of the syndicate. The sales in the first half were generally weaker than in the second half of the current year. Nevertheless, the sales in the first half attained a higher standard than has yet been reached since the syndicate has been established, as is clear from the following figures. The sales of potassium chloride amounted :—

In the	1st	half of	1884	to	875,197	ctr.[*]
,,	2nd	,,	1884	,,	912,012	,,
,,	1st	,,	1885	,,	930,054	,,
,,	2nd	,,	1885	,,	1,009,851	,,
,,	1st	,,	1886	,,	879,032	,,
,,	2nd	,,	1886	,,	1,005,028	,,
,,	1st	,,	1887	,,	1,062,024	,,

—*Kuhlow's.*

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[*] The centner equals 110lb. roughly.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

UNITED STATES.

Customs Decision.

Sugar known as "cube sugar," refined in the United States from imported raw sugars, is held upon exportation to be entitled to the rate of drawback prescribed by the existing instructions of the Treasury Department as to "refined loaf, cut-loaf, crushed, granulated, and powdered sugar," viz., $2\frac{68}{100}$ cents. per pound, less the legal retention of 1 per cent.

NEW CUSTOMS TARIFF OF BRAZIL.

(Continued from page 613 of the September Number of the Journal.)

(*Note.*—Kilogramme = 2·204lb. avoirdupois. Litre = 0·22 Imp. gallon. Milreis = 2s. 3d.—nominal value.)

No. in Tariff.	Articles, etc.	Rates of Duty.	
	XI.—CHEMICAL PRODUCTS, PHARMACEUTICAL COMPOSITIONS AND MEDICAMENTS IN GENERAL.—*contd.*		Reis.
332	Sulphates and hyposulphates:		
	Of alumina:		
	And potash, alum stone, crystallised	Kilog.	30
	And potash, alum stone, calcined	..	600
	And of ammonia and other bases	..	400
	.. ammonia	..	400
	.. baryta, common, heavy spar or Bologne stone, and artificial or precipitate ..	..	650
	.. cadmium	..	7,000
	.. lime or plaster, pure or precipitate	..	500
	.. cerium	..	6,000
	.. lead	..	500
	.. cobalt	..	7,000
	.. copper:		
	Pure, blue vitriol or blue copperas	..	50
	Of ammonia or ammoniacal	..	4,600
	.. iron:		
	Impure, green vitriol or common green copperas	..	10
	Pure salts of iron	..	160
	Of ammonia or other bases	..	350
	.. lithia	..	10,000
	.. magnesia, Epsom salts......	..	40
	.. potash, neutral, Duobus salts, polychrest salts, and acid or bisulphate of potash	..	300
	.. silver	..	40,000
	.. quinine, neutral or acid	..	10,000
	.. soda:		
	Neutral or Glauber salts..	..	40
	Acid or bisulphate of soda	..	300
	.. strontian:		
	Natural or in the lump ..	..	300
	Artificial or precipitate..	..	1,000
	.. zinc, white vitriol or white copperas	..	200
	.. any metal, not otherwise mentioned	..	1,600
	.. alkaloids or organic bases ..	Gramme	100
333	Sulphites, bisulphites, and hyposulphites:		
	Of soda...	Kilog.	160
	.. any metal, not otherwise distinguished	..	800
	.. alkaloids or organic bases ..	Gramme	100
334	Sulphocyanides of any kind	Kilog.	2,000
335	Sulphides, hydrosulphates, and sulphydrates:		
	Of antimony:		
	Native or crude antimony	..	70
	Of sulphur, coated with antimony	..	1,000
	Hydrated, or mineral kermes..................	..	2,000
	Vitrified or antimony glass	..	500
	.. arsenic, yellow or red	..	250
	.. carbon, impure	..	320
	.. lead, neutral, or galena	..	250
	.. iron	..	250
	.. copper	..	200
	.. mercury, black mineral, and (deuto or bi), yellow or red	..	1,200
	XI.—CHEMICAL PRODUCTS, PHARMACEUTICAL COMPOSITIONS AND MEDICAMENTS IN GENERAL.—*contd.*		Reis.
	Sulphides, hydrosulphates, and sulphydrates—*contd.*		
	Of silver	Kilog.	30,000
	.. any metal or metalloid not otherwise specified	..	1,000
336	Suppositories of any kind..........	..	2,000
337	Tannates:		
	Of any metal....................	..	1,500
	.. alkaloids or organic bases ..	Gramme	100
338	Tannin, pure, or tannic acid	Kilog.	1,600
339	Tartrates:		
	Of bismuth	..	4,000
	.. iron, pure, and of potash and of ammonia or ammoniacal and of manganese (manganesiferous iron) ..	..	1,300
	.. potash:		
	Neutral or soluble tartar of potash (vegetable salts) and of emetic antimony	..	1,000
	Acid (bi):		
	Pure, or cream of tartar, crystallised or in powder	..	400
	Do., soluble	..	900
	Impure, crude tartar or wine lees	..	70
	.. silver	Gramme	50
	.. soda, neutral or acid, and of potash, Seignette salts ..	Kilog.	1,000
	.. metals, not otherwise mentioned	..	2,000
	.. alkaloids or organic bases	Gramme	100
340	Turpentine, distilled	Kilog.	800
341	Theriac and diascordium	..	1,000
342	Alcoholic dyes:		
	Of musk	..	6,000
	.. ambergris....................	..	6,000
	.. saffron	..	4,000
	.. vanilla	..	4,000
	.. hachich......................	..	8,000
	.. green plants and those not otherwise mentioned	..	1,000
	(*Note.*—Etherated dyes or etherolatures will pay 25 per cent. over and above the respective duties)		
343	Troches and perfumes:		
	Mentol.....	..	5,000
	Not otherwise mentioned......	..	1,300
344	Tungstates of any kind	..	6,000
345	Medicinal salves, cerates, and pomades of any kind	..	1,000
346	Urea and its salts	Gramme	40
347	Valerianates:		
	Of metal of every kind	Kilog.	10,000
	.. quinine	Gramme	25
	.. alkaloids or organic bases not otherwise mentioned	..	100
348	Vanadiates of any kind	Kilog.	14,000
349	Vaseline, white or yellow..........	..	1,000
350	Medicinal vinegars of every kind	..	1,000
351	Medicinal wines:		
	Bitters	..	320
	Vermouth	..	320
	Not otherwise distinguished ..	..	1,000
352	Medicinal syrups of any kind......	..	700
353	Xyline	..	4,000
354	Chemical products, natural or artificial, pharmaceutical preparations and medicaments in general, not otherwise mentioned	48 % *ad val.*	
	(*Note.*—Articles included in this category, if they are of a nature to be imported in the following conditions, viz.:—bruised, scraped, grated, and in powder will pay, in the first three cases, 10 per cent., and in the latter case, 25 per cent. over and above the respective duties.)		

RUSSIA.

Recent Customs Decisions.

(*Note.*—Poud = 36lb. avoirdupois. Funt = 0·902lb. avoirdupois. Gold rouble = 3s. 2d.)

Sesquicarbonate of soda.—Section 151. Duty, 10 roubles per poud gross, with an addition of 20 per cent. on each rouble of duty leviable.

Disinfecting powder, composed of carbolic acid not cleaned.—Section 16. Duty, 5 copecks per poud gross, with an addition of 20 per cent. on each rouble of duty leviable.

Mixtures of starch and borax.—Section 45. Duty, 1 rouble per poud, with an addition of 20 per cent. on each rouble of duty leviable.

Spirits of wine mixed with ammoniac and imported in bottles.—Section 77. Duty, 75 copecks per bottle

Solution of cochineal.—Section 119, Part 2. Duty, 5 roubles per poud.

Precipitate of alumina.—Section 125. Duty, 11 copecks per poud.

Pyrogallic acid.—Section 137, Part I. Duty, 4 roubles per poud.

Solution of chloric lime—Section 140. Duty, 2 roubles per poud, with an addition of 20 per cent. on each rouble of duty leviable.

Naphthalene.—Section 140. Duty, 2 roubles per poud, with an addition of 20 per cent. on each rouble of duty leviable.

It has been decided by the Customs authorities to prohibit in future the importation of *Tamar Indien*, unless it is accompanied by a statement setting forth the manufactory at which it was prepared, and an exact description of its properties.

FINLAND.

Modification of Customs Duties.

It appears from a report of Mr. Charles J. Cooke, British Vice-Consul at Helsingfors, dated the 5th September last, that the Imperial Finnish Senate has decreed that raw asbestos and asbestos powder should be imported into Finland duty free, while all goods made of asbestos should pay a duty on importation of 12 marks per 100kilos., with an addition of 20 per cent. if these goods consist of ready-made clothing of asbestos.

TRADE BETWEEN SPAIN AND THE UNITED KINGDOM.

Imports into the United Kingdom from Spain.

PRINCIPAL ARTICLES.		August 1886.	August 1887.
Chemical products unenumerated	Value	£6,401	£6,524
Copper ore and regulus	Tons	3,115	4,268
	Value	£66,568	£67,335
Manganese ore	Tons	..	..
	Value	..	..
Pyrites of iron or copper	Tons	40,826	42,053
	Value	£84,795	£74,836
Quicksilver	lb.	17,920	..
	Value	£1,200	..
Rags, Esparto	Tons	3,193	4,830
	Value	£17,594	£25,794

Total Value	1886.	1887.
August	£548,550	£660,821
September	£719,560	£710,363

Exports of British and Irish Produce from the United Kingdom to Spain.

PRINCIPAL ARTICLES.		August 1886.	August 1887.
Alkali	Cwt.	21,961	27,147
	Value	£7,466	£9,038
Caoutchouc manufactures	Value	£537	£1,385
Cement	Tons	1,355	258
	Value	£2,442	£460
Chemical products, including dyestuffs	Value	£5,993	£1,813
Coal products, including naphtha, etc.	Value	£856	£1,153
Glass manufactures	Value	£508	£740
Grease, tallow, and animal fat	Cwt.	1,332	2,302
	Value	£1,328	£2 171
Manure	Value	£184	£4,212
Painters' colours and materials	Value	£1,491	£2,580
Paper of all sorts	Cwt.	763	242
	Value	£1,548	£581
Soap	Cwt.	475	355
	Value	£451	£272

Total Value	1886.	1887.
August	£233,447	£313,297
September	£328,466	£304,001

STATISTICS.

TRADE STATISTICS FOR SEPTEMBER.

The Board of Trade Returns for September show the following figures:—

Imports.

	Sept. 1886.		Sept. 1887.
Total value	£28,898,505	....	£27,191,594

Exports.

	Sept. 1886.		Sept. 1887.
British and Irish Produce	£18,928,975	....	£19,833,830
Foreign and Colonial Produce (partly estimated)	4,496,979	....	4,553,461

Below are the details affecting drugs and chemicals:—

Imports.

		Sept. 1885.	Sept. 1886.	Sept. 1887.
Drugs, unenumerated	value £	72,984	60,655	46,456
Chemical manufactures and Products, unenumerated—	value £	98,810	98,214	105,167
Alkali	cwt.	6,910	5,440	5,952
,,	value £	5,375	4,088	4,952
Brimstone	cwt.	90,200	52,307	66,907
,,	value £	21,596	13,413	14,910
Nitre (nitrate of soda)	cwt.	110,370	28,300	54,249
,, ,,	value £	60,280	11,655	23,131
,, (nitrate of potash)	cwt.	47,414	21,175	21,599
,, ,,	value £	39,883	18,315	20,911
Quicksilver	lb.	22,500	63,750	38,270
,,	value £	1,750	5,130	3,252
Bark (Cinchona)	cwt.	7,180	11,011	8,604
,,	value £	43,217	25,537	35,057
Gum Arabic	cwt.	4,637	4,024	4,174
,,	value £	14,541	17,813	20,462
Lac, seed, shell, stick, and dye	cwt.	7,599	6,414	3,969
Lac, seed, shell, stick, and dye	value £	22,752	16,924	9,290
Barks and tanning materials—				
Bark (for tanners' or dyers' use)	cwt.	50,907	23,300	32,285
Bark (for tanners' or dyers' use)	value £	22,018	7,824	13,510
Aniline dyes	value £	16,241	21,973	25,310
Alizarin	value £	31,570	19,718	23,227
Other coal-tar dyes	value £	109	210	660
Cochineal	cwt.	722	916	854
,,	value £	4,329	6,210	5,434
Cutch and gambier	tons	2,590	3,015	2,507
,,	value £	53,483	75,361	62,050
Indigo	cwt.	835	1,200	826
,,	value £	11,825	20,620	14,617
Madder, madder root, garancine, and munjeet	cwt.	1,262	2,818	1,426
Madder, madder root, garancine, and munject	value £	1,595	3,120	1,820
Valonia	tons	1,989	1 489	1,574
,,	value £	32,636	21,079	22,231
Chemicals and dyestuffs, unenumerated—	value £	168,734	160,689	123,361
Oils—				
Cocoa-nut	cwt.	33,464	6,933	9,173
,,	value £	51,261	9,181	11,199
Olive	tuns	674	1,308	1,309
,,	value £	26,786	50,587	43,636
Palm	cwt.	73,552	98,533	77,097
,,	value £	95,618	101,637	75,729
Petroleum	gals.	9,672,123	3,965,723	6,153,916
,,	value £	292,177	131,560	168,070
Seed, of all kinds	tuns	1,237	1,262	1,233
,,	value £	34,841	33,215	29,139
Train, blubber, and sperm	tuns	3,205	2,025	1,402
Train, blubber, and sperm	value £	92,002	50,699	29,363
Turpentine	cwt.	61,847	13,568	32,591
,,	value £	84,917	19,078	41,275
Oils, not enumerated	value £	51,101	71,620	79,054
Tallow and Stearine	cwt.	72,100	75,461	61,781
,,	value £	101,776	91,090	73,631

Exports.

		Sept. 1885.	Sept. 1886.	Sept. 1887.
British and Irish produce:—				
Alkali	cwt.	614,330	479,080	511,165
,, ...	value £	172,633	140,108	153,431
Bleaching materials	cwt.	132,314	126,869	128,562
,, ,,	value £	44,504	40,707	48,380
Drugs and medicinal preparations (unenumerated)	value £	64,928	68,299	68,269
Other chemicals and medicinal preparations	value £	168,017	176,419	181,101
Chemical manure ..	value £	130,599	129,613	139,633
Oil (seed)............	tuns	5,981	4,479	5,021
,, ...	value £	138,776	99,362	109,316
Soap	cwt.	11,204	35,143	40,198
,, ...	value £	16,587	36,276	37,908
Painters' colours and materials (unenumerated)	value £	104,055	111,282	121,427
Foreign and Colonial merchandise:—				
Bark, Cinchona	cwt.	9,007	8,611	10,107
,, ,, ...	value £	51,299	39,729	33,332
Chemicals (unenumerated)	value £	12,954	9,471	17,521
Cochineal	cwt.	657	1,424	508
,, ...	value £	4,510	9,291	3,183
Cutch and gambier	tons	549	1,237	1,006
,, ,,	value £	14,418	33,093	26,853
Gum Arabic	cwt.	7,924	3,046	2,917
,, ...	value £	28,252	11,273	10,987
Indigo	cwt.	3,066	2,792	2,336
,, ...	value £	60,202	55,304	46,969
Lac, various kinds..	cwt.	3,884	7,755	8,551
,, ,, ,, ..	value £	12,102	23,101	21,533
Lard	cwt.	3,894	1,216	1,802
,, ...	value £	7,614	2,343	3,068
Oils, cocoa-nut	cwt.	8,968	12,507	5,408
,, ,, ...	value £	12,975	18,002	7,150
,, olive	tuns	216	209	213
,, ,, ...	value £	10,193	8,928	8,859
,, palm	cwt.	27,548	65,342	83,831
,, ,, ...	value £	36,386	67,626	80,713
,, petroleum	gals.	27,792	24,780	28,728
,, ,, ...	value £	1,462	1,123	1,222
Quicksilver	lb.	723,252	603,937	252,538
,, ...	value £	55,524	51,787	24,628
Nitre (nitrate of potash)	cwt.	2,255	586	973
,, ,,	value £	1,814	591	908
Tallow and stearine	cwt.	19,886	29,617	28,867
,, ,,	value £	26,110	33,408	33,530

CONSULAR REPORTS.

CHILI.

Saltpetre Exports.

19,230,047 pesos, or two fifths of the whole exports of Chili, are represented by saltpetre. Signs are not wanting that the production of saltpetre is to be materially reduced, and the effects of this upon consuming markets in Europe will be considerable. It is estimated that of the total quantity exported, one-third finds its way to England, the remaining two-thirds going to the Continent. The average freight is £1 10s. per ton, the vessels employed being mostly sailing ships. The Italian Florio-Rubattino Co. is beginning to ship direct to Italy.

EGYPT.

Candles, etc.

The French Consul at Alexandria, in his report, says that France supplies wax candles very largely. Nearly all those consumed come from the Marseilles factory of M. Fournier. The activity and enterprise of this firm have succeeded in establishing almost a monopoly of the trade. For several years Austria endeavoured to find a market in Egypt for these goods, but all serious competition has now been abandoned. As to the English products they exist only in the Customs returns. They are either manufactures which have been warehoused in England or transported to Egypt by English steamers. The strongest competition which French manufacturers have to face comes from Belgium. It is calculated that Belgian traders, owing to the smaller charges on their industry, can save five francs per 100kilos. in the manufacture of their goods, compared with the cost of producing French products. This makes Belgian competition serious. French manufactures, however, still maintain superiority in quality to those of other countries.

According to the Belgian Consular Agent at Mansoorah, Belgium has for some years competed strongly with French products. Belgian prices are lower than those of the French, and if the natives had not had a superior article offered to them at less cost, they would not have purchased as they have done from Belgian traders. French wax candles are still very much sought after at the present time, but now there are competitors in the field the prices have been very considerably reduced.

HOLLAND.

Candles.

The imports of wax lights and candles, says the Secretary of the Belgium Legation, at the Hague, are unimportant, and tend to be still further reduced. In 1881 they amounted to 21 000 florins, while in 1885 they were only valued at 14,000 florins. Candle factories at the Hague are important, although not numerous; the "Apollo" factory, established in 1869, and employing between 400 and 500 men, being the chief one. The candles turned out by this factory are not only employed throughout Holland, but are used in all parts of the world. Each year the factory consumes between 8000 and 9000 tons of tallow from Austria, America, or Russia. The factory is a prosperous concern. It manufactures candles of all kinds, shapes, sizes, and colours. The total export of candles in 1885 was 7,244,000kilos., a decline of upwards of 2,000,000 kilos. on 1881.

The Chemical Industry.

The chemical industry is not as flourishing as it used to be. Dutch manufacturers of chemical products are now seeing Germany, their best market, closed to them owing to the high Customs duties of that country. Germany, however, still remains the best market for Dutch chemical products. Dutch manufacturers have since sought to establish a new trade with this country.

Soap Manufacture.

Soap making during the past few years has, from a manufacturing point of view, made considerable progress. Dutch soaps are partly consumed in the country and partly exported to the Dutch East India possessions, where they bid fair to successfully compete with the English and French products, which until recently were the only kinds known. The soap works are divided into two principal categories, those which manufacture soft soap, which are the most numerous, and those that make the hard soap. In 1883 there were sixty-six manufactories of the first kind and thirty-three of the second, which produced 17,831,000kilos. The toilet soaps the most estimated are those bearing the mark of Sanders & Co., of Leyden. This firm is equally noted for the best makes of soap as for the commoner kinds. This industry has not been so flourishing lately, as protective duties have been adopted in the countries which offered the best openings. It has suffered also from English, French, and German competition, the raw materials in these countries being cheaper than in Holland. Belgium, Africa, and the Dutch possessions are the chief markets for Dutch soaps.—*Brit. and Col. Druggist.*

OUR TRADE LAST YEAR.

The year 1886 was a year of marked commercial depression, and we therefore cannot expect to find very satisfactory reading in the annual statement of the trade of the United Kingdom with foreign countries and British possessions which has just been issued in the form of a bulky Blue Book. We imported during the year merchandise to the value of £349,863,472, a less value than in any year since 1882 inclusive. To this amount, foreign countries contributed £267,979,429, and British possessions £81,884,043, in each case a diminution upon the figures for any corresponding period during the previous four years. Our exports during the year amounted to £268,667,017, again a less figure than in 1885, 1884, 1883 or 1882. British produce contributed to this sum £212,432,754, and foreign and colonial produce £56,234,263, in each case the smallest amount in the five years. It is significant that the falling off in our exports last year, in comparison with 1885, was due to a decreased demand in our own possessions. While we sent to foreign countries goods to the value of £186,599,306, an improvement of nearly a million upon the preceding year, our exports to British possessions only amounted to £82,087,711, as against £85,424,218 in 1885.

Turning to the articles in which our readers are mainly interested, we find that the drugs unenumerated, Peruvian bark, and opium, imported last year were valued respectively at £669,979, £801,353 and £307,666, in each instance a considerable falling off in comparison with the figures for any of the preceding four years. Our imports of alkali amounted to £55,828, again a smaller sum than in any other of the five years, while our imports of chemical manufactures and products are put down at £1,281,537, which figures also compare unfavourably with those for the former years.

On the export side, which is of course the most important, we find a falling off under almost every item. The value of our exports of medicines, drugs and medicinal preparations is put down at £814,213 as against £842,725 in 1885, £893,184 in 1884, £922,649 in 1883, and £935,233 in 1882. We exported alkali to the value of £1,788,078 as against £1,955,790 in 1885, and still larger sums in each of the three preceding years. One of the few redeeming features in the character of our exports during the past year is to be found under the head of chemical products and preparations, our exports of which were valued at £1,492,574, an improvement upon each year of the five with the one exception of 1882.

The statement before us also contains a table showing the total value of the articles of foreign and colonial produce and manufactures exported. From this table it appears that the values of the drugs unenumerated, Peruvian bark and opium, of this class exported, were respectively £363,398, £517,794 and £215,868. All these figures compare badly with the figures for the preceding four years, with the exception of those relating to opium in 1882.

One of the most interesting parts of the compilation from which we take the figures given above is that portion which shows the extent of our imports and exports from and to the different foreign countries and British possessions. From this it appears that of the drugs unenumerated brought into the country, foreign countries contributed to the value of £508,880, and British possessions to the value of £161,099. The United States, the British East Indies, Holland, and France sent us the largest amount. What is tabulated as Peruvian bark—though why does not appear was imported from foreign countries to the value of £167,688, and from British possessions to that of £633,669. For Peruvian (?) bark we were indebted chiefly to Ceylon, Madras, the United States of Columbia, and France. The value of opium imported from foreign countries and British possessions is put down respectively at £298,682 and £8981. Turkey sent us this drug to the value of £239,662 and Persia to that of £50,727. £31,885 and £23,913 represent the value of the alkali imported last year from foreign countries and our possessions respectively. Our imports from British North America amounted to £23,930, from Holland to £11,313, and from France to £10,532. Our imports of chemical manufactures and products from foreign countries amounted to £1,269,527, while those from British possessions are put down at £15,010. France, Holland, Germany, and Italy were our largest suppliers.

Turning again to the export side, we find that last year we exported alkali to foreign countries to the value of £1,666,454, and to British possessions to that of £121,624. America was by far our largest customer for this article, Russia and Spain coming next, a long way behind. Our exports to foreign countries of chemical products or preparations not specially enumerated amounted to £1,219,532, while those to British possessions were estimated at £273,042. The United States, France, and Germany took the largest quantity. Of medicines, comprising drugs and medicinal preparations, we exported to foreign countries to the value of £306,323, and to our own possessions to that of £507,890. Australasia and India were our largest customers.—*Brit. and Col. Druggist.*

The Rock Salt of Belfast and Carrickfergus.

Mr. Robert Hanoa, of Belfast, has published a letter with regard to local industries. In that communication he says:—

"It is now almost half a century ago since Sir Robert Kane wrote that the strata in the vicinity of Belfast corresponded with that of Runcorn, near Liverpool; for all that, he remarked, there was no rock salt in the vicinity of Belfast.

"If this scientist did not hit the mark, he took a good aim at all events, for in the hills at Carrickfergus for many a year there appeared a well of water that was continually sending up bubbles. People wondered at this phenomenon. At last the boring-rods went down, and rock salt was found to explain the phenomenon.

"And now we come to a greater wonder. Here, within a few miles of Belfast, there are several rock salt mines. One of them, 'Logan's,' contains 100ft. of a solid seam. The manufacture, like the others in full operation, has a siding to the railway within a few miles of Belfast, and for all that there was imported last year from England nearly 6000 tons of manufactured salt. At Runcorn the mines are flooded to produce brine. At Carrickfergus the rock salt is lifted from the mine, melted, and conveyed by pipes to the pans. This prevents the salt water from being in any way impregnated with terrene matter. And as for the samples of rock and manufactured salt of Carrickfergus, I, as a geologist, proclaim them to be the finest samples in God's five broad continents. For all that, how does it come this vast importation of manufactured salt into Belfast? It is surely shipping coals to Newcastle with a vengeance. It is wonderful the mania we have at present for the importation of everything we use from England. Even the Tramway Company and the Town Council must have every stone for square sets from England. *Mais revenons a nos moutons.* Lately there has been a prospectus issued and sent to this country from, I believe, the vicinity of Runcorn, near Liverpool, enlarging on the merits of a company that is about to be formed for the manufacture of soda ash, crystals, bleaching powder, etc. Of course, the materials are at hand for the manufacture of these commodities, and it would appear 'a patent' is in the background to forward this important scheme. Wishing this company every success, I would like that these 'patents' that are issued should be confined to the respective countries of England, Ireland, and Scotland. It creates a monopoly that is highly injurious to the countries not interested. For instance, it is well understood we have salt in millions of tons at Carrickfergus; we have limestone and coal slack cheap enough; ammonia in abundance in Belfast. For all that, it may happen that for fully fifty years we will be debarred the manufacture of these chemical ashes, although all the materials are at hand. Consequently we lose thousands on thousands of pounds to the capitalist and loss of employment to our local population. Formerly in Ballymacarrett this industry of the manufacture of chemical ashes was carried on on a very extensive scale, but English monopoly ruined it. Now, it is understood the Ballymacarrett manufacturers were not able to hold their ground, when at Runcorn they had all the materials at hand—viz., lime, salt, ammonia, etc.; but things do change, and here at Carrickfergus we have lime and salt in inexhaustible supplies, ammonia cheap enough, and coal slack at a nominal rate could be landed near Eden at a very cheap item.

"Now, last year there were imported into Belfast soda ash and soda crystals, 3983 tons; bleaching powder, 2177 tons; and soda ash, 3128 tons. This is not taking in the quantity imported into Larne. Now, in handing out patents, I do maintain that these patents should be confined to the several countries interested, for why should a patent of any individual debar another country from developing its great resources? It looks also very strange to see almost 6000 tons of manufactured salt imported into Belfast last year, and millions of tons of it at our own doors; and, if an effort was only made, we should be able to ship it to all parts of the world, instead of only shipping one single ton last year.

"Now, there are three salt mines open at present in Carrickfergus, and—would it be believed!—the rock salt has been found in the vicinity of Belfast, and the owner is afraid to let it be known for fear of too high a rate of royalties! And, if we are not capable of manufacturing chemical ashes, perhaps we might be allowed to open our salt mines, manufacture and sell it."

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS AND MACHINERY.

APPLICATIONS.

12804 J. Parsons, Liverpool. Method and apparatus for preventing incrustation in steam boilers

12876 F. Livet, London. Steam generator, its flues and furnaces, with feed water combination, for producing heat and steam. September 22

12963 A. Siegert and W. Dürr, London. Devices for measuring the density of gases. September 24

12986 J. Vicars, T. Vicars and J. Vicars, jun., Liverpool. Furnaces of externally-fired steam generators. September 26

13015 W. R. Lake—From Madme. Marcoux, France. Apparatus for raising liquids. September 26

13017 P. A. Newton—From Theisen and Langen, Germany. Apparatus for cooling or heating liquids and air. September 26

13043 H. Wilson and A. Wilson, Stockton-on-Tees. Apparatus for injecting air, gas, oil or other fluids into furnaces, for increasing draught, reducing smoke, and assisting combustion. September 27

13105 J. Butterworth, Rochdale. An improved valve. September 28

13256 F. W. Allchin, London. Apparatus for mixing substances or materials in a dry state. September 30.

13266 A. T. Clarkson, London. Valves for regulating the flow of gases under pressure. September 30

13395 H. Kilburn, Bishop Auckland. Valves for regulating the flow of fluids. October 4

13431 W. P. Thompson—From W. B. Wright and E. T. Williams, United States. Improvements in furnaces burning hydrocarbons. Complete specification. October 4

13483 W. E. Carrington and J. Brocklehurst, London. Kilns for calcining limestone, iron ore, and for other analogous purposes. October 5

13667. L. Perkins, London. Cooling and refrigerating apparatus. October 8

13852 J. Spencer, Glasgow. Reverberatory furnaces for heating, metallurgical, glass making and similar operations. October 13

*COMPLETE SPECIFICATIONS ACCEPTED.**

1886.

14682 L. Rouviere. Generation, application and utilisation of steam, and apparatus therefor. September 28

15076 C. A. Sahlstrom. Apparatus for projecting oil or other fuel into furnaces in the form of spray. September 28

15125 F. L. Merritt. See Class II.

15158 J. E. Hodgkin and E. Perrett. Filters. September 21

15171 T. Richmond—From W. Wills. Apparatus for the separation of smoke from the gases evolved during combustion of fuel. September 21

15176 E. M. B. Faull and F. W. Cannon. Method and apparatus for prevention of corrosion in steam boilers. September 28

15240 O. Bowen and J. Cobeldick. Deodorising, decolorising and filtering medium. September 28

16029 C. de Montgrand. Process and apparatus for the production of heat and cold. October 12

16525 F. C. Bond. Apparatus for heating liquids by steam. October 19

16547 J. Atkinson. Refrigerating apparatus. October 19

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* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

1887.

3719 M. Kotyra. Electrical apparatus for prevention of corrosion and scale in steam boilers. September 28

3804 J. Howes. Filtering apparatus. October 19

5251 G. E. Wright. Valve for regulating passage of gas. October 5

9077 S. Pitt—From J. R. Knapp. Blowpipe apparatus for producing intense heat and artificial light. October 12

9206 J. Howes. Rotary filtering apparatus. October 19

11139 R. Johnson. Air compressors. September 24

11284 J Smeaton and J. D. Simpson. Valves for controlling the flow of liquids, gases and steam. October 19

12210 J. T. King—From H. Kennedy. Hot blast stoves and furnaces. October 12

II.—FUEL, GAS AND LIGHT.

APPLICATIONS.

12801 A McKune Margerison, London. Improvements in fire lighters. Complete specification. September 21

12946 W. Guest and others. See Class III

13096 R. Wallwork and A. C. Wells, London. Self-generating oil, gas, or vapour burners, and arrangements connected therewith. September 28

13388 J. Atkinson, London. Improvements in gas-making apparatus. October 4

13450 S. R. Dickson, London. A process and apparatus for the manufacture of gas for heating and illuminating and of cyanogen or some of its compounds. Complete specification. October 4

13521 W. Gadd and W. F. Mason. Manchester. Improvements relating to the construction of gas-holders. October 6

13544 P. Jensen, London—From J. Leete and V. D. Stockbridge, United States. Improvements in Carburettors. Complete specification. October 6

13627 E. Kenyon, Manchester. Improvements in the production of illuminating gas, ammonia and other products, and in apparatus therefor. Complete specification. October 8

13734 K. R. Kilbourn, London. Improvements in methods of generating heat. October 11

13922 J. Y. Johnson—From C. Bertou, France. A new or improved compound for lighting and heating. October 13

13993 W. Wilkie, Glasgow. An improvement in effecting the combustion of fuel. October 15

14085 H. J. Fenner and G. H. Fenner, London. Improvements in the manufacture of naphthalene into forms suitable for use in illumination and in apparatus employed therein. October 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

8348 J. Hammond. Method and apparatus for purification of coal gas by concentrated liquid ammonia, and the recovery of sulphur and ammonia for the manufacture of sulphuric acid and sulphate of ammonia. October 1

12610 H. Suteliffe. Utilising the waste heat of gas and combustion explosive motor-engines for heating water. September 24

14395 J. Hammond. Method of and apparatus for the utilisation of gas tar. October 12

15125 F. L. Merritt. A retort fire bar to generate water gas as fuel in furnaces, where the ordinary fire bar is used. October 5

15287 J. S. Sellon. Apparatus to be employed in lighting and heating. September 24

15716 S. Cutler. Apparatus for the distribution of liquid in gas scrubbers. September 28

15728 F. J. Jones. Method and apparatus for manufacturing gas for illuminating, etc. October 5

16581 A. Paget. Use and construction of mantles for incandescent gas-lighting. October 15

1887.

11439 W. C. P. Asselbergs. Hydraulic mains for gas works. September 24

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATIONS.

12946 W. Guest, T. Guest, G. Guest, and A. Guest, Mapplewell. An invention to take the waste gases from coke ovens to fire boilers and light works, and to make shale and waste dirt into oxide of iron and calcine and creosote oil. September 24

13366 W. L. Wise—From The Actien Gesellschaft fur Chemische Industrie, Germany. New process of manufacturing retene from resin oil. October 3

13462 T. Nicholson, Beeston. Improvements in the construction of coke ovens designed to secure the by-products. October 5

COMPLETE SPECIFICATION ACCEPTED.

1886.

15772 R. B. Tennent. Destructive distillation of shale and other minerals, and retorts therefor. October 1

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

12736 R. Ashton. Manchester. An improved method of preparing blue for laundry use. September 20

13088 B. Willcox—From The Farbenfabriken vormals. F. Bayer & Co., Germany. Improvements in the manufacture of methylen chloride. September 27

13950 S. E. Ganyon—From P. Fournayre, France. New or improved colouring matters and methods or processes for the preparation thereof. October 8

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

126 H. J. Walder. Production of colouring matters from carbolic acid and other phenols. October 15

127 H. J. Walder. Producing colouring matter from anthraquinone. October 15

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

13593 C. B. Warner. London. A process for rendering fabrics and other articles water repellent. Complete specification. October 7

13669 I. Singer and M. W. Judell. London. An improved process for obtaining cleansing and other products, applicable also to the extraction of oils, and similar purposes, together with an apparatus for carrying the same into effect. Complete specification. October 10

13743 P. M. Matthew, jun., Edinburgh. Improvements in the manufacture of indiarubber waterproof textile fabrics. October 11

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

15343 W. Mather. Apparatus for treating textiles with liquids, gases, or vapours. September 24

15599 J. B. Whiteley and W. Whiteley. Machinery for drying wool and other fibre. October 1

15600 J. B. Whiteley and W. Whiteley. Machinery for washing and scouring wool and other fibrous substances. October 1

1887.

11570 S. S. Bromhead—From U. C. Allen. Apparatus for separating wool, silk, etc., from vegetable fibre or matter. September 28

11665 W. Nelson and E. Bowen. Machine for drying wool. September 28

VI.—DYEING, CALICO PRINTING, PAPER STAINING AND BLEACHING.

APPLICATIONS.

13145 W. J. S. Grawitz, London. Improvements in dyeing vegetable and animal textile materials before spinning. Filed October 4. Ante-dated March 4 under International Convention.

13896 A. J. Boult—From W. S. Alexander, United States. Improvements in the dyeing of wool tops and in apparatus therefor. Complete specification. October 13

13944 J. S. Knott, London. Bleaching and finishing all descriptions of textile fabrics, yarns and all fibrous substances. October 14

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

14971 E. Sutcliffe and G. E. Sutcliffe. Apparatus for bleaching, damping, and dyeing loose fibre yarns, threads, etc. September 28

15258 T. Lebrowski. Method and apparatus for washing, scouring and bleaching wool. September 24

15135 R. Holt. Method and apparatus for dyeing warps Turkey red, alizarin red and other fancy colours. September 28

1887.

7710 E. Boursier. Dyeing fabrics and apparatus therefor. October 8

11426 E. W. Wrigley. Method and apparatus for passing warps into and receiving them from dyeing machines and drying cylinders. October 12

11497 A. Graemiger. Processes and apparatus for dyeing, scouring, bleaching and otherwise treating yarn in cops. September 24

12358 T. Sampson and F. H. Jealous. Dyeing yarn and other fibrous materials and apparatus therefor. October 15

VII.—ALKALIS, ACIDS AND SALTS.

APPLICATIONS.

13001 W. P. Thompson From S. Wolf, Germany. Improvements in or connected with the application or utilisation of acid sulphate of soda in the manufacture of cellulose and for other purposes. September 26

13018 J. Beveridge, Frodsham. Improvements in the manufacture of sulphuric acid. September 27

13061 P. Bateson and M. C. Arnholtz, Liverpool. Improvements in or connected with the manufacture of carbonate of soda from the bicarbonate of soda made by the ammonia soda process. September 27

13323 E. Solvay, London. A new or improved revolving furnace for the decomposition of bicarbonate of soda. October 1

13336 J. E. Johnson—Johnson, London. Improvements in the manufacture of acetic acid and in apparatus therefor. October 1

13617 C. Heinzerling, Berlin. A process for separating chlorine from gas mixtures. October 8

13618 C. Heinzerling. Improvements in a furnace for decomposing chlorides of metals. October 8

13695 C. Huggenberg, London. Processes for obtaining nitrates, chromates, manganates, permanganates and arsenates. October 10

13746 B. J. B. Mills From T. B. Fogarty, United States. A process of and apparatus for manufacturing ammonia. Complete specification. October 11

13747 B. J. B. Mills—From T. B. Fogarty. A process of and apparatus for producing sulphate of ammonia. Complete specification. October 11

13983 D. Herman, Liverpool. Improvements in the manufacture of sulphate of soda and in apparatus therefor. October 15

14000 F. Bale, Droitwich. Improvements in the manufacture of ammonia and hydrochloric acid and in the apparatus employed therein. October 15

14001 F. Bale, Droitwich. Improvements in the manufacture of ammonia and chlorine and in the apparatus employed therein. October 15

14016 G. E. Davis, Manchester. An apparatus for extracting arsenic from oil of vitriol and muriatic acid, and for the absorption of gases by liquids and by substances held in suspension in liquids. October 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

8348 J. Hammond. See Class II.

14875 J. R. Francis and F. F. Jones. Process and apparatus for obtaining sulphur, etc., from ores, and for purifying such substances. October 1

15391 S. H. Croll. Distillation of ammoniacal and other liquors, concentration of liquids and salts in solutions and apparatus therefor. October 5

15188 W. Burns. Manufacture of sulphate of soda and bleach in one operation under high pressure, and apparatus therefor. October 15

15198 W. Bramley and W. P. Cochrane. Treating solutions of calcium chloride so as to obtain magnesium chloride and other products. October 15

16118 H. Kenyon. Production of sulphide of zinc and chloride of ammonium. October 12

1887.

62 W. Donald. Production of chlorine from hydrochloric acid gas. October 19

11492 H. H. Lake—From A. Kayser, H. Williams, and A. B. Young. Production of caustic alkali, carbonates of the alkaline metals, muriatic acid, etc. September 21

11493 H. H. Lake—From the same. Producing silicate of sodium or of potassium. September 24

11491 H. H. Lake—From the same. Producing muriatic acid. September 21

11500 C. J. E. de Haën. Manufacture and application of the compounds of fluoride of antimony with the chlorides or sulphates of sodium, potassium or ammonium. October 1

VIII.—GLASS, POTTERY AND EARTHENWARE.

APPLICATIONS.

12765 M. W. Samuel, London. Manufacture of a plastic compound, and treatment thereof, for the production of moulded and decorated tiles, slabs and other articles. Sept. 20

12835 T. A. Green, S. Green, and H. Leak, London. Improvements in the manufacture of box cranks or rings for use in baking china or the like, and in apparatus therefor. September 21

13022 J. F. Carey, London. Improvements in the formation of tiles for roofing and such like purposes. September 26

13211 J. H. Greathead. See Class IX.

13502 T. B. Gibson, London. Improvements in the manufacture and ornamentation of vessels to imitate earthenware, china, porcelain, terra-cotta and such like. October 5

13577 J. Emery and H. Lockett, Longport. Improvements in the method of decorating potteryware. October 7

13591 E. Leak, London. An improved method of supporting plates, saucers, dishes and other similar potteryware while being fired. October 7

13723 C. Amand-Durand and R. P. Engelmann, London. Improvements in decorating glass, and in apparatus therefor. Complete specification. October 10

13852 J. Spencer. See Class I.

14028 G. F. Chance, London. New or improved machinery for rolling glass. October 15

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

12990 J. Armstrong. Manufacture of glass, opal crystal porcelain, etc., and apparatus therefor. October 8

14519 A. Oestreicher. Machines for cutting, grinding, and polishing glass. September 24

16268 J. Armstrong. Blowing and moulding glass, and apparatus therefor. October 12

16366 A. D. Brogan and A. M. Malloch. Manufacture of rippled glass and apparatus therefor. October 15

1887.

10812 J. Earle, G. Bourne, and T. Bourne. Apparatus for cutting and ornamenting glass. September 21

11496 A. J. Boult—From F. Czech. Decorating ceramic ware. October 15

IX.—BUILDING MATERIALS, CLAYS, MORTARS AND CEMENTS.

APPLICATIONS.

12775 W. R. Manders, London. Red or white-faced stock bricks. September 20

13180 J. Hargreaves, Liverpool. Improvements in the manufacture of cement. September 29

13211 J. H. Greathead, London. A method of moulding articles in cement or other semi-fluid setting material. September 29

13322 E. Solvay, London. Improvements in lime kilns. October 1

13167 W. Smith, Dublin. Improvements in the manufacture of cement. October 5

13531 T. C. Hutchinson, Stockton-on-Tees. Improvements relating to the treatment of blast furnace slag for the manufacture therefrom of hydraulic or similar cement. Oct. 6

13902 R. Punshon, London. Paving, flooring and roofing material. October 13

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

12741 G. G. Mullins, London. A process of purifying, hardening and otherwise greatly improving iron. Complete specification. September 20

12747 A. J. Boult—From E. E. Ries, United States. Improved method of and apparatus for welding and tempering metals. Complete specification. September 20

12751 W. P. Thompson—From A. J. A. Lagane, France. Improvements in rollering machines or apparatus for imparting a given form to iron plates, called in France "machine a Galbord." September 20

12761 S. Massey, Manchester. Improvements in presses for forging, cutting, punching, beading and otherwise operating on iron, steel, or other metals or alloys or other materials. September 20

12856 C. A. Burghardt and W. J. Twining, Manchester. Improvements in the production of aluminium and aluminium bronze. September 22

12861 S. Dawes and W. Smith, London. An improved process for converting iron into steel. September 22

12883 C. Philippart, London. Improved method of and apparatus for producing finely-divided metal, especially for use in secondary batteries. September 22

12887 W. P. Thompson—From A. Schneider and Co., France. Improvements in or appertaining to the hardening or tempering of steel or steely iron. September 23

12912 R. R. Gubbins, London. Improvements in rolls for rolling metal. September 23

12951 J. Dennis, Sheffield. Improvements in miners' safety lamps. September 24

13150 G. F. Redfern, London—From J. Molas, France. An automatic apparatus for indicating the presence of explosive gases. September 28

13177 T. Appleby, Middlesbro'-on-Tees. An improved construction of ingot moulds and a better method of casting various shaped iron or steel ingots. September 29

13212 G. Hatton, London. Improvements in the open-hearth method or process of manufacturing iron and steel, and in furnaces employed therein. September 30

13321 J. Nicholas and H. H. Fanshawe, London. A new and improved method for the recovery of the precious metals and platinum. October 1

13325 J. Nicholas and H. H. Fanshawe. An electro-chemical process for the recovery of the precious metals. October 1

13318 J. Cooke, Birmingham. Improvements in safety lamps. October 3

13157 J. H. Smith and J. Talbot, Birmingham. Improvements in the manufacture of bars from scrap iron, applicable to other like purposes. October 5

13183 W. E. Carrington and J. Brocklehurst, London. See Class I.

13522 C. A. Burghardt and W. J. Twining, Manchester. Improvements in the production of aluminium. October 6

13560 J. Butler, London. Improvements in machinery for compressing iron or metal scraps for the manufacture of bars therefrom. October 6

13570 T. R. Weston, London. An improvement in the manufacture of steel forgings and the like. October 7

13586 H. de Mosenthal, London. Improvements in cartridges for blasting and shot firing in mines October 7

13787 W. Blackwood and T. Blackwood, jun., Edinburgh. An improved machine for corrugating metallic plates or tubes, or for corrugating and bending metallic plates. Oct. 12

13852 J. Spencer. See Class I.

13926 W. H. Penning and H. G. Owen, London. Improvements in apparatus for saving fine or flour gold in milling, hydraulising and sluicing. October 14

13938 M. Adams and J. Jenkins, London. Improvements in ventilating mines and in means employed in connection therewith. October 14

13950 M. Darnbrough and E Darnbrough Drighlington. The saving of waste of material in the tempering and coating of steel or iron wire by molten lead, of mixture of lead and tin, or tin, or during the galvanising of wire with zinc. October 14

14001 S. Dawes and W. Smith, London. An improved process for converting iron into steel. October 15

14015 C. Auty, London. An improved method of, and apparatus for, electrically lighting miners' safety lamps whilst locked, and which is also applicable to lighting other lamps. October 15

14051 D. G. Fitzgerald, London. An improved electrochemical process for the extraction of the precious metals from their ores. October 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

12128 E. R. Cummios—From G. P. Schweder. Extracting gold and antimony regulus from auriferous antimony ore. September 28

13073 A. Parkes. Extracting gold, silver, and other metals, from ores or compounds containing the same. October 12

14020 J. T. Dann—From A. Schaag and Messrs. Flurscheim & Bergmann. Galvanising iron and steel October 19

14875 J. R. Francis and F. F. Jones. See Class VII.

15308 C. W. Crossley. Apparatus for the separation, extraction, and amalgamation of metals. September 28

15531 A. E. Tucker and F. W. Harbord. Materials used in the construction of metallurgical furnaces and converters. October 1

15535 R. Dixon. Apparatus for purifying coal or like material by the washing process. October 1

15790 W. G. Copestake and C. Jones. Converting or reconverting old steel, iron and other kinds of metal into compounds known as the different kinds of steel. October 15

15916 J. Clark. Obtaining alloys of aluminium with certain other metals. October 8

15993 A. W. Conquist and C. O. Lundholm. Fuse for mining purposes. October 15

16923 E. Vlasto. Apparatus for cleaning and pickling metals and utilising the used liquids. October 19

1887.

624 H. H. Lake—From J. Illingworth. Manufacture of metal ingots, and apparatus therefor. October 15

10614 L. Mellett. Apparatus for indicating the presence of mineral ores or metallic substances. October 8

10922 C. Roth. Safety apparatus for igniting fuses in blasting operations, and for preventing explosion of fire damp. October 1

11174 P. C. Gilchrist. Manufacture of steel and ingot iron by the basic process. September 24

XI.—FATS, OILS AND SOAP MANUFACTURE.

APPLICATIONS.

13017 J. W. Paton, Liverpool. A new or improved cleansing powder or compound. September 27

13085 W. P. Thompson—From La Société Industrielle des Glycerine et Acides gars, France. Improvements in the treatment and distillation of fatty acids, and in apparatus therefor. September 27

13139 M. J. Whibley, H. G. Whibley, and A. Williams, London. Improvements in soap making. September 28

13499 W. E. Heath, London. Improvements in the manufacture of scented and coloured soaps, and apparatus for making the same. October 5

13669 I. Singer and M. W. Judell. See Class V.

13739 J. McClure, C. Paton, and J. Wilkinson, Manchester. Improvement in the plates of presses for the extraction of oil from seeds. October 11

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

13865 H. G. Nixon and W. Stewart. The preparation of iodised oil. October 1.

16086 J. Butler and J. Evans. Apparatus for carrying or lifting patterns, or removing patterns from the sand, etc. October 1

XII.—PAINTS, PIGMENTS, VARNISHES AND RESINS.

APPLICATIONS.

13286 S. Washington, Manchester. An improved compound for application to leather as a stain or varnish. October 1

13400 S. C. Rowell and J. W. Newell, London. Improvements in the manufacture of plumbic oxide or litharge, and in apparatus employed therein. Complete specification. October 4

13885 A. G. Wass, London. A new or improved combination of substances for the manufacture of varnish, paint, enamel, and other similar articles. October 13

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

9122 J. F. F. F. Lowe. Process of manufacturing white lead. September 28

12031 H. J. Allison—From G. W. Banker. Paints and paint compounds. October 8

XIII.—TANNING, LEATHER, GLUE AND SIZE.

APPLICATION.

13012 C. J. Viscount d'Hauterive—From A. Bedu, France. Improvements in tanning. September 26

XIV.—AGRICULTURE, MANURES, ETC.

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

16214 T. B. Wilson. See Class XVII.—B.

17000 A. W. Carlson. Process and apparatus for utilising urine as manure. October 12

XV.—SUGARS, GUMS, STARCHES, ETC.

APPLICATIONS.

12834 N. Tscherikowski, London. An improved process of producing refined sugar from raw sugar. September 21

13643 W. Hoskin, Halifax. A new or improved treatment of lump sugar. October 8

13671 H. Siebert, London. A process for and materials used in the production of a substitute for gutta-percha. October 8

13955 S. Fisk, London. Improvements in apparatus or devices for the treatment of sugar cane. Complete specification. October 14

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

15240 O. Bowen and J. Cobeldick. See Class I.

1887.

7119 C. Steffen. Process for systematically lixiviating raw sugar by means of aqueous alcoholic or other saccharine solutions. October 19

12596 C. H. J. Franzen. Manufacturing white lump or loaf sugar directly from boiled refinery mass. October 19

12597 C. H. J. Franzen. Process and apparatus for treating raw, clarified or perfectly white sugar masses in loaf forms by means of the centrifugal machine. October 19

XVI.—BREWING, WINES AND SPIRITS.

APPLICATIONS.

12988 J. Bonthrone and R. B. Bonthrone. Falklands. Improvements in brewing. September 26

13031 A. de Gaulne, London. Improvements in apparatus for filtering alcoholic beverages. September 26

13102 C. C. Clausen, London. Improvements in furnaces for malt kilns. Complete specification. October 4

13840 A. H. Huntley, Newcastle-on-Tyne. An improved process for the manufacture of yeast and vinegar. October 12

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

15175 J. C. Mewburn—From L. Teilliard. See Class XX.

15896 W. P. Thompson—From S. Bensaude. Manufacture of alcohol from manioc. October 8

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, ETC.

APPLICATIONS.

A.—CHEMISTRY OF FOODS.

13049 J. Allegretti, London. Certain improvements in a preserving system for perishable articles. Complete specification. September 27

13315 T. Carroll, Dublin. Preserving milk, cream, butter, meat, fish, eggs and other foods. October 3

13829 W. R. Baker, A. L. Savory and C. Ekin, London. An improved preparation of milk. October 12

B.—SANITARY CHEMISTRY.

13271 T. Donnithorne, London. Improvements in the treatment of sewage. September 30

13539 J. Bates, Liverpool. Improvements in and relating to the purification of sewer gas and noxious vapour. October 6

13781 W. Mann, London. Improvements in refuse burners. Complete specification. October 11

13943 J. H. Porter, G. Porter and J. Porter, London. Improvements in filtration in relation to the process known as Clarke's process, and to other purposes. October 14

13996 G. Roger, London. Improvements in water purifiers and sludge separators. October 15

COMPLETE SPECIFICATIONS ACCEPTED.

A.—CHEMISTRY OF FOODS.

1886.

16270 C. D. Abel—From C. Linde. Process and apparatus for making clear ice. October 5

16950 R. Glover. Dog biscuits. October 15

1887.

12035 H. H. Lake—J. H. Stebbins, jun. An improved food compound. October 8

B.—SANITARY CHEMISTRY.

1886.

13007 J. C. Butterfield and H. H. Mason. Treatment of sewage, and recovery of valuable products therefrom. October 8

15240 O. Bowen and J. Cobeldick. See Class I.

16244 T. B. Wilson. Treatment and purification of sewage and other liquids, and obtaining fertilisers therefrom. October 15

16161 F. D. Brown—From A. Howatson. Treating sewage, and apparatus therefor. October 12

C.—DISINFECTANTS.

1886.

14685 H. E. Harris. Manufacture and application of antiseptic, disinfecting, curative and healing agents. October 12

1887.

2831 J. H. Harford and W. W. Reeves. Disinfecting and curative device, and composition to be used therewith. October 5

4283 Dr. A. Dupré and C. N. Hake. Preparation of disinfectants, deodorants and antiseptics. October 15

XVIII.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

12883 C. Phillipart, London See Class X.

12885 G. E. Cabanellas, London. Improvements in dynamo-electric or magneto-electric machines. September 22

13080 W. Fritsche, London. Improvements in and relating to dynamo-electric machines. September 27

13159 W. W. Dunn, London. Improvements in electromotors and dynamo electric machines. September 28

13309 C. V. Burton, London. A new dynamo-electric machine. October 1

13325 J. Nicholas and H. H. Fanshawe. See Class X.

13420 E. L Mayer, London. Improvements in elements or electrodes for electric batteries. October 4

13440 G. Zanni, London. Improvements in electric batteries. October 4

13611 T. Coad and H. V. Coad, London. Improvements in voltaic or electric batteries. October 8

13722 C. E. Ponder, J. MacGregor, and P. Harris, London. An improvement in electrical secondary batteries. Complete specification. October 10

13805 H. M. Musgrove and H. Lyon, Glasgow. Improvements in electric batteries. October 12

13890 D. Urquhart, London. Improvements in or connected with electric batteries. October 13

13903 R. Kennedy, Glasgow. Improvements in and relating to thermo-electric generators. October 13

14021 N. de Benardos, London. Improvements in secondary batteries or electrical accumulators. October 15

14051 D. G. Fitzgerald. See Class X.

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

12778 S. F. Walker. Dynamo-electric machinery. October 8.

13987 J. G. Statter, S. L. Brunton, and J. W. Kempster. Collector or brush for dynamo or magneto-electric machines. September 21

14033 C. D. Abel—From Siemens and Halske. An improvement in electrolysis. September 28

14286 A. Wunderlich and O. Eisele. A Galvanic battery. October 8

16151 W. Webster, jun. Primary voltaic batteries, and preparation of the elements and solutions employed therein. October 12

16823 E. Barbier and M. Leclanché. Electrical batteries, and depolarising bodies to be used therein. September 21

17056 G. Kapp. Dynamo-electric machines. September 28

1887.

3719 M. Kotyra. See Class I.

4311 H. H. Lake—From A. W. Meserole. Secondary batteries. October 5

7079 E. Wilson. Dynamo-electrical machines. September 28.

7975 L. C. E. Liebez. Secondary batteries. October 8

9104 A. P. Trotter, H. W. Ravenshaw, and W. T. Goolden. Dynamo electric generators and motors. October 12

11917 R. Kennedy. Continuous current dynamo-electric machines and electro-motors. October 5

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

12712 G. Mills and G. H. May, Glasgow. Improvements in machinery for manufacturing paper. September 20

12762 P. E. E. Pesier, London. Improvements in treating vegetable materials to fit them for the manufacture of paper, pasteboard, threads, tow, or other like objects. September 20

12903 A. Wright, Glasgow. Improvements in the manufacture of paper pulp. September 23

12917 C. Beadle, London. A new or improved method of treating or preparing paper for the manufacture of paper bags and other envelopes therefrom, and for other purposes. September 23

13255 A. B. Warhurst, Manchester. Improved paper for toilet and other purposes. September 30

13792 J. Robertson, Manchester. Improvements in the manufacture of paper from Esparto straw or other material, and in the arrangement of machinery or apparatus employed for such purposes. October 12

13926 A. Schleipen, Paris. Improved process and machinery for the treatment of peat used in the manufacture of paper pulp, also applicable to the washing of the raw material for the manufacture of paper pulp generally. October 14

14034 E. Casper, London. Improvements in treating the barks of rhea or China grass and like plants, and apparatus therefor. Complete specification. October 15

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

15856 H. Blackman. Disintegrating fibrous substances, and manufacturing paper pulp, and apparatus therefor.

1887.

11610 J. E. Warren and F. A. Cloudman. Apparatus for effecting the recovery of chemicals from spent liquors of pulp digesters. October 1

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

APPLICATIONS.

13196 W. P. Thompson — From F. Kleeman, Germany. Improvements in the purification of extracts or juices from fruits, roots, malt, and other vegetable matters, and of juices from maltose. Complete specification. September 29

13277 F. Nettlefold, London. The synthetical or artificial production of quinine or body of the chemical composition of quinine. September 30

13693 G. Trier, London — From C. R. Poulsen, Denmark. Apparatus for producing ozone. October 10

13839 A. G. Salamon, London. Improvements in the treatment of benzoyl sulphonic amide, commonly known as "saccharine." October 12

COMPLETE SPECIFICATION ACCEPTED.

1886.

15175 J. C. Mewburn—From L. Leilliard. Manufacture of ozone and apparatus therefor, and application of ozone to the purification of alcoholic liquids, etc. October 5

XXI.—EXPLOSIVES, MATCHES, ETC.

APPLICATIONS.

12735 D. Grünfeld and H. J. Schumann, London. The manufacture of "repeating matches." Complete specification. September 20

13029 T. Nordenfelt, London. Improvements in fuses for projectiles. September 26

13541 J. Cope, Sheffield. Improvements in fog signals for railways. October 6

13730 T. G. Hart, London. Improvements in explosives for use in firearms. October 11

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

10580 D. Johnson and W. D. Borland. Ammunition. Oct. 19.

15993 A. W. Conquist and C. O. Lundholm. See Class X.

16595 W. H. Noble. Manufacture of gunpowder and charges for guns. October 19

16656 H. E. Newton—From A. Nobel. Explosives, and use of same, especially shells and torpedoes. October 19

1887.

418 E. Edwards—From R. Sjoberg. A new explosive. September 28

10655 E. Turpin. Production of explosives. September 28

10667 E. Turpin. Explosives. September 28

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NOTICES.

Notice is hereby given that the numbers for January 1882, 1883, and 1886, and February, 1886, are exhausted, and no orders for those copies can be executed.

The Secretary is instructed to negotiate for the purchase of copies of the Society's Journal for January, 1882 and 1883, at the following prices:—January, 1882, 5s.; January, 1883, 2s. 6d. Members possessing odd copies of these numbers are particularly requested to communicate at once with Mr. Cresswell.

Authors of communications read before the Society or any of its Local Sections are requested to take notice that, under Bye-Law 43, they cannot receive the prescribed 50 copies of their communications unless they comply with the condition laid down in that Bye-Law—viz., that they give notice of their desire to receive such copies upon their manuscript before sending it to the Editor. Mention should also be made as to whether the Discussion is to be included in the reprint.

Members are requested to note that the subscription of 25s. for 1888 falls due on the 1st January next. Cheques and orders should be made payable to the Honorary Treasurer, Mr. E. Rider Cook, and forwarded either to him, at Bow, or to the General Secretary. Until payment is made members are not entitled to the Society's Proceedings, under Rule 29 of the Bye-Laws.

CHANGES OF ADDRESS.

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LIST OF MEMBERS ELECTED, 25th NOVEMBER, 1887.

J. J. Candlish, Bottle Works, Seaham Harbour, Co. Durham, glass manufacturer.

Jas. P. Cornett, Ford Paper Works, Hylton, near Sunderland, paper manufacturer.

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Wm. A. McGubbin, The Elms, West Derby, Liverpool, chemical student.

Sydney Martineau, South Road, Clapham Park, S.W., analyst in sugar refinery.

Gideon Pott, c/o Watson, Laidlaw and Co., Kingston, Glasgow, engineer.

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W. Lascelles Scott, Chemical and Physical Laboratories, Forest Gate, E., chemical engineer.

Dr. J. A. Voelcker, Royal Agricultural Society of England, 12, Hanover Square, W., consulting chemist

And. Wallace, 15, Abbey Street, Paisley, N.B., dyer.

Death.

Thos. Routledge, Claxheugh, Hylton, near Sunderland.

Communication.

REPORT ON SECTION III. OF THE MANCHESTER ROYAL JUBILEE EXHIBITION:

THE CHEMICAL AND ALLIED INDUSTRIES.

BY WATSON SMITH,

Lecturer in Chemical Technology in the Victoria University, etc.

(Continued from p. 643.)

GROUP VIII.—METALLURGY.

The Abram Coal Co., Bickershaw, Wigan (No. 799).—This firm shows, among specimens of *Gas Coals,* the Abram new boghead cannel, giving gas of high illuminating power; selected cannel chippings, washed cannel nuts and Arley gas coal. This latter coal gives gas of high illuminating power, and furnishes, it is said, a good yield of residual products. Specimens are also shown of Wigan 4ft., 5ft. and 6ft. gas coals.

As regards *House Coals,* there are the best Arley coal, one of the best house coals in the district; Orrell 5ft. coal and Abram Main coal. These are raised from depths varying from 300 to 650 yards. A peculiarity with respect to the cannel is that it occurs in the *middle* of the Wigan 4ft. mine, and is much thicker than at any other colliery in the district.

The Astley and Tyldesley Coal and Salt Co., Limited, near Manchester (No. 813).—The specimens shown are blocks of the following:—"Astley," best house coal; "Hartley," house and steam coal; "Six Feet Rams," steam coal; "Crombouke" coal and Great Seven Feet coal.

The two latter blocks give sections of the upper part of the seams referred to, just as when taken from the mine at a depth of about 340yds. from the surface.

Platt Brothers & Co., Limited, Oldham (No. 806)—Specimens of "Big Mine" coal for house-fire purposes, very clean and hot, with a minimum of ash. It is obtained from Moston Colliery, Failsworth, near Manchester. Calcined shale is also shown, for carriage drives, footpaths and garden walks, as well as close-fire bricks made from pit shale and clay ground together and passed through two pairs of rollers obtained from materials from the same colliery. Very good specimens of machine-made facing bricks and ornamental bricks are exhibited. Specimens of Mountain Mine coal, from the Jubilee Colliery, Shaw, near Oldham, are also shown:—(1) For house-fire purposes, slow-burning and clean in use; (2) washed smithy coal for weldings; and (3) hard coke, made from Mountain Mine slacks, ground and washed, and containing carbon 93·23, sulphur 0·77, moisture 0·79 and ash 5·21 per cent.

Statistics of Coal Trade.

The approximate annual output of coal is about 160 million tons, and the value at the pits about 43 millions sterling. The output of coal reached its maximum in 1883, when the quantity raised was 163,737,000 tons. Since this date the amount raised each year has declined, that for 1885 (the most recent year for which statistics are available) being 159,351,418 tons, and it is said the quantity for 1886 will only be about 158,000,000 tons. The value has also decreased in the same period from about £45,000,000 to £42,500,000.

Percy C. Gilchrist, Palace Chambers, Bridge Street, Westminster, S.W.—The specimens exhibited illustrate the basic material used in the converter or open-hearth furnace, the phosphoric pig used, the lime used during the process and the steel made, showing some of the uses to which it has been applied; finally, the slag, both as made and as ground ready for use as a manure.

Prior to 1879 it was believed that intense heat was the obstacle that prevented the elimination of phosphorus in the Bessemer and open-hearth processes. The Basic or Thomas-Gilchrist process, introduced in 1879, proved that excellent steel could be commercially made from phosphoric pig by simply changing the lining in the converter and open-hearth furnace from a silicious—*i.e.*, acid one, to a lime—*i.e.*, basic one, and by adding some 2cwt. to 4cwt. of lime for each ton of pig treated. In other words, these processes, instead of being conducted so that the slag produced with the steel contained over 60 per cent. of silica and traces of lime, were conducted so that the slag produced contained, roughly, 6 per cent. of silica and 50 per cent. of lime and magnesia ; under the former (acid) conditions the steel contained rather more phosphorus than the pig from which it was made ; and under the new (basic) conditions the steel only contains 3 per cent. of the phosphorus in the pig treated.

The lime lining in general use is made by roasting or igniting limestone (preferably magnesian limestone) at a very intense heat, by which means the limestone becomes reduced in weight and bulk to one-half of its previous weight and bulk, and also becomes intensely hard. This material is ground and made plastic by admixture with boiled tar, and the resulting material put into place by ramming; or it is used in the form of bricks made under a very considerable pressure ; the object of this basic lining being to allow of the production and retention of a lime (*i.e.*, basic) slag. The 2cwt. to 4cwt. of lime used per ton of pig treated consist of ordinary lime as free from silica as possible, the function being to produce a limey slag capable of absorbing the phosphoric acid produced by the oxidation of the phosphorus in the pig treated.

The pig used contains :—

Silicon	0·2 to 1·5	per cent.
Sulphur	trace to 0·15	,,
Phosphorus	0·08 to 3·2	,,
Manganese	0·5 to 2·0	,,

The steel made contains :—

Silicon	trace.		
Sulphur	trace to 0·08	per cent.	
Phosphorus	0·002 to 0·08	,,	
Manganese	0·1 to 0·5	,,	
Carbon	0·08 to 0·5	,,	as required.

The slag made contains 97 per cent. of the phosphorus in the pig treated, averaging :—

Phosphoric acid	17	per cent. to 20 per cent.
Lime	50	,,
Magnesia	4	,,
Silica	8	,,
Oxide of iron	14	,,
Oxide of manganese	5	,,
Alumina	2	,,

This slag, ground to an almost impalpable powder, has been proved to be a valuable manure, giving the best results on sandy, peaty and loamy soils, and is now becoming generally known as a valuable fertiliser.

The production of basic steel has been :—

	England	Other Countries.	Totals.
12 Months ending 30th Sept. 1878	20	—	20
,, ,, ,, ,, 1879	1,150	50	1,200
,, ,, ,, ,, 1880	10,000	40,000	50,000
,, ,, ,, ,, 1881	46,120	289,880	336,000
,, ,, ,, ,, 1882	109,364	340,636	450,000
,, ,, ,, ,, 1883	122,380	511,993	634,373
,, ,, ,, ,, 1884	179,000	685,000	864,000
,, ,, ,, ,, 1885	145,707	799,610	945,317
,, ,, ,, 31st Dec. 1886	277,259	1,097,758	1,375,017
	891,000	3,764,927	4,655,927

In 1886 some 1,650,000 tons of pig, scrap and ferro-manganese were employed ; 171,000 tons of limestone for lining ; and 240,000 tons of lime for additions—producing some 1,375,000 tons of ingots of the value of £4,125,000, and 412,500 tons of slag of the value of £412,500.

Before the introduction of this process one-tenth only of all the iron ores in Europe was available for steel-making, owing to their containing too much phosphorus, and owing to the fact that no phosphorus is eliminated in the processes of steel-making then practised. By this process the remaining nine-tenths can be made into excellent steel, the phosphorus at the same time being converted into a phosphate of lime, easily assimilated by plants.

THE COLLEGE OF AGRICULTURE, Downton, near Salisbury (No. 812), illustrates in a series of interesting specimens the experiments and researches of Dr. Munro on the utilisation of basic slag for manurial purposes, as already referred to in the last-named exhibit. A chart is shown indicating the effects of basic cinder used as a fertiliser. (See this Journal, 1886, pp. 104, 433, 464, 610 and 611.)

THE MOSTYN COAL AND IRON Co., North Wales (No. 809), exhibits specimens of spiegeleisen, ferro-manganese, silico-spiegel, silicious iron, ferro-chromium, and also samples of manganese, whilst the WEST CUMBERLAND IRON AND STEEL Co., LIMITED (No. 811), shows specimens of material and products illustrative of the manufacture of Bessemer pig iron, steel rails, plates and steel castings.

MESSRS. CARRICK & BROCKBANK, Pall Mall, Manchester (No. 730), show a beautiful model of Gjers, Mills & Co.'s Ayresome Iron Works, Middlesbrough, and a case containing samples of Ayresome foundry iron and hematite iron, with ferro-silicon and silico-spiegel.

MESSRS. JOHNSON, MATTHEY & Co., Hatton Garden, London (No. 802).—Platinum in the form of apparatus for the concentration of sulphuric acid, etc., is shown to the value of £3000. Glass is gradually giving way to platinum for the purpose of concentrating sulphuric acid. In German vitriol works these stills are of much more frequent occurrence than in English factories. Even in the comparatively small Swiss factory of Gebrüder Schnorf, of Uetikon, near Zürich, referred to by Lunge in his book on the Alkali Manufacture as amongst the first to adopt Malètra's smalls kiln, there are two such platinum stills in operation. An interesting feature is the standard metre in irido-platinum, and of great value.

JAMES SMITH, 39 and 41, Bridge Street, Manchester (No. 803).—The process of manufacturing gold leaf is here seen in practical operation. In beating out the leaf a peculiar method of administering the blow with the mallet is necessary, one in which a certain forward movement of the whole body appears to be involved. This is one of the most popular exhibits in the section.

THE MAGNESIUM METAL Co., Patricroft, near Manchester (No. 804).—Prominent in this exhibit are very fine specimens of the ores of the metals antimony, bismuth, magnesium, mercury, potassium, sodium, vanadium, also silver and gold, with beautiful specimens of each of these metals. One of the ingots of antimony is perhaps the largest specimen ever exhibited. On its surface is distinctly seen the beautiful fern-like or "star" crystallisation that characterises this metal when pure ; hence its technical name, "Star Antimony." One of the specimens of bismuth shows the beautiful crystals, Grecian key-like in pattern, that characterise this peculiar metal. Magnesium is seen in the various forms in which it is produced for the market, such as ribbon, wire, ingots and powder. Possibly the finest specimen of quicksilver ore existent in the world may be seen in this case. This magnesium company is the only firm in the kingdom which distils mercury from its ore or matrix. A fine specimen of metallic sodium is exhibited. Attention may also be called to the splendid exhibit of "silver cake," which weighs some 8000 ounces, and to a valuable specimen of auriferous or gold quartz from the Sheba Reef, in the Transvaal.

The ore is found to average from five to seven ounces of gold to the ton. Immediately beneath this auriferous quartz may be seen a small bottle of pure gold, the actual product of one ton of this ore. Adjoining will be found some quartz in which the gold is visible. In addition to the precious metals, this firm exhibits a variety of chemicals. Amongst these we may mention sodium chlorate, crystallised; an article first introduced by the Magnesium Company, and which is now manufactured on a fairly large scale. Here also may be seen large specimens of salts of vanadium. The oxide of vanadium exhibited is a portion of the first specimen ever produced, and was shown a few years ago by Sir Henry Roscoe at a lecture delivered by him on "Vanadium" at the Royal Institution, London, as one of the greatest chemical novelties of that year. The specimens of Senarmontite crystals, one of the oxides of the metal antimony, will be very interesting to mineralogists. The fine specimens of crystallised sodium and potassium have attracted much attention. With this firm, whose exhibits denote much skill and scientific enterprise, the name of its director, Mr. Samuel Mellor, is intimately connected.

Joseph Walker Parker & Co., Lead Works, Chester (No. 805).—This firm has long been noted for its sheet lead, termed "chemical lead," supplied to sulphuric acid manufacturers for their vitriol chambers. Red lead, and red lead for the use of glassmakers; flake and powdered litharge, also flake litharge specially refined for varnish manufacturers; orange lead, and sublimed lead made from lead fumes, are represented. Laminated lead for damp walls, and all kinds of sheet lead; water piping, gas piping, lead pipe tinned inside, and pure and block tin pipe, offer considerable interest. Specimens of patent shot and hard shot, and also lead bullets, are shown. Special stress is laid on the dry white lead ground in oil, and the oval lead piping for resisting the action of frost.

Henry Wiggin & Co., 55, George Street, Birmingham (No. 810).—Specimens illustrating the manufacture of nickel and cobalt, from the raw material to the finished product, are shown. As raw materials, samples of nickeliferous pyrites from Norway, double silicates of nickel and magnesium from New Caledonia, arsenical nickel and cobalt from Hungary, and manganiferous cobalt ore from New Caledonia, are shown. The metals termed speiss or regulus, obtained in the smelting of these ores, and their ultimate solutions from which the iron, copper, etc., are separated by precipitation or otherwise, form an interesting feature. The nickel and cobalt are precipitated by a process applied by Mr. Chas. Askin, the originator of the firm, as hydrated oxides. The nickel oxide is then converted into metal for the manufacture of German silver and other white alloys, whilst the cobalt obtained in the form of various oxides is used for producing blues on earthenware, porcelain, and glass. Specimens of all these are shown, together with pure nickel oxide and metal in cubes and grains; also, an alloy containing respectively 50 per cent. of copper and of nickel, for casting purposes; and an ingot of German silver ready for rolling, as well as all kinds of utensils. Specimens of refined black cobalt oxide, cobaltous oxide, silicate of cobalt (printing blue), red silicate and carbonate of cobalt, and a handsome plaque illustrating the way in which various shades of cobalt may be produced upon china. Nickel and cobalt occurring in many complicated minerals containing sulphur, arsenic, iron, copper, antimony, bismuth, tin, lead and various earthy matters, all of which require to be separated by smelting or wet processes. Various by-products obtained in these processes are exhibited. Amongst specialities in the form of white alloys is Wiggins's registered metal "Silveroid," used largely for harness furniture, railway carriage fittings, steamship and lavatory fittings, etc. This alloy possesses the whiteness of silver, and does not become tarnished under ordinary conditions. The patent rolled nickel and cobalt, used specially for anodes in the processes of nickel and cobalt plating, and also a variety of cast and wrought anodes, are shown. As regards the ores, much of the nickel ore does not contain more than 2 per cent. of the metal, whilst the richest specimens obtained from Hungary are found with 15 per cent., and also 5 or 6 per cent. of cobalt. Nickel is at present very low in price—about 2s. per lb.; a few years ago it was as high as 16s. per lb. The introduction of nickel as the means of whitening and coating copper has proved of the greatest value, and thus the extensive and important industry of electroplating with it has been built up.

Webster's Patent Aluminium Crown Metal Co., St. Mary Axe, London, E.C. (No. 807).—Aluminium is very light, and also capable of receiving a high polish; does not easily tarnish, and gives out a clear and beautiful ring when struck. It is, therefore, not surprising that inventors have paid it great attention. In the handsome show-case of this firm are exhibited articles illustrating the manufacture of aluminium and its alloys. As a raw material, a specimen of the chloride is shown, and also a large button of aluminium as reduced in the matrix in which it was formed; pure aluminium in pig, etc.; and various forms of alloys as applied to the requirements of the different industries.

Duncan McKechnie, St. Helens, Lancashire (No. 808).—The wet process of copper extraction is here illustrated, and among the specimens of materials and products shown are Rio Tinto Spanish pyrites, burnt Spanish pyrites, purple ore, lead precipitate, silver precipitate and copper precipitate. These are worked up to the production chiefly of refined ingot copper, refined bar silver and pig lead, specimens of which are exhibited. The manufacture of sulphate of copper as a branch of the foregoing is illustrated as to material and product by specimens of argentiferous and auriferous shot copper, sulphuric acid, sulphate of copper and silver residue.

Wet Process of Copper Extraction.—This process is used in the extraction of copper from the burnt cupreous pyrites used in the vitriol manufacture. The process, as worked, is generally designated Henderson's, but the idea was first worked out by Mr. Longmaid. In 1842 he took out a patent for "Improvements in treating ores and minerals, and in obtaining various products therefrom, certain parts of which improvements are applicable to the manufacture of alkali." This consisted in calcining pyrites with sodium chloride at a low red heat, lixiviating, precipitating the copper with iron and evaporating the liquor down to obtain crystals of sodium sulphate. This process was worked at St. Helens for some time, but was abandoned in 1862. Mr. Henderson's process incorporated in a more or less modified form Longmaid's ideas, but to the former must be ascribed the credit of first recognising the suitability of burnt Spanish pyrites for this method of treatment. Various kinds of furnaces have been in use in calcining the ore with sodium chloride. In Longmaid's process the ore was calcined in an open reverberatory furnace. There have also been employed long open furnaces fired by gas, furnaces in which an arch extended from the bridge half over the bed, thus protecting the ore nearest the bridge from too intense a heat. Mr. Gibb patented a mechanical furnace with revolving hearth, which was used at the Bede Metal Company's Works, Newcastle-on-Tyne, but has a long time been abandoned, and now the furnace in general use since 1872 is the blind roaster, or muffle furnace.

The mixture of burnt ore and salt is calcined until the copper is converted into soluble cupric chloride. It is then lixiviated in vats containing about 14 tons of ore, with water alone, and later on with acidulated water, which removes the copper, silver and lead, leaving the oxide of iron, called "purple ore," behind in the vat. The first three washes contain 95 per cent. of the silver, which is recovered by Claudet's process. In this process a precipitation with a soluble iodide is adopted. The resulting silver iodide is decomposed with zinc, and the zinc iodide then used to precipitate more silver. The silver precipitate obtained is smelted into argentiferous pig lead, which is then cupelled, and the silver cast into bars. The cupric liquor, after desilverisation, is run into tanks containing scrap iron, and boiled until all the copper is precipitated as metallic copper: this, after washing and sieving, is either smelted and refined by itself, or along with the produce of other ores, into cake or ingot copper. The purple ore, or oxide of iron, is sold either in the fine state, for "fettling" puddling furnaces, or made into blocks for the blast furnaces. The lead precipitate is smelted in the Cornish furnace into pig lead.

Sulphate of Copper Manufacture.—This salt was at one time chiefly prepared as a by-product in silver smelting works. In argentiferous copper mattes obtained from these works the copper and silver were separated by means of sulphuric acid, the liquor obtained being run into leaden tanks, and copper sulphate crystallised therefrom. The silver and gold were left undissolved by the acid. Owing to the increasing demand for copper sulphate, and this source not being sufficiently productive, special works are now engaged in its manufacture.

Wet Copper Extraction.—Quantities of the above metals extracted in Great Britain during 1884, 1885, and 1886:—

	Burnt Ore. Tons.	Metallic Cu extracted. Tons.	Extracted by Claudet's Process.	
			Gold. Ounces.	Silver. Ounces.
1884	416,412	15,200	1900	335,000
1885	407,700	11,880	1810	328,000
1886	393,699	13,799	1780	316,928

About one-eighth part of this ore is treated at the exhibitor's works.

Sulphate of Copper.—The quantity manufactured is about 16,000 tons, of which about one-sixth is produced at the exhibitor's works.

GROUP IX.—ALKALIS, ACIDS AND SALTS.

JOHN RILEY & SONS, Hapton Chemical Works, near Accrington (No. 814).—This firm makes a special feature of pure sulphuric acid produced from brimstone and concentrated in platinum. This pure acid is much in request for dissolving indigo, to form the sulphonic acid, as well as for the preparation of white and pure sulphate of ammonia.

A soda ash (Leblanc process), which has undergone special refinement for the purposes of the calico printer, is also a speciality. It is an article free from insoluble matter, iron, etc., and which can be used by bleachers without fear of iron stains, etc., in the cloth after bleaching, so detrimental to the colours used in printing and dyeing. In obtaining such a soda ash, besides special purifying processes, a system of mechanical furnaces, heated by coal-gas, is adopted. For the wool scourers a pure and highly carbonated ash, free from hydrate, is made. Stannate of soda, made by Riley's patent process, and in a very pure state, is exhibited. It is used as a mordant by calico printers, dyers, etc. Ferrous sulphate ("copperas") as used in black dyeing and for preparing the indigo vat; and also ferrous and ferric chlorides, as used by dyers and papermakers. Copper sulphate and nitrate, tin crystals (crystallised stannous chloride), and also acetate and nitrate of tin, likewise serving as mordants, are exhibited, as prepared for mordanting purposes.

Zinc chloride is largely used by the Lancashire cotton merchants in the sizing of their goods, to prevent the starch of the size from contracting mildew. It is made in the pure state and liquid form for home consumption, but solid for export. Sulphate of zinc is also used for antiseptic purposes. Besides these, alizarin oil and oleine oils are specialities, as well as a series of chemicals made for the use of indiarubber manufacturers, of whom there are a great many in the Manchester and Salford districts.

GASKELL, DEACON & CO. (No. 815).—The chief articles exhibited are bleaching powder, bicarbonate of soda, crystal carbonate, calcium chloride, soda ash of 30 per cent. and 58 per cent. of Na_2O, refined alkali at 30 and 58 per cent., cream caustic at 60 per cent., and white caustic at 60 and 70 per cent. Also a fine block of soda crystals under a glass shade.

Crystal Carbonate.—For an account of this valuable salt the reader is referred to the report on the chemical exhibits in the International Inventions Exhibition of 1885. (This Journal, 1885, p. 523.)

Bicarbonate of Soda.—From the crystal carbonate, itself a very pure article, a fine high strength bicarbonate is made which, on analysis, gives the following numbers:—Bicarbonate of soda, 99·48; monocarbonate, 0·33; sulphate, *nil*; chloride, 0·05; magnesium chloride, *nil*; moisture, 0·10; insoluble, *nil*; total = 99·96.

The full account of the improved processes of manufacture patented by this firm will be found in Mr. Muspratt's address to the Society of Chemical Industry. (This Journal, vol. **5**, p. 401; also vol. **4**, pp. 523 and 524.)

WIGG BROS. & STEELE, Old Quay, Runcorn (No. 817).—This firm exhibits specimens illustrating the manufacture of sulphuric and other acids, salt cake, copper by the wet process, pearl hardening, bleaching powder and paints, with the raw materials used.

MESSRS. JOSIAS C. GAMBLE & SON, Gerrard's Bridge Chemical Works, St. Helens (No. 819).—The name of Col. Gamble will always be closely associated with the history and development of the Leblanc alkali industry. It was in the works of this firm that

Weldon first discovered the true conditions on which depends the success of the Weldon process for recovering peroxide of manganese from the otherwise waste still-liquors.

Besides the usual products of the alkali maker in an alkali-making district, this firm shows the following specialities of interest :—

Sulphide of sodium, in crystals, and of the formula $Na_2S + 9H_2O$, made by Schaffner and Helbig's patent process, pure chlorate of sodium, made by Pechiney's patent process, the same in small crystals, pure chlorate of barium in crystals, and of the formula $Ba(ClO_3)_2 + H_2O$, barium chlorate (pure) in powder, chlorate of strontium (pure) $Sr(ClO_3)_2$, sodium hypochlorite $NaClO$, potassium hypochlorite $KClO$, aluminium hypochlorite $Al_2(ClO)_6$, chloric acid $HClO_3$, calcium chlorate $Ca(ClO_3)_2$, ammonium chlorate NH_4ClO^3, aluminium chlorate $Al_2(ClO_3)_6$, Pearl hardening.

TENNANTS & Co., Mill Street, Clayton, Manchester (No. 818).—Like most of the alkali makers in the Manchester district, this firm has grafted on to the usual products of the Leblanc alkali industry, those used by the dyer, calico printer and bleacher. Since it may be interesting to other alkali makers not resident in a district the prevailing industries of which are so largely those devoted to dyeing and calico printing, the list of exhibits shown by Tennants & Co. is given :—

Iron.	Tin.	Sodium.	Potassium.	Zinc.
Ferrous chloride	Stannate of soda	Sodium bisulphite	(Acid potassium sulphate)	Zinc chloride
Ferric chloride	Stannous chloride (tin crystals)	Sodium sulphate (Glauber salts)	(Potassium bichromate	Zinc sulphate
Ferrous sulphate	Stannic chloride	Sodium bichromate (dry)	Red and yellow Prussiates of potash	—
Ferric sulphate	Tin nitro-muriate	Sodium bichromate (Crystals)	—	—
—	Tin oxymuriate	—	—	—
—	Tin acetate	—	—	—

Magnesium.	Manganese.	Copper.	Acids.	Calcium.
Magnesium sulphate (Epsoms)	Precipitated pure Peroxide of Manganese	Copper sulphate	Rectified oil of vitriol	Calcium bisulphate
Magnesium carbonate	Manganese chloride	Coppor nitrate	Brown oil of vitriol	—
Magaesito	Manganese carbonato	—	Hydrochloric acid	—
—	—	—	Aquafortis (com)	—
—	—	—	Aquafortis (pure)	—

JAMES MUSPRATT & SONS, Liverpool and Widnes (No. 820).—James Muspratt was the founder of the South Lancashire Alkali Industry, and any exhibition of chemical products would be incomplete without being represented by so historic a firm.

The specialities illustrated in the examples shown are sulphur recovered from alkali waste by Mond's process, manganate of soda, chlorates of potash and soda, produced by Messrs. Muspratt and Eschellmann's process, together with the materials and by-products. (See this Journal, 1885, p. 524.)

Barium Products.—Barium sulphide, zinc sulphide, blanc fixe, barium chloride and hydrate.

A. G. KURTZ & Co., Sutton Alkali Works, St. Helens, Lancashire (No. 825).—The manufactures of this old-established firm are chiefly confined to salt cake designed for alkali and glass making, caustic soda, chlorate of potash, bleaching powder, soda ash and soda crystals.

THE WIDNES ALKALI Co., Limited, Widnes, Lancashire (No. 830).—*Articles exhibited.*—Caustic soda, 76, 74, 72, 70, 64, and 60 per cent. white ; chlorate of potash in crystals, containing 99·98 per cent. of $KClO_3$, and extra fine ground ; chlorate of calcium in solution ; manganate of soda, the new disinfectant ; permanganate of soda, crude and in solution ; black ash or crude carbonate of soda ; sulphate of soda (salt cake) ; bleaching powder.

GENERAL STATISTICS OF THE ABOVE PRODUCTS OF THE ALKALI MANUFACTURER.

The manufacture of caustic soda has increased within the last twenty-two years from about 100 tons per week to about 3000 tons per week.

Caustic Soda is chiefly used by paper makers, and in the manufacture of soap ; but it has also a considerable application for various other purposes. Its selling value in 1865 was £13 per ton for 60 per cent., in 1873, £22 to £24, and the price has now declined to £7 per ton.

Manganate of Soda has been recently developed on a manufacturing scale for the deodorisation of sewage, and as a disinfectant.

The total weights of caustic soda and bleaching powder made for the year 1886, were :—

Caustic Soda : 153,884 tons.

Bleaching Powder : 136,234 tons.

The return of the exports to foreign countries for the year 1886, was :—

Alkali, including Caustic Soda, Soda Ash, Bicarbonate, Crystals, etc. : 284,634 tons, at a value of £1,609,484.

Bleaching Powder : 77,524 tons, value £503,000.

The annual consumption of raw materials for the above, which merely include the two chief export centres, and two articles out of the numerous products of the alkali trade, will be about :—

1,423,465	tons of fuel.
394,742	,, ,, pyrites.
713,112	,, ,, salt.
234,493	,, ,, lime.
134,619	,, ,, limestone.

The trade also employs some thousands of work-people, and a surrounding of dependent trades for machinery, packages, etc., etc.

The value of chemicals (with the exception of bleaching powder, which is supported by a combination of manufacturers) has been reduced about one half during the last ten years.

THE GREENBANK ALKALI WORKS Co, LIMITED, ST. HELENS, LANCASHIRE (No. 831). — This firm acquired many years ago a high reputation, both in this country, the Continent and America, for a very pure and high-strength caustic soda, and it was, the writer believes, the first to put in the market a 76 per cent. caustic soda. The improvements introduced into the various processes which mainly led to the production of this high-strength caustic, as well as increased yields of chlorate of a superior quality, in the operations involved in that branch of manufacture, were mainly the work of the late Mr. W. H. Balmain, the former manager, whose name is historically connected with the development and improvement of the Leblanc soda industry in South Lancashire.

The specialities exhibited may be enumerated as doubly-refined caustic soda, and the same in powdered form for bleachers, dyers, etc., and for making hard soap; pure caustic potash for woollen manufacturers, and for making pure potash soaps; refined pearl ashes: chlorate of potash in crystal and powder; bleaching powder; pure red oxide of iron and oxide paint.

John Thom, Birkacre, Chorley, Lancashire (No. 824).—This exhibit is of great historic interest, being a faithful representation in model form of the simple apparatus which Mr. John Thom, now for many years a citizen of Manchester, though originally hailing from the neighbourhood of Glasgow, constructed in 1836 for making soda by the ammonia process. Mr. Thom was the original discoverer of the simple reaction between sesquicarbonate, or otherwise bicarbonate of ammonia and sodium chloride, which forms the essential principle of the ammonia soda process. He was the first who made paraffin wax as a commercial article, obtaining the paraffin, however, from wood-tar by Reichenbach's process. He made small candles with this paraffin so obtained. Moreover, Mr. Thom was the first to manufacture artificial manures containing ammoniacal salts; he was actually the founder of the artificial manure industry. This work was accomplished in a chemical factory at Camlachie, near Glasgow, belonging to Messrs. Turnbull & Ramsay, in whose service he then occupied the position of chemist at the not too liberal salary of £30 per annum.

We have already referred to the fact that Dalton impressed penny ink-pots and soda-water bottles into his service in the pursuit of scientific research, but he was outdone by Thom in point of economy, the latter illustrating the reaction between sodium chloride and ammonium sesquicarbonate in apparatus simply composed of the hollow in the palm of one hand, using the finger of the other as a stirrer. I will use Mr. Thom's own words in a letter to his son:—"My first experiment was made by taking a good pinch of the substances (bicarbonate of ammonia and common salt), placing them in the palm of my left hand, mixing them with the forefinger of the right hand, and allowing water to drop from the fingers of my right hand to wash with as little water as possible. The heat of my hand dried very soon the product, and I learned that the decomposition could be made, whether profitably or not. This experiment done in the same way was shown by me to Professor Graham, the late Dr. Young, and many others, amongst whom I may mention Mr. William Henderson, of Glasgow—then a pupil of Graham's. After ascertaining that soda could be made in that way, I tried it in increasing quantities. I had no machinery in connection with it, except an old screw-press (model shown). I mixed the two salts in tubs (see models) and then placed the product in the till or burnt clay moulds, then used for refining or refined sugars. Later on, we substituted wooden ones of a similar shape, but larger. The soda was not crystallised by itself, but was dissolved with soda from other processes and crystallised in 500-gallon pans. It was considered better to carry this product from the ammonia soda process than put up dissolving, crystallising and draining apparatus specially for it." This latter statement, of course, means that so impure a soda would not bear the expenses alone of a sufficient purification, and hence it was mixed with the liquors of a stronger and purer Leblanc soda, and converted into soda crystals, relying upon the fact of formation of these crystals from a tolerably dilute solution, and the retention in the mother-liquors of the salt in excess and sal-ammoniac. The writer has received from Mr. William Henderson, of Glasgow, complete confirmation of Mr. Thom's statements, and he (Mr. Henderson) describes not only the experiments wrought in the palm of Mr. Thom's hand, but the apparatus for making larger quantities of the crude ammonia soda.

The following clause in a letter from Mr. Thom to the writer is worth quoting:—"When I left my employers," writes Mr. Thom, "I informed them that I did not think it advisable for them to continue this process, unless they got a chemist or someone who would feel interested in its success. I left them because I did not get paid enough. I had £30 a year for, I think, four years, and the attention required through bad joints, etc., etc., was very great. I left in 1838." Those, therefore, who feel disposed to institute any comparison between John Thom and Dyar and Hemming, to the disadvantage of the former, should reflect on the fearful disadvantages of Thom's situation, and that despite all these he still succeeded in passing from his crude laboratory performances to his equally crude manufacturing operations, and did succeed in putting ammonia soda in the market.

Some may be curious to know in what spirit he left such not very liberal employers. The account of the final episode deserves recital; it redounds to his credit, as it doubtless did to theirs—in quite another sense! As it was resolved to stop the process when Thom left, he "collected all the odds and ends with ammonia in them," to use his own words, "mixed them and all the urine on hand, with the charred siftings—that is, the charcoal not saleable from being too small—and with a lot of old animal charcoal which we had from the 'yellow prussiate' process and 'red liquor bottoms'—*i.e.*, the sulphate of lime resulting from making the 'red liquor' or aluminous mordant for calico printing, I took enough of the latter to at least fix all the ammonia in the lot. These were mixed in large heaps, many scores of tons, and I advised my employers to sell all as fertilisers. This mixture was tried in the Vale of Leven, Scotland, and in the West Indies, for sugar cane, by James Ewing, then M.P. for Glasgow. The result was astonishingly successful. Mr. Turnbull came up to Manchester to see how the stuff had been made, and tried to get me to go back to make more. I advised him to obtain slaughter-house offal, dead horses or cattle dying of disease, and place this material in a chamber where uncondensed muriatic acid gas could pass through, and continue the purchase of the urine of the neighbourhood (previously the material, bought at 3d. per ten gallons, for the ammonia soda process) along with the red liquor bottoms. He followed my instructions more or less, and laid the foundation of a most lucrative trade to him, and I believe, and the late Dr. R. Angus Smith believed, of the first manure works, of which there are now so many."

Messrs. Brunner, Mond & Co., Limited, Northwich, Cheshire (No. 816).—The description and general report given of the exhibit of this firm in the late Inventions Exhibition of 1885 (see this Journal, 1885, pp. 526 and 527), may be very well referred to in this case, with the statement that this exhibit in Manchester is, as regards specimens, show-case, and general appearance, incomparably finer than that in London. The specimens illustrate the Solvay ammonia-soda process, with the improvements introduced by Mr. Mond and other members of the firm. A specimen of bleaching powder made by Mond's recently patented processes is now to be seen—(this Journal, 1887, p. 140)—as also one of caustic soda, and another of a beautifully crystallised sesquicarbonate of soda, made by the process of Watts and Richards. This salt, which is crystallised in fine needles, is not a true sesquicarbonate, but has the formula $Na_2CO_3.NaHCO_3.2H_2O$. A great advantage of this salt is that it does not effloresce or deliquesce. It is readily soluble in water, and is free from insoluble matter. The writer understands that this salt has already been tried in Bradford for wool-washing with most satisfactory results. It is said to serve in the washing of flannels without shrinking them.

Messrs. Bell Brothers, Limited, Middlesbrough (No. 822), exhibit specimens illustrating the character of the salt deposits and the salt industry of the Tees: also the Schlösing ammonia-soda process. Samples illustrating the manufacture of pig iron at the Clarence Iron Works, near Middlesbrough, and also the manufacture of barium compounds, on the Tyne. For further information on Schlösing's process, see this Journal, 1885, pp. 527—528.

The Eureka Salt Manufacturing Co., Limited, Northwich, Cheshire (No. 836).—Rock salt, natural brine, and manufactured salt. A fine bust of Queen Victoria in manufactured salt forms a conspicuous object in this exhibit.

John Howarth Padgett, Brookdale Salt Works, Northwich, Cheshire (No. 826).—Various qualities and brands of salt.

R. & J. Garroway, Netherfield Chemical Works, Glasgow (No. 832).—An interesting model of the Netherfield Chemical Works, and fine specimens illustrating the sulphuric, nitric, acetic, boric, oxalic and hydrochloric acid manufactures; as also the manufacture of mordants and other dyers' and printers' chemicals.

Messrs. Peter Spence & Sons, Manchester Alum Works, Manchester (No. 829).—The leading feature of this exhibit is a colossal block of alum standing 12½ft. high, measuring 6ft. in diameter, and weighing slightly over 10 tons. This is the largest block of crystallised alum which has ever been manufactured, and has an imposing appearance, the colour being exceedingly white; the light transmitted through the mass, when looked at from the hollow inside, is of a beautiful pale blue tint.

In the case standing alongside the block there is a rich variety of manufactured products.

One pile is composed of blocks of "Turkey red" alum, manufactured by the firm. This alum is employed by all the great Turkey-red dyers, and is the purest which has ever been produced on so large a scale. Specimens of ground alum and granulated alum, and a collection of splendid alum octohedra, are exhibited.

The sulphate of ammonia is manufactured by Messrs. Spence's patented process, and is of extremely pure quality.

The column of light brown material is aluminoferric cake, an article patented by Messrs. Spence a number of years ago, and is used very extensively in sizing ordinary classes of paper, also in the clarifying of water for towns and manufactories. This article is now employed in almost every part of the world for one or other of these purposes.

"*Alfersil*" is the new sewage precipitant lately introduced by this firm, and is used for the purification by precipitation of refuse waters from manufactories and town sewage. It is claimed as the cheapest known source of soluble alumina for this purpose.

Specimens of sulphate of ammonia and sulphate of potash.

A bottle containing a liquid representing the average tint of Manchester sewage is shown. A second is a sample of Manchester sewage after purification by the *Alfersil* above referred to, the result being a very pure effluent obtained at an insignificant cost. The small bottle by the side of this contains the impurities precipitated from one gallon of this sewage. A third bottle represents the average tint of the water of the river Irwell. A fourth the same water after purification by aluminoferric. This is the quality of water with which the Ship Canal will be supplied when all the manfacturers in the district purify their refuse water. The small bottle alongside the last contains the impurities precipitated from one gallon of Irwell water.

Of the two 2ft. tubes, the first shows Manchester water as drawn from the mains of the Exhibition. The second contains the same water purified with Messrs. Spence's aluminoferric cake, used in the proportion of one ton to twenty million gallons. A comparison of these will show to what a degree of purity town's water supplies can be brought by the use of those materials. Few people have examined perfectly pure water in the analyst's 2ft. tube, and the lovely blue tint of this purified product is very striking. It may be noted that the water after treatment with aluminoferric contains no constituent which it did not contain before.

The other exhibits are sulphuric acid, manufactured from Spanish pyrites, and sulphuric acid from the spent oxide of gas works.

It is now nearly half-a-century since Messrs. Spence commenced the manufacture of alum in the neighbourhood of Manchester, and the name of the firm is now universally associated with alum and aluminous products of the best quality.

The firm also exhibits a set of the new international hydrometer devised by Mr. Frank Spence as a standard measurer both of the strength and specific gravity of solutions and other liquids, and proposed by him in replacement of the arbitrary and incommensurate hydrometric scales in use in Great Britain, the Continent and America. Mr. Spence's object is to unify the hydrometric scales of all nations. His hydrometer possesses the unique advantage of showing at a glance both the strength and specific gravity of a solution.

R. & N. Pott, 22, Southwark Bridge Road, London (No. 827).—All the vinegars exhibited are brewed from grain only. *Brown vinegars:* These are in their pure state as brewed. *Pale vinegars:* These are the same as brown vinegar, but reduced in colour by being blended with pure distilled vinegar. *Concentrated vinegars:* These are produced by an improved patented process of fractional distillation, whereby all empyreumatic and foreign flavours are expelled, leaving nothing but a pure concentrated vinegar. *Distilled vinegars:* These differ only from the concentrated vinegar in the strength, the distillation not having been carried to so high a point. Samples of grain used in the manufacture of vinegar. Samples of rape seed used as a filtering medium. Models of vat, showing the new process of acetifying patented by the exhibitors, illustrating the advantages over the old process and apparatus (of which latter there is also a model). Model of vat, showing method of cleansing and clarifying the vinegar by filtration through rape seed. Models of casks used in the trade.

In Concannon's History of Southwark mention is made of the Vinegar Works of Messrs. Pott as existing in the year 1641.

W. G. Pursell & Co., 13, Bernard Street, Leith (No. 833).—Borax in various forms suitable for manufacturing, chemical, therapeutic and domestic purposes. Refined boric acid, and a specially prepared powder for the preservation of fresh fish and other articles of food. The exhibitors refer to the statement of an Italian physician to the effect that the workpeople in borax factories appear to be safeguarded from the attacks of cholera. During the terrible epidemic of 1864—65 the workmen in seven contiguous factories in Italy were quite free from the disease, which killed one-third of the population of a village in the immediate vicinity. He recommends the internal administration of borax as a specific for cholera, in doses of five grammes per diem. He believes that it destroys not only the microbes in the intestinal canal but also in the blood.

The Trustees of the late James Buckley, 108, Higher Ardwick, Manchester (No. 834).—Crystallised ferrous sulphate (copperas), largely used, especially in black dyeing, ink manufacture, and for the reduction of the indigo vat, and other purposes.

J. M. Collett & Co., High Orchard Works, Gloucester (No. 823).—Specimens of pure bisulphites of lime, soda, potash and magnesia, and also of the sulphites of lime, potash and soda. Solutions of sulphurous acid and a sulphite composition called the "Universal Preservative." Samples of isinglass from Russia, Siberia, Hudson's Bay, Brazil, West Indies, Penang, Bombay, Kurrachee, China and Manilla.

C. B. Cullerne & Co., Crown Works, Napier Street, Liverpool (No. 824).—Samples of isinglass, finings, bisulphite of lime, sulphurous acid, etc.

Anthony K. Kaye & Son, Mold Green Chemical Works, Huddersfield (No. 828), exhibit specimens of a variety of dyestuffs, mordants, soaps, dyewoods, dyewood extracts and general drysalteries.

H. D. Pochin & Co., Limited, Quay Street, Salford (No. 835).—*Aluminous Cake.*—Mr. Pochin, previous to 1884, undertook a series of experiments for the purpose of obtaining a concentrated sulphate of alumina, which he succeeded in doing in 1854 by the decomposition of kaolin. This process was patented in 1855. The quantity consumed in the first year was only a few hundred tons, but before the patent expired the sale had increased to very many thousands of tons per annum of his own manufacture, besides a quantity made by other persons under a royalty paid to him. This article (aluminous cake) is very largely used by paper makers.

Sulphate of Alumina is produced from aluminous cake, this being much cheaper than by employing the old process, which consisted in precipitating the iron from the very crude sulphate of alumina by means of ferrocyanide of potassium, This article is used in the manufacture of tissue papers and the finest kinds of writing papers.

Concentrated Alum.—A neutral sulphate of alumina of a low price, which may be advantageously employed for paper sizing and the precipitation of waters containing sewage and other flocculent matter. This article contains 14 per cent. of alumina, and will compare favourably with any alumina compound now in the market at an equal price. The results are not equal to those obtained by the use of aluminous cake, but they are satisfactory to those who prefer a neutral sulphate.

It is perhaps desirable to explain here that all paper would be blotting paper unless it was made partially waterproof by precipitating with the pulp in the process of manufacture, rosin obtained from a rosin soap, and then mixing with either aluminous cake or sulphate of alumina—the waterproofing material consisting, in the aluminous cake, of hydrated silica, alumina, and rosin; and in the case of sulphate of alumina, of rosin and alumina alone.

China Clay.—This article, which is the raw material for the aluminous cake and sulphate of alumina, is found in very large quantities in Cornwall, and results from the decomposition of felspar in granite. It is in its natural condition, pipe clay, but as made artificially is a very pure silicate of alumina. Messrs. Pochin are amongst the largest manufacturers in Cornwall, the production and sale amounting to tens of thousands of tons per annum. It is also used in pottery, and is one of the best articles used for stiffening and finishing cloth.

Binarseniate of Soda as used by calico printers as a dung substitute.

Dextrin has been made by this firm since the year 1830.

Acetate of Alumina obtained by a new process, which has been in operation for the past two and a half years. It is free from colour and from excess of acid.

The *Refined Rosin* exhibited is the result of the patent taken out by Messrs. Hunt and Pochin. By this patent common black rosin is distilled by superheated steam and deprived completely of its colouring matter.

Patent Anhydrous Rosin Size.—This size is prepared for use with Pochin's patent aluminous cake, and is quite free from water. When used in the following proportions, the greatest economical results are obtained—there is no loss of size on the one hand, or aluminous cake on the other. This result, we think, has in very few cases been obtained by paper-makers, previous to the introduction of this size: it is now obtained with certainty, if used in the following proportions: To 5lb. of the size, 7lb. of aluminous cake. The best way of proceeding is to dissolve the size in water, in the proportion of say 3lb. to one gallon of water, boil it for about 15 or 20 minutes, *so as to ensure complete solution*: it is then fit for use.

In the Irish Section, Messrs. Harrington Brothers, of the Shandon Chemical Works, Cork, exhibit a variety of preparations comprising oxides for the glass, porcelain and enamel industries, such as cobalt, nickel, copper, tin and other oxides. Besides these are metallic tungsten and its salts, stannate of soda, oxalate of antimony, penta- and trichlorides of phosphorus, golden sulphide of antimony, etc. A series of organic preparations is also shown, as well as one of chemically-pure salts for analytical and scientific purposes, and finally a set of pharmaceutical preparations. This enterprising firm publishes an exceedingly neat price list in the form of a small book, which excels even those supplied by well known firms in Germany. This serves not only as a price list, but as a pocket-book, since it contains most of the usual tables, such as those of the atomic weights, specific gravities, and percentage strengths of acids and alkalis, alcohol tables, with other useful data.

London Section.

Chemical Society's Rooms, Burlington House.

Chairman: David Howard.

Committee:

Sir F. A. Abel.
H. E. Armstrong.
W. Lant Carpenter.
W. Crowder.
W. J. Dibdin.
C. Graham.
S. Hall.
C. C. Hutchinson.
R. Messel.
B. E. R. Newlands.
B. Redwood.
T. Royle.
John Spiller.
Wm. Thorp.
C. R. Alder Wright.

Hon. Local Sec. and Treasurer: Thos. Tyrer,
Garden Wharf, Church Road, Battersea, S.W.

The meetings of the London Section will be held on the first Monday in each month.

SESSION 1887–88.

Prospective Arrangements.

Dec. 5.—Professor Dewar, M.A., F.R.S. (President of the Society), "The New Weldon-Pechiney Process for the Manufacture of Chlorine from Chloride of Magnesium."

Communications to be addressed to the Local Secretary.

Mr. C. C. Hutchinson, of Stratford, desires to state that he was not the member of that surname present at the meeting of the London Section of the Society, held November 7, 1887.

Meeting held Monday, November 7, 1887.

MR. D. HOWARD IN THE CHAIR.

NOTE ON THE COMPARATIVE ANTISEPTIC VALUES OF CHLORIDES, NITRATES AND SULPHATES.

BY C. T. KINGZETT, F.I.C., F.C.S.

The simple observations of which I propose in this note to give a brief description, were not intended to serve as a definite measure of the antiseptic values of the substances employed, but were only made by way of a preliminary introduction to another study. As, however, they were comparative in character, they may possess some little interest and value. Two series of experiments were made, one being upon flour-paste, to ascertain for what period certain quantities of 5 per cent. solutions of the various substances protected it from the growth of mould, and the other upon extract of beef, to ascertain for what period the same 5 per cent. solutions protected it from putrefaction.

It is to be noted that in cases where the salts were not perfectly soluble in water, the solutions containing the undissolved compound in suspension were used.

The manner of proceeding with the flour-paste observations was as follows: In each case 4grms. of flour were boiled up with the water until a gelatinous product was obtained, and when nearly cold the solutions to be tested were well stirred in. One series of observations (*a*) was made with a mixture of 4grms. flour, 38cc. water, and 2cc. of the 5 per cent. antiseptic solutions; and another (*b*) with 4grms. flour, 36cc. water, and 4cc. of the 5 per cent. antiseptic solutions. Practically, therefore, the mixtures contained respectively about 5 per cent. and 10 per cent. of the 5 per cent. solutions under examination. In other words, the actual weights of substances employed in these two series of trials were severally 0·1 and 0·2grm.

By way of comparison, an unprotected mixture of flour and water was similarly made and employed, using 4grms. flour and 40cc. water.

For the other series of observations (*c*) 5lbs. of lean fresh beef was digested at 40° C. with distilled water during three hours, the extract was diluted up to 4 litres, and after cooling, strained through fine muslin.

Quantities, each of 95cc., of this extract were then taken, and to them was added 5cc. of the respective 5 per cent. solutions under examination (= to 0·25grm. dry substance). All the test glasses were left uncovered.

SUMMARY OF RESULTS.—SERIES A.

CHLORIDES.

On 2nd day mould was seen upon the following mixtures:—$NaCl$, $CaCl_2$ and $SrCl_2$.*

On 3rd day on NH_4Cl, $BaCl_2$, $MgCl_2$, $ZnCl_2$.

On 4th day on the standard flour-paste.

On 5th day on $SnCl_2$.

On 6th day on Al_2Cl_6.

On 9th day on Fe_2Cl_6.

On 16th day on $PbCl_2$.

On 26th day the following mixtures were still free from mould, but had dried up:—$HgCl_2$ and $CuCl_2$.

NITRATES.

On 4th day KNO_3, $NaNO_3$, NH_4NO_3, $Sr(NO_3)_2$, $Ca(NO_3)_2$, $Mg(NO_3)_2$.

On 5th day flour paste standard, $Ba(NO_3)_2$, $Zn(NO_3)_2$ and $Fe(NO_3)_2$.

On 7th day $Pb(NO_3)_2$.

On 15th day $Hg_2(NO_3)_2$ (mercurous nitrate).

On 24th day the $Cu(NO_3)_2$ mixture had dried up free from mould.

SULPHATES.

On 5th day mould was to be seen on the following mixtures:—flour-paste standard, K_2SO_4, Na_2SO_4, $(NH_4)_2SO_4$, $Al_2(SO_4)_3$, $MnSO_4$, $ZnSO_4$.

On 7th day on $MgSO_4$.

On 9th day on $FeSO_4$.

On 20th day on $CuSO_4$.

On 24th day the $HgSO_4$ mixture had dried up free from mould.

SUMMARY OF RESULTS.—SERIES B.

CHLORIDES.

On 2nd day mould had appeared on the $CaCl_2$ mixture.

On 3rd day on KCl, $NaCl$, NH_4Cl, $BaCl_2$, $SrCl_2$.

On 4th day on flour-paste standard, $MgCl_2$, $ZnCl_2$.

On 7th day on Al_2Cl_6.

On 9th day on Fe_2Cl_6, $SnCl_2$.

On 26th day the following mixtures had dried up free from mould:—$HgCl_2$, $PbCl_2$, $CuCl_2$.

NITRATES.

On 4th day KNO_3, $NaNO_3$, $Sr(NO_3)_2$, $Ca(NO_3)_2$.

On 5th day flour-paste standard, NH_4NO_3, $Ba(NO_3)_2$, $Mg(NO_3)_2$, $Zn(NO_3)_2$.

On 7th day $Fe(NO_3)_2$.

On 8th day $Pb(NO_3)_2$.

On 20th day $Hg(NO_3)_2$.

On 24th day the $Cu(NO_3)_2$ had dried up free from mould.

SULPHATES.

On 5th day on the flour-paste standard, K_2SO_4, Na_2SO_4, $(NH_4)_2SO_4$, $Al_2(SO_4)_3$, $ZnSO_4$.

On 7th day $FeSO_4$, $MnSO_4$.

On 9th day $MgSO_4$.

On 24th day $CuSO_4$ and $HgSO_4$ mixtures had dried up free from mould.

It should be mentioned that, although in the preceding records, the first day on which mould made its appearance on the pastes has been noted in each case, yet the quantity so appearing differed within wide limits; in some instances the growth was barely decisive in character, whereas in others it was well developed.

Reviewing the results generally, it may be said that the compounds of the alkalis and alkaline earths appeared in many instances to promote the growth of mould in the same sort of way as Warrington has observed the presence of gypsum facilitates the nitrification of urine. In no instance was the growth of mould postponed by the presence of salts of potassium, sodium or ammonium, and among the compounds of the alkaline earths, magnesium sulphate alone exhibited a slight prohibitive effect. The zinc compounds rank with those of the alkaline earths. The sulphate of manganese in the higher proportion slightly delayed the growth of mould. The compounds of iron, tin, lead and aluminium exercised distinct but not very powerful prohibitive effect, excepting the chloride of lead, the antiseptic action of which must be described as incisive and as ranking with the sulphate of copper. As to copper and mercury, the chlorides of those metals rank apparently as of highest and equal value, side by side with nitrate of copper and sulphate

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* The KCl paste did not go mouldy, but smelled sour o the 7th day, when maggots appeared.

of mercury. Somewhat below these compounds in antiseptic action stands sulphate of copper and nitrate of mercury, the first-named of these substances being decidedly the most effective of the two.

SUMMARY OF RESULTS.—SERIES C.

Chlorides.

On the 2nd day the solutions containing the following salts were putrid:—KCl, NaCl, NH_4Cl, $BaCl_2$, $SrCl_2$, $CaCl_2$, $MgCl_2$. (Mould on $BaCl_2$ solution 3rd day).

On the 6th day Al_2Cl_6, Fe_2Cl_6, $PbCl_2$, $SnCl_2$. (Mould on Al_2Cl_6, $PbCl_2$ and $SnCl_2$ solutions on 3rd day).

On the 8th day, $ZnCl_2$.

The solutions containing $CuCl_2$ and $HgCl_2$ alone remained good during the whole period of observation (summer weather)—viz., some 10 days.

Nitrates.

On the 2nd day the following solutions were putrid:—KNO_3, $NaNO_3$, NH_4NO_3, $Mg(NO_3)_2$, $Fe(NO_3)_2$.

On the 3rd day $Sr(NO_3)_2$, $Ca(NO_3)_2$ (also mould).

On the 6th day $Ba(NO_3)_2$, $Pb(NO_3)_2$ (mould appeared 3rd day).

On the 10th day $Zn(NO_3)_2$ (been suspicious some three days).

The $Cu(NO_3)_2$ and $Hg(NO_3)_2$ solutions alone remained intact from putrefaction, although there was a speck of mould on the copper solution on the 5th day; it did not grow appreciably.

Sulphates.

On the 2nd day the following solutions had broken down:—K_2SO_4, Na_2SO_4, $(NH_4)_2SO_4$, $MgSO_4$, $MnSO_4$.

On the 3rd day $FeSO_4$.

On the 6th day $Al_2(SO_4)_3$, $ZnSO_4$ (also mould on both).

The $CuSO_4$ and $HgSO_4$ solutions alone stood the test, but a speck of mould appeared on the copper solution on the 4th day; it did not appreciably develop.

The standard meat extract was very bad on the 2nd day.

With respect to the observations made with extract of meat, the results generally accord with those of the flour-paste series, excepting that the salts of zinc appeared to exercise a distinctly superior antiseptic action to that which they exhibited in protecting flour paste from the growth of mould. The chloride of lead did not behave up to expectation, based upon the flour-paste experiments with that substance, but in all probability its effect is modified by the precipitation which the solution undergoes when added to meat extract. The compounds of mercury and copper again come out as most effective, and, if any choice is to be made, it seems to fall upon the chlorides of those metals.

DISCUSSION.

The **Chairman** said the thanks of the meeting were due to Mr. Kingzett for his record of an admirable and accurate research, the value of which he had underestimated. It was only by experiments of this kind, made with various substances and under varying conditions, that one could realise the great differences in the action of various reagents on various micro-organisms. Without such knowledge there was the danger of over-wide generalisation from insufficient evidence. For example, the action of boracic acid was widely different on animal and on vegetable life. To animal life it was a doubtful poison, but to vegetable life it was most deadly. The whole question of the application of such bodies to preservative or disinfectant uses, therefore, depended on the nature of the substances to be treated. Mr. Kingzett's experiments were very interesting as showing that it was only in very dilute solutions that one could determine the specific action of the antiseptic body. Everybody knew that a strong solution of common salt was a powerful preservative, and it was desirable that it should be equally well known that the same body, if dilution were carried beyond a certain point, not only ceased to be a preservative agent, but probably encouraged the growth of organisms. Mr. Kingzett's experiments seemed to show that the most powerful destroyers of these low forms of life were the salts of mercury and copper. Without wishing to propose that blue vitriol should be run into the drains, he certainly thought that this salt ought to have a more extended use for sanitary purposes, as it was comparatively inexpensive, and its action was far more powerful than was generally realised.

Mr. **Tyrer** considered the paper to be a striking example of the good work which many members might, but from motives of diffidence did not, bring before the Society. It would be most useful if results of this kind—*i.e.*, laboratory notes—were recorded in the Society's Journal, with the discussions to which practical points always gave rise.

Mr. A. H. **Hutchinson** expressed surprise that Mr. Kingzett had not compared the action of the bodies dealt with in his paper with that of other preservative agents. He would be glad if Mr. Kingzett would explain the nature of the action of his Sanitas solution, and state why it prevented decomposition where bichloride of mercury did not.

Mr. J. **Heron** wished to ask what was Mr. Kingzett's object in making these experiments? It seemed to him that the object was to determine at what period mould would first appear. Nothing had been said about other forms of micro-organisms, which could be seen only under the microscope. It was well known, however, that where mould might appear on the surface of the bodies treated, other organisms originally present might have been destroyed by the antiseptic used—in short, that the salts would have a different antiseptic action on different forms of organisms. He would like to know whether Mr. Kingzett had differentiated his experiments, whether he could say, for instance, that nitrate of zinc would destroy bacteria and other ferments, as well as mould, up to a certain point, or that mercury chloride would practically kill everything it came in contact with, or, at least, prevent its development. He understood that Mr. Kingzett had boiled the flour and the meat extract. It would have been much better, however, to have simply mixed the substances with water and then added the antiseptics.

Mr. **Kingzett**, replying to the last speaker's remarks first, pointed out that in describing how his experiments had been conducted, he had expressly stated that the flour paste had in all cases been prepared by boiling the starch with water only, and that when the paste was nearly cold the antiseptic solution was stirred in, and the mixture placed in open glasses exposed to the air. In the case of the meat extract, to have boiled it would have been to entirely defeat the experiment, because it would have coagulated. He had avoided that by preparing it at a temperature at which the constituent albumen would not coagulate. The experiments were only intended to ascertain the comparative antiseptic value of the various solutions employed upon the specific growth of mould, and the active bacteria—notably *bacterium termo*—concerned in the process of putrefaction, and for these two growths there was no question of the value of the comparative results obtained. He willingly admitted that if he wished to place before a scientific body an adequate explanation of the action of any one antiseptic, he should not deal with a mixture like flour paste, nor with extract of beef. He would prefer to take a number of well-known simple substances. For example, he would take so much sugar, and ascertain how much alcohol and carbonic anhydride were produced, and in every case would not be content till the sum total of the products equalled the amount of substances operated on. That had not been his object in the present experiments, which were merely preliminary to such a study. Some two years ago he had occupied himself for eight months with an investigation of that kind. In that case the antiseptic employed was exclusively his own "Sanitas" fluid. He had always regretted that he did not communicate those results to the Society, because they were quantitative throughout. Even if resuscitated now they would be robbed of much of their interest, because they had been already published in pamphlet form. With reference to Mr. Hutchinson's remarks, he could only say that he had studiously avoided any reference to his own products. If he had desired to compare the "Sanitas" products with other antiseptics, he would have been compelled to pursue the investigation much further than seemed desirable on the present occasion. Thus, instead of being content with the bare comparative antiseptic results as obtained from laboratory experiments, he would consider it necessary to ascertain how far it was possible to take practical advantage of them not only in a public sense, but in such special direction, also, as in the practice of antiseptic surgery, and the chemical modification (destruction) of those poisonous substances which are often produced as concomitants of the life and development of micro-organisms.

DISCUSSION ON MR. J. RUFFLE'S PAPER ON "THE CORRECT ANALYSIS OF SUPER PHOSPHATES, PLAIN AND AMMONIATED"

—Printed in the July (1887) Number of the Society's Journal.

Mr. B. E. R. Newlands, while fully recognising the great merit of Mr. Ruffle's work, could not agree with his views on certain points. He thought that Mr. Ruffle attached too much importance to the quantity of water in these manures. His process would give the percentage of uncombined water; but then that percentage would vary week by week as the manure aged, and so it would be impossible to verify results. On the other hand, by the old method of determining the whole of this useless water at 212°, one got uniform results. Supposing a manure intended for export to America; a certain degree of moisture guaranteed; and that moisture determined by the calcium chloride test at 10 per cent. On its arrival in America, some weeks later, the results would appear so much lower that the American buyer would be apt to lose faith in the skill of the London analyst. Mr. Ruffle was of opinion, too, that there was practically no monocalcic phosphate, on the ground that "the SO_3 is present in less quantity than is necessary to combine with all the CaO." It seemed to him, however, that, there being insufficient SO_3 to combine with the three molecules of lime, this was a good reason for its combining with two—on the principle that an army of soldiers desiring to take three cities, but being insufficient in numbers, would make sure of two cities first rather than attempt the impossible feat of taking all three. Mr. Ruffle's paper was an interesting one, and abounded in conscientious work; he hoped it would do much to ventilate an important subject and to clear up results which had been, to some extent, a disgrace to public chemists, because of their variations and incongruities.

Mr. Bernard Dyer thought he might anticipate Mr. Ruffle's reply to Mr. Newlands in so far as to say that if, continuing the military comparison, "third regiment of molecules" were read for "third molecules," the passage would be perfectly clear. The paper had finally disposed of the supposition that the so-called monobasic phosphate formed a constant or sometimes even a very appreciable quantity of the so-called "soluble phosphates" present. In devising his method of moisture determination, and in the work that had led up to it, Mr. Ruffle had done a great deal for the chemistry of the subject. There would, of course, be practical difficulties in the way of adopting the process, the chief one being perhaps that of getting chemists to agree on this mode of statement. Each one would be afraid to take a new departure, for fear of bringing about what would be looked upon as hopeless clashing. With regard to Mr Ruffle's general method of stating results, the old method of writing out an analysis of superphosphates could be defended on only one ground: that it was convenient because it was conventional. Scientifically, it was lamentable that four out of five items of an analysis should be more or less meaningless; but, practically, it was of little consequence. The cases in which full analyses of superphosphates were required were rare, the usual course being merely to show the percentage of soluble and insoluble phosphates of ammonia, and sometimes of (so-called) moisture. But, on the scientific question, he must quarrel with the author, not for introducing a reform, but for not being a good thorough-going Radical while he was about it. In this case Mr. Ruffle, if he would forgive him for saying so, was posing rather as a sort of analytical Whig. He (Mr. Dyer) objected to analyses which mixed up acids and bases stated as such with salts stated as such. Mr. Ruffle had quarrelled with the old method because of its "assumptions," but it was surely an assumption on his part to make the insoluble phosphoric acid all tribasic phosphate of lime, whereas a considerable percentage of it might be phosphate of iron or of alumina. He had also assumed that all the SO_3 was present as sulphate of lime. But there were many bases present: oxide of iron, alumina, magnesia, potash and soda. Why then give all the SO_3 to lime? Then, too, the difference that Mr. Ruffle had shown in the composition of ordinary superphosphate and ammoniated superphosphate came in to bother one, the total sulphuric acid in the one case being calculated as sulphate of lime and in the other case the lime, other than insoluble phosphate, being stated as sulphate of lime. In the one case, he assumed the "sulphate of lime" from the SO_3; in the other case from the lime. But there were different degrees of "ammoniation," so to speak, and the variation in composition might be considerable in different cases. He would suggest that, to place the thing on a scientific basis, no assumptions at all should be made, but that the various constituents should be stated as they were determined—acids and bases being written separately. He felt, as would all brother agricultural analysts, personally grateful to the author for the work he had done, but while having a full sense of the value of that work, he would like to see the reform in the statement of results—if there were to be any reform—made complete.

Mr. T. W. B. Mumford, referring to Mr. Newlands' remarks that water had no value, said that a manufacturer who produced a superphosphate containing much water soon found that he had to put his hand in his pocket and allow for it. Mr. Ruffle's experiments had shown that it was possible to determine the amount of actual or uncombined moisture, whereas the old method determined the whole of the water present. Assuming that a superphosphate tested by the old method gave 20 per cent. of moisture, by the calcium chloride test it might show, say 10 per cent., which later on would be somewhat reduced, as more of the water would combine with sulphate of lime. But if the same manure were then again tested by the water-bath, it would still show 20 per cent. of water; and hence the manufacturer was placed in an invidious position. It was therefore very desirable that analysts should adopt some one method which could be depended on.

Mr. G. D. Macindoe said that was just the point at issue. All who understood the American trade knew that if the calcium chloride method were adopted makers would be required to guarantee a certain moisture *on arrival* in America. Sellers had to guarantee a 14 per cent. moisture, and if they were to be called on to adopt what it might be, say after three months, more difficulties and quarrels would arise than at present.

Mr. A. H. Hutchinson differed from both the author and Mr. Dyer as to the form in which the results of the analyses should be expressed, and indicated on the black board the formulæ which he considered should be used.

Mr. Hughes pointed out that the difficulties which arose between manufacturers of superphosphates and American buyers practically turned upon the question of what *was* moisture. If manufacturers would agree to adopt either the determination by the calcium chloride method or by the water-bath method, and stipulate for a certain percentage by one or the other method when contracts were made, many of the disputes which now occurred would be avoided. It was matter for regret that the subject of the statement of analytical results in regard to superphosphates should not have been taken up long before; and Mr. Ruffle deserved their thanks for his work. He would like some further information with respect to the free acid in superphosphates. He had found that when an excess of sulphuric acid was used there was a perceptible amount of free acid, and if the superphosphate were kept for some time it became wet, not dry. In such cases the determination of the free acid would be of great use to the manufacturer.

Mr. Crowder thought that Mr. Hughes had answered his own question. If a superphosphate contained free acid, it was clear that it was badly made and that too much acid had been used. His objection to analyses as at present expressed, was that statements were made which sellers found it very difficult to prove, and Mr. Ruffle had done good service in drawing attention to the subject. The whole of the phosphoric acid was calculated as monocalcic phosphate, whereas really two-thirds only was so. Mr. Ruffle had, however, been illogical in not stating his insoluble as well as his soluble phosphate in terms of phosphoric acid, so that anyone could readily see what it represented in phosphate of lime. The question of moisture could be regarded from two points of view, the commercial and the scientific standpoints. The commercial manager of course regarded it from the first, and the works manager from the other standpoint. It might be necessary to make elaborate analyses for the works manager, but for the other it was waste of time. The question of moisture did not often arise in the English trade. The condition of the manure was the main point. One might have half-a-dozen different manures all in good, dry, powdery condition, and yet showing several per cents. difference as to moisture. Therefore moisture did not represent the condition, and it was the latter point to which the farmer chiefly looked. Mr. Ruffle's plan for the determination of moisture had doubtless great scientific value, but was not of much commercial importance. Mr. Ruffle argued rightly enough that if a thing was "worth doing at all it was worth doing well." Still that mode of analysis entailed great expenditure of time. If an analysis was required during the day, and it took one-and-a-half days to do it by the $CaCl_2$ method, surely it was better to use the old water-bath method and so get the work done quickly.

Mr. C. G. Cresswell said that users of these manures complained greatly of the method in which analyses were stated to them. Farmers of average intelligence found themselves unable to grasp the information given to them, though anxious to do so, simply because the terms employed were as so much Greek to them. It was to be desired that such useful works as Mr. Wyatt's "Modern High Farming" should become generally known to farmers, since they would therein find a clear and simple translation of all the analyses with which they were concerned.

The Chairman, in calling on Mr. Ruffle to reply, said that he would probably tell them that he had stated his phosphate as "soluble" and "insoluble," because those were the states in which it was found in the manure. He must nevertheless admit that even to the mind of the average chemist there would be an advantage in stating both in terms of phosphoric acid.

Mr. Ruffle, in reply to Mr. Newlands, admitted that the results of his method would vary with time: but it was right that they should do so, since the composition of the manure itself varied with lapse of time. That seemed to him an argument in favour of the adoption of the proposed method. He thanked Mr. Dyer for his suggestion of the "regiments" of molecules of sulphuric acid attacking the equivalents of lime, which was quite in accordance with what he wished to express. It had been suggested that the sulphate of lime should be determined by one method for both plain and ammoniated phosphates. He thought not. If one method were adopted the results would be incorrect, for there was an essential difference between the two compounds. In the one case the lime could be estimated from the sulphuric acid, in the other it could not. The first duty of the analyst was to get the result correct in each case, although it might entail more trouble.

Mr. Newlands asked whether the sulphate of lime could not be determined from the lime in each case?

Mr. Ruffle replied that it could not, for whilst possible in ammoniated superphosphates, owing to their containing practically no lime as monocalcic phosphate, yet in plain superphosphates the amount of lime present as monocalcic being appreciable, was yet too irregular to permit any rule. As to the question of whether the water in these manures was of any value, it was to be remembered that although the manure was not sold at so much per unit of water, yet if it were the fact that a maker had a manure which was wet and out of condition, and by keeping it for two or three months it came into good condition, simply by the water combining, the water question did appear to be of considerable importance. He did not believe that American buyers would succeed in forcing any manufacturer to guarantee a certain condition on arrival. No maker would agree to that, not knowing the time which would be taken in transit. The most he would agree to would be to deliver it on this side in a certain condition and have it examined here. Mr Dyer had complained that he had mixed up acids, bases, and salts. That was perfectly true. He had done so because it was the practice among merchants and brokers to speak of soluble P_2O_5, and he thought it would be going too far to introduce such terms as soluble phosphoric acid hydrated, or soluble phosphoric anhydride. He had carried the matter as far as it was likely to be accepted commercially. Whether the insoluble phosphoric acid existed as insoluble phosphate of lime, alumina, or iron, the usual course was, after showing how much soluble phosphoric acid could be got out, to call the remainder insoluble phosphate. He would have liked to state his results with more scientific accuracy, but feared to go too far lest his readers would not accompany him. He could only claim to have started the subject. No doubt as time went on other questions would arise in connection with it, and if he could make a further communication he would willingly do so.

Liverpool Section.

Chairman : J. Campbell Brown.
Vice-Chairman : F. Hurter.

Committee :

E. G. Ballard.
Ernest Bibby.
Eustace Carey.
H. Deacon.
J. C. Gamble.
S. Hamburger.

D. Herman.
J. W. Kynaston.
E. K. Muspratt.
G. Shack-Sommer.
Jas. Simpson.
A. Watt.

Local Sec. and Treasurer : W. P. Thompson, 6, Lord Street, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held November 2, at the University College, Brownlow Street, Liverpool.

DR. J. CAMPBELL BROWN PRESIDING.

CHAIRMAN'S OPENING REMARKS.

Dr. Campbell Brown opened the Session with the following short address :—

I shall probably be not far wrong if I assume that the great majority of manufacturers think mainly of their manufactures as a means of making money. Yet manufacture performs far higher functions, which should not be lost sight of, but which should be a source of pride to the established, and a consideration to the prospective, manufacturer. He, by his industry, benefits not only himself, but the rest of the world, providing employment for those under him, and generally a useful product for his customers. He has the opportunity of choosing whether he will devote himself to the supply of something beneficial to his fellows, or something which will merely tickle their fancy or please their senses. He has the opportunity of meeting with new facts and new things which may add to the general store of knowledge ; these he ought not to neglect, but either follow them up himself or take care that some one else has the opportunity of doing so ; and he ought to impart his knowledge to others, unless in such instances where it is necessary to withhold information for a little time in order to secure commercial success. He often has the opportunity of fostering in many ways the growth of the science, and of perfecting the art of chemistry, by working out details or making suggestions whereby others may do so.

The most satisfactory thing to contemplate in looking at the history of the development of the akali manufacture, for instance, is not that it made the fortunes of the fathers and grandfathers of so many members of this Society, nor even that it gave employment to so many thousands of workmen, although both were great things to accomplish ; but that it brought cheap and abundant means of cleansing themselves and their dwellings and raiment within the reach of every family among the civilised nations of the earth, and facilitated in countless ways the manufacture, not only of soap, but also of many other things of high utility, which would never have been introduced to the public use without a plentiful and economical supply of sulphuric acid, alkali or chlorine.

One of the greatest developments that we have witnessed has been that of the coal-tar industry and its numerous dependencies. When one sees the glaring colours which are now flaunted before the public eye, often without any thought of harmony and with no consideration of appropriateness of position or surroundings—in advertising placards, house decoration, dress and so forth—one is sometimes tempted to ask whether the production of these new dyes has been a good thing for mankind, and whether, when our last mines are worked out and coal-tar dyes cease to be manufactured, the world will be any better for having had them, and whether the huge industry, which is at present flourishing, is not a waste of time, and of carbon compounds that would be better saved to keep us warm in winter—whether, at least, its highest merit is not that it affords a present means of livelihood to so many thousand workmen.

We sometimes hear it said that the production of artificial alizarin has done an immense service in setting free so many square miles of land for the growth of grain ; but I am afraid this is not a great merit, and that perhaps the Egyptian farmer might have been better off with his madder crop than with his grain crop. The world has abundance and superabundance of acres on which to grow food. The great difficulty seems to be not to find acres to grow food on, but to find something that will grow on all the acres that are in cultivation or available for cultivation, and that will sell at a price which will enable the grower to buy something more than the mere grain necessary to keep him alive.

It is possible that the art sense may be influenced by some of the colours which have been introduced and popularised by the coal-tar industry ; but no improvement of that kind, if it takes place at all, can last after the supply of material has ceased.

When all the available coal in the world has been exhausted, and we have to depend again on tar from vegetable sources, and when our fuel has to be cut from living forests instead of dead mineralised ones, and the progress of manufacture of coal-tar colours has shrunk to insignificant dimensions, the world will still have a knowledge of the structure of chemical compounds, and of the modes of transformation which they undergo—knowledge which has been acquired through the stimulus given to organic research by this industry, and whose acquisition would not have been possible but for the industrial development of coal-tar products.

The knowledge which we already have of the laws and modes of organic synthesis, of the symmetry which we see in the groups of carbon compounds from the simplest to the most complete—knowledge which is increasing every day, and is destined to increase for a long time to come—is the real justification of that waste of our sources of crude carbon compounds out of which it has sprung, the highest reward for all the ingenuity, labour and resources which have been expended upon the coal-tar industry, and will be the most lasting benefit which that industry has indirectly bestowed on mankind. This, rather than cheap alizarin, gaudy bills, brilliant shop windows and rainbow-coloured dress, is the thing of which the coal-tar manufacturer should be proud.

Casciorolus doubtless made excellent shoes and sold them at a fair price ; but the world would not know his name nor feel the least indebted to him, had he not introduced into the chemical laboratories of his time barium sulphide or Bononian phosphorus.

John Kunkel was manager of a Potsdam glass manufactory which produced a famous ruby glass ; he also published a book in which all the known receipts for making glass are given. Yet, when one names Kunkel, it is phosphorus and not glass that rises before one's mental vision.

Balard is revered now not because he manufactured and sold so many thousand kilos. per week of salt extracted from sea water; but because he one day, in the course of his experiments with the mother-liquor, observed some reddish-brown vapours which he had never seen nor heard of before, and did not carelessly neglect them, nor selfishly conceal his discovery, but made a very elaborate examination of these red fumes and made known to the world the now very useful element—bromine.

Joule doubtless made excellent beer, because he is the sort of man who does everything well that he undertakes; but his great work for which the world is most indebted to him, and by which he will be remembered with gratitude throughout all time, was his determination of the mechanical equivalent of heat, whereby he laid the foundation of chemical dynamics and of the science of thermal chemistry, as well as brought about a revolution in an important branch of physics

It is desirable that the manufacturer should remember that he has other and higher privileges, and that nobler duties devolve upon him than those which necessarily occupy the greater part of his thoughts during business hours.

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COMPARATIVE EFFICIENCY OF VARIOUS MODES OF TREATING LIQUIDS WITH GASES.

BY FERD. HURTER, PH.D.

Two years ago I read a paper before this Section, entitled "Comparative Efficiency of Various Modes of Treating Liquids with Gases." The following short paper forms a continuation. I can hardly expect the members to recollect that paper, and I will, therefore, recapitulate briefly its contents. The intention of the paper was to compare the efficiency of various apparatus for bringing into intimate contact liquids and gases, that apparatus being considered most efficient, which produces the most intimate contact with least expenditure of mechanical work. I divided the various modes of treating a liquid with a gas into three classes. The first method consisted in propelling the gas divided into small bubbles through a column of liquid. The second method, the inverse, divides the liquid into fine drops, which fall through a column of gas, and in the third method, which is the most important, the liquid is spread over extensive surfaces of solids, the gas filling the interstices between the solids.

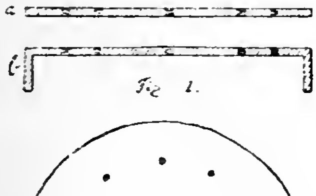

Fig. 1.

In my last paper I only dealt with the mechanical principles of apparatus of the first class, and showed that it is cheaper to force the gas through the liquid than to pull it through, and that it is best to allow the gas to escape at atmospheric pressure from the surface of the liquid, when that is possible. The arguments were based upon experiments on the behaviour of gas bubbles under various pressures, and upon the uniform velocity with which they rise through the solution. I assumed a uniform and perfect distribution at the bottom of the column of liquid in all cases, and I gave a warning that the mere consideration of mechanical principles and disregard of the chemical side of the question might lead to the reverse of economy.

It is my intention to-night to complete my remarks as to how to obtain a good distribution of the gas; and also to show how the chemical side of the question may influence the economy of the process.

The usual methods of distributing a gas at the bottom of a column of liquid are:—Either the employment of a false bottom (Fig. 1), which is a perforated plate sometimes plain (*a*), sometimes provided with a downward flange so as to make it into an inverted perforated flat dish (*b*), or the distributor consists of a system of radiating pipes, perforated with small holes (Fig. 2), or it often consists of a bell or cone open at the bottom (Fig. 3), under which the gas is delivered, and from the serrated circumference of which the gas rises in a number of fine streams.

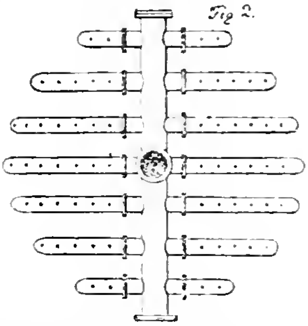

Fig. 2.

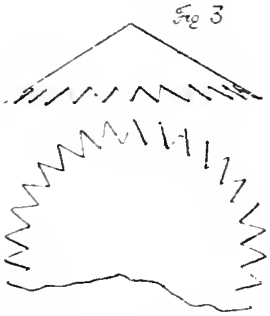

Fig. 3

Only the false bottom and the pipe system can be called distributors in the wider sense of the word, since they alone can distribute a gas equally over a large area, whilst the serrated cone only causes the gas to rise in a number of streams instead of only one, and is a distribution in that sense, but it does not attempt to distribute the gas equally over a large area.

The purpose of the perforated plate and the perforated pipes is to divide the gas into as many streams as there are perforations, and to equally distribute these streams over the sectional area of the vessel.

A rule often observed by engineers in designing these distributors, is to choose the number and size of the perforations so that the total area of the perforations shall be at least equal to or rather larger than the area of the supply pipe.

I had some doubts as to this rule, and I decided to test the question as to whether the gas would always divide itself into as many streams as there are perforations by direct experiment.

At the bottom of a circular glass vessel I placed a flanged perforated plate, as shown in Fig. 4. At the side of this false bottom through the flange, I provided an inlet pipe. Another inlet pipe passed through the bottom of the glass vessel in the centre. I may at once state that in all experiments it was found perfectly indifferent which of these two inlets was used, the position of the inlet pipe in no way affected the result.

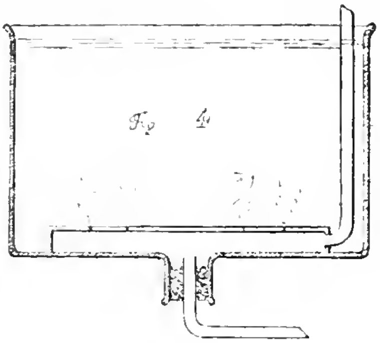
Fig. 4

The false bottom had two circular rows of holes, one larger circle containing 12 holes, and a smaller circle containing six holes, all of exactly the same diameter, $\frac{1}{16}$ of an inch. The supply pipe was $\frac{1}{4}$-in., and it will be seen that 16 holes would have equalled the supply pipe.

On admitting air into this arrangement it was found that only a particular amount of air could be fairly distributed with it. When a small quantity of air was used, only a few of the perforations were supplied; no gas issued from the others. Spasmodically the holes which were supplied would cease to deliver and others would start. By increasing the quantity of air a greater number of the holes began to deliver, and with a certain supply all the 18 holes were fairly and regularly supplied. But if now the quantity of air was still further increased, it would find its way in large masses from under the flange of the false bottom, and regular distribution no longer existed.

I measured the quantity of air which each hole delivered; first when only a few of the holes were supplied, and secondly when the whole 18 were all fairly supplied. I measured it by allowing it to enter a vessel held over the hole, and observing the time required to completely fill that vessel (see Fig. 7).

I thus found, first, that every one of the 18 holes delivered the same amount of air, and secondly that when only a few holes were working, the amount of air delivered by one of them was the same as when the 18 were working. It was evident, therefore, that the relative areas of the perforations and the supply pipe had no connection whatever with the regular distribution, but that the number and areas of the perforations must depend upon the quantity of gas to be distributed, and that only one particular quantity of gas could be distributed by a given distributor of this type.

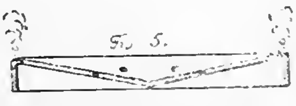
Fig. 5.

I next tried another form of false bottom, as shown by Fig. 5. This was intended to deliver and distribute two different quantities of gas. The distributor consisted of an indented flat cone; apex downwards, and a downward flange at the periphery. Twelve holes were drilled into the ridge, and six on a circular line on the side of the cone. The gas could be delivered either from the supply pipe soldered to the flange, or from the central pipe through the bottom of the glass vessel. The results again in no way depended upon the position of the inlet pipe.

The intention was, that a small amount of air should issue only from the holes in the ridge, and a larger quantity of air should supply both the holes in the ridge and the holes in the side of the cone.

On delivering a small quantity of air any number of holes up to the 12 in the ridge could be gradually supplied, but on increasing the supply the air found its way from under the flange of the false bottom, and none issued from the six holes at the side, not until they had been made considerably larger. The amount of air delivered by one hole in the ridge was equal to that delivered by a hole in the former apparatus.

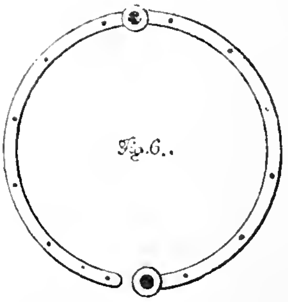
Fig. 6.

I next tried a pipe $\frac{1}{4}$-in. bore bent into a circular ring (Fig. 6). One end of the pipe was sealed, the other open end formed the inlet. There was a branch soldered on at half length of the pipe, which could be used as an inlet. Again it was found that the position of the inlet pipe did not affect the results at all.

When a small current of air was passed into this pipe, of the twelve holes which were drilled into it, only a few began to deliver. The position of these holes could not be foretold when the ring was perfectly level, but, if the ring was slightly out of level, the highest holes had the lead. On gradually increasing the air all the twelve holes could be supplied. When measuring the quantity of air delivered by each hole, it was found that the holes delivered all the same quantity, those nearest to the inlet pipe delivering no more than those furthest from it. On increasing still further the current of air, each hole delivered more and more air, all alike. Of course there was no other outlet for the air than the twelve holes. This type of apparatus is the one which can distribute any amount of air, larger than a certain minimum, which

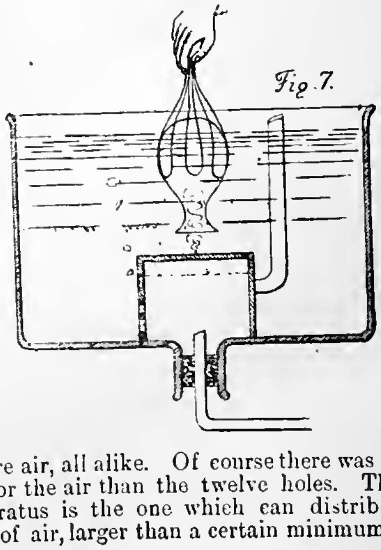
Fig. 7.

was necessary to supply all the holes. To find that minimum and how to calculate for any given case the number and size of the holes was the purpose of the next experiment.

I placed a cylindrical vessel, open at bottom, having one single hole $\frac{1}{16}$in. drilled in the centre of the top, under water (Fig. 7). On the vertical side of this vessel I drilled four holes in a vertical line ½in. apart, the first hole being ⅜in. from top of vessel.

Air was supplied and so regulated that whilst a regular stream issued from the top hole, now and then a bubble would rise from one of the side holes, the others being plugged. This side hole, by delivering bubbles, showed how far the liquid was depressed under the cylinder and served thus as a simple pressure gauge. By measuring the time necessary to deliver a given bulk of air when the level of the liquid was depressed under the cylinder by a certain amount, the following results were obtained, each measurement being repeated several times :—

No. of Experiments made.	Depression below level of vessel.	Time required for filling bulk.	Lineal Velocity in feet per second.	$56\sqrt{p} \times 0{\cdot}9$ Velocity calculated.
3	⅜in.	11 sec.	35·59	36·23
3	⅞ „	6·8 „	57·58	55·26
4	1⅜ „	5·75 „	68·10	69·50
3	1⅞ „	5 „	78·30	81·36

In this table I have added a column which contains the lineal velocity calculated by the usual ordinary formula used for finding the lineal velocity of air flowing from a vessel through an orifice into the atmosphere, the pressure in the vessel being p-inches of water above atmospheric pressure ; 0·9 being taken as coefficient of friction, etc.

It will be seen at a glance that the discharge of air from the orifice of my cylinder obeys evidently the same law, and that the discharge from an orifice under water is nearly the same as the discharge through the same orifice with the same hydraulic head would be in air. This can be proved by a simple experiment, particularly with higher velocities. If a current of air be allowed to issue from an orifice, and the velocity of the current is indicated by an anemometer, the mere submerging of the orifice under water does not alter the velocity as indicated by the anemometer, unless the depth to which the orifice is immersed becomes serious in comparison to the pressure which forces the gas out of the orifice.

It is thus evident that in order to distribute a gas properly the number and area of the holes must be such as correspond to the smallest amount of gas to be distributed. Suppose that amount known in cubic feet per second. Take the smallest pressure at which all the holes are supplied as ⅜ of a inch, then the lineal velocity of discharge is about 35ft. Divide the quantity of gas by 35 ; that will give the total area of all the holes.

It will also be evident that a false bottom is as good as the pipe system, when its flange is deep enough, which in my experimental apparatus it was not. Hence the reason why in the inverted cone the second row of holes did not deliver.

I have now communicated the mechanical principles upon which the efficient working of apparatus of the first-class depend, as far as I know them.

In my former paper I said that intimate contact might be wasted, if we did not pay sufficient attention to the chemical part of the problem.

In order to show how this is possible with apparatus of this description—*i.e.*, where the gas is allowed to rise in bubbles through a column of liquid—I will direct your attention to two special cases.

It can be shown theoretically that as the height of the column of liquid is increased the efficiency of an apparatus continually decreases. But the demonstration of the general problem is tedious, and the consideration of special cases is more interesting, and will give a better illustration of what I wish to convey.

One of the simplest operations usually carried out by means of such apparatus is the carbonating of crude soda solutions in alkali works. These solutions contain about ⅓ of the soda in the state of caustic soda, which is converted into carbonate of soda by forcing through the solution impure carbonic acid gas, either products of combustion simply, or the gases from a lime-kiln. Such a solution absorbs carbonic acid with tolerable rapidity.

If it were only the caustic alkali which contributed to the absorption, the rapidity of absorption would decrease as the caustic is gradually converted into carbonate. When the solutions are boiling hot, this is more or less the case. But when the solutions are cool, the carbonate of soda also absorbs carbonic acid, and the result is that as the caustic decreases, and the carbonate increases, the absorption remains tolerably uniform from the beginning of the operation to the end. But when bi-carbonate of soda begins to form in the solution, the rate of absorption decreases fast, as the following experiments show :—

ABSORPTION OF CO_2.

	At Beginning.	1st hour.	2nd hour.	3rd hour.	4th hour.
1.	46·4%	55·3%	52·6%	38·9%	—
	Samples of solution not analysed.				
2.	—	48·7	44·6	55·3	—
	NaHO at beginning 31·6grms. per litre. NaHO at end 0·0grm. per litre.				
3.	57·4	66·0	53·4	31·7	—
	NaHO at beginning 40grms. per litre. $NaHCO_3$ at end 9·2grms. per litre.				
4.	67·7	63·5	42·2	61·4	37·4
	NaHO at beginning 51·2grms. per litre. $NaHCO_3$ at end 6·72grms. per litre.				

This operation then represents one of the rare cases where a chemical reaction continues at uniform rate to its end.

I found that with such solutions on an average from 40 to 50 per cent. of carbonic acid could be absorbed with a given distribution under a column of two meters in depth.

Since the gas used is fuel gas, the cost of the operation is simply that of propelling the gas through the solution. Theoretically, the amount of work which must be expended to propel one cubic meter of gas through two meters of water is 1930 kilogrammeters ; and through four meters of water 3643 kilogrammeters. It does not theoretically require quite double the expenditure of work to drive the gas through four meters of water than to drive it through two only. But in practice the small difference is not worth taking into account, and we may safely take it that the cost of pumping the gas through four meters of liquid is double that of pumping it through two meters only.

If, then, four meters of liquid absorbed twice the amount of carbonic acid which two meters of the same liquid absorb, the cost of carbonating would be independent of the depth of the solution. Unfortunately, that is not so. Whilst two meters of liquid absorb 40 per cent. of CO_2, four meters absorb only about 60 per cent., so that for double the amount of work we obtain little more than 1½ times the result, and the operation becomes the more costly the deeper the column of liquid is chosen.

But immediately we put a price on the gas, however small, the aspect of the case is considerably altered.

Suppose, for instance, we had a blowing engine delivering 1000 cubic meters of gas per hour, and that this engine cost £300. At 10 per cent. interest this would amount to about 1d. per 1000 cubic meters of gas delivered. The cost of blowing for steam, etc., would be for every meter of depth of liquid 2d. per 1000 cubic meters (at the rate of ½d. a horse-power per hour).

Consequently the total cost would be for D meters depth,—

2D + 1 penny per 1000 cubic meters.

If, now, the absorption of gas is represented by the following series which I have interpolated from experiments :—

At 1 meter	22 per cent.
2 „	40 „
3 „	53 „
4 „	64 „
5 „	72 „
6 „	78 „

and the gas contain 20 per cent. by volume of pure CO_2, the cost of every 100 cubic meters pure carbonic acid gas really absorbed would be at

1 meter	2 meter	3 meter	4 meter	5 meter	6 meter
6·6d.	6·25d.	6·6d.	7·2d.	7·6d.	8·2d.

We see that under such conditions about two meters in depth gives the most economical result.

If, however, interest and depreciation include other plant, if costs have to be charged for freeing the gas from tar and sulphurous acid or other impurities, or if for other reasons the gas has a value, the result becomes still more altered.

Assuming, for instance, a charge of 10d. per 1000 cubic meters, instead of 1d., and taking otherwise similar conditions, the costs for 100 cubic meters pure CO_2 absorbed amount to for

1 meter	2 meter	3 meter	4 meter	5 meter	6 meter
27·0d.	17·5d.	15·2d.	14·0d.	13·8d.	14·0d.

which shows that under these altered conditions the most economical result is obtained at about five meters depth.

Let us consider as another example the Weldon process. Here atmospheric air is pumped through a solution of calcium chloride, holding in suspension manganese monoxide, which absorbs the oxygen of the air, and is thereby converted into di-oxide. As rapidly as the monoxide decreases, as rapidly does the rate of absorption decrease, and when about 80 per cent. of the manganese monoxide has been charged, the absorption of oxygen is very small indeed.

From some figures given in Professor Lunge's treatise, I calculate that the average absorption amounts to about 10 per cent. Weldon quotes instances where it was more, but I have seldom found it to exceed 5 per cent. on the average.

Now, when the rate of absorption is so small, the effect of doubling the depth of the solution is so nearly that of doubling the resulting absorption, that in such a case the costs of the operation continually decrease as the depth of the liquid is increased, particularly when the charges for the gas are for any reason high. Consequently, in such a case, we must use as deep columns as are practicable.

If our engineers could so construct blowing engines that a gas could be forced economically through a great depth of solution it would be a great advantage. Theoretically, the cost of propelling a gas by means of a cylinder which is not cooled through a column of 20 meters ought not to be more than about 13 times that of blowing through one meter, and with a well-cooled cylinder, it ought not to cost more to force a gas against 40lb. of pressure than six times the cost of forcing it against 4lb. of pressure.

But owing to the difficulties of leakage and noxious space it costs more and more per lb. additional pressure to force a gas against high pressures.

The efficiency of apparatus of the class I have discussed can therefore be improved very much more by attention to good blowing engines than by attending to the other points. But I think I have shown that they are worthy of attention too, particularly the rate of absorption, and if I have succeeded in making it clear that for some operations there are certain depths which are more economical than either greater or lesser, I hope I may be considered to have rendered a small service.

DISCUSSION.

Mr. **Rawson** wished to know whether Dr. Hurter had made any experiments on the shape of the orifices through which the gas passed? As far as he understood, the orifices used in Dr. Hurter's experiments were of a circular shape. He would like to know whether any square or rectangular orifices were used also? It appeared to him that, supposing the orifices had been small and circular, the bubble would pass over it, like a bridge; it would not have time to pass through that orifice, but would simply cross; whereas, if the orifice had been long and narrow, it was quite possible that it would pass through it. Also, he would ask whether nipples placed over each of the little holes would have made any difference? Then as regards the absorption of CO_2 in the caustic soda, it was shown that in the second experiment, if he remembered rightly, at the end of the second hour the amount of CO_2 absorbed had, as compared with the absorption at the end of the first hour, much diminished ere bicarbonate had been formed, whilst in the fourth experiment the amount of CO_2 absorbed had increased at the end of the third hour, and yet much bicarbonate had been formed, and he did not see how these two results agreed together.

Mr. W. P. **Thompson** asked was it a fact that if a pipe closed at the end, with a series of orifices along it, were placed very obliquely, the amount of gas evolved from each of these orifices, when full pressure was on, would be the same? He thought there should be very much more from the top orifice than there would be from any of the others, as there would be less resistance from head of water above the orifice. And with regard to the differential absorption of carbonic acid at different heights, when there was only 10 per cent. of carbonic acid in the mixture, was not the lessening effect very greatly due to the fact that through the bottom meter most of the carbonic acid was absorbed, and that as it got to the top there was a film of air all around the bubble of gas, almost clear of carbonic acid, so that it was a simple mechanical effect? Then, again, as the bubble gradually got to the top it would increase so much more in velocity. Might he ask whether an experiment was tried with pure carbonic acid?

Dr. **Kohn** said there were few manufacturers to which the subject was of greater importance than to those of coal gas. The gas had to be brought in contact with liquids in order to be washed, and he would like to point out that to a great extent this washing of the gas is purely a mechanical question, the impurities being so much more readily removed when the orifices through which the gas issues are very small, so as to break up the gas. The two special things which he wished to call their attention to were :—1st, The removal of tar. It was well known that coal gas contained benzene, etc., and many attempts had been made to recover these substances, although their removal was certainly a bad thing for the gas. In the tar-condenser of Pélouze and Audouin they adopted a principle in which the gas, by impinging on a large number of small holes and then spreading over a large surface, was readily broken up, and the benzene, etc., which was contained in the gas as a kind of mist, was then removed. This was a very efficient apparatus for the removal of tar from gas, and it showed how very much the removal of the tar in this way was a mechanical operation. In the second place, the purification of gas in the gasworks depended partly on the gas being brought into contact with liquids, and in this connection the extent to which effective washing was a mechanical question was shown by the efficiency of Messrs. Kirkham, Hulett & Chandler's scrubber-washer, the good results obtained with this apparatus being due to the large wetted surface which the gas meets. The relative amounts of washing effected by the different portions of a column of water, as pointed out by Dr. Hurter, was well illustrated in the ordinary coke-scrubbers of gasworks, which were now made much higher than formerly, the additional height being necessary to remove the ammonia satisfactorily, although by far the greater part of the removal was effected in the lower half of the column.

Mr. Carey: How fast do these discs revolve; fast, or very slowly?

Dr. Kohn: Slowly. There is no spray; they simply get wetted.

Dr. Campbell Brown said that in connection with Mr. Rawson's question it might be just as well to tell them whether the air travelled up in bubbles, as he fancied there was a reservoir of gas beneath the false bottom.

Mr. Rawson said he had not quite understood that there was a reservoir of air underneath the cone, but had supposed the air to be admitted more slowly.

Dr. Hurter said, in reply to Mr. Rawson, that they must not forget that in these experiments on the absorption of carbonic acid, the place where the inlet sample was taken was a considerable distance from where the outlet sample was taken, and it required two operators. Consequently the result of one single test could not be relied on for any argument. What he wanted to represent by the series of experiments, was that on the average there was not much difference in the rate of absorption from beginning to end. But when the solution began to contain bicarbonate of soda, it had a tension for carbonic acid (for the temperature was at least from 130—140° F.), and then the absorption decreased rapidly. The hours in the various experiments had nothing to do with each other; the third hour of one experiment could not be compared with the third of another. As regards the bubbles rushing past the holes, this was not so. The false bottom was of a certain thickness of metal, and before the water made room for the air in the holes, there must be a certain pressure of gas below the false bottom. Now in his conical false bottom the flange was not deep enough, and sufficient pressure could not be got before the air rushed past the flange. But he had made no experiments with holes of any other shape than circular. In reply to Mr. Thompson, he had tried similar experiments with an oblique pipe, and as Mr. Thompson quite correctly supposed, the highest holes delivered most air. With regard to the reason for the decrease of absorption with increased height, the gradual decrease of carbonic acid in the gas was partly the reason, but the chief reason was that the upper half of the column absorbed of the gas presented to it just as many per cent. as the lower half did. Thus, if the lower half absorbed 50 per cent. and left 50 per cent., the upper half would absorb 50 per cent. of what was left—*i.e.*, 25 per cent. of the original amount. If pure carbonic acid were employed, that would be a different thing altogether. Here the gas would remain equally rich throughout, and the absorption would be very much faster. In reply to Dr. Kohn, the removal of tar from coal-gas was an entirely different problem to the one he had been discussing where a gaseous constituent had to be removed. Without very careful experiment he would not be inclined to accept as a fact that the coke tower was so much superior an apparatus as the one Dr. Kohn had described, and which was very similar in principle to one Professor Lunge had lately proposed for hydrochloric acid gas. In reply to Mr. Carey, there always was a layer of gas under the false bottom. When the false bottom was constructed of glass, that layer could be seen.

Manchester Section.

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H. Grimshaw.
Peter Hart.
I. Levinstein.
W. H. Perkin, jun.
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T. Warole.
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Local Secretary:

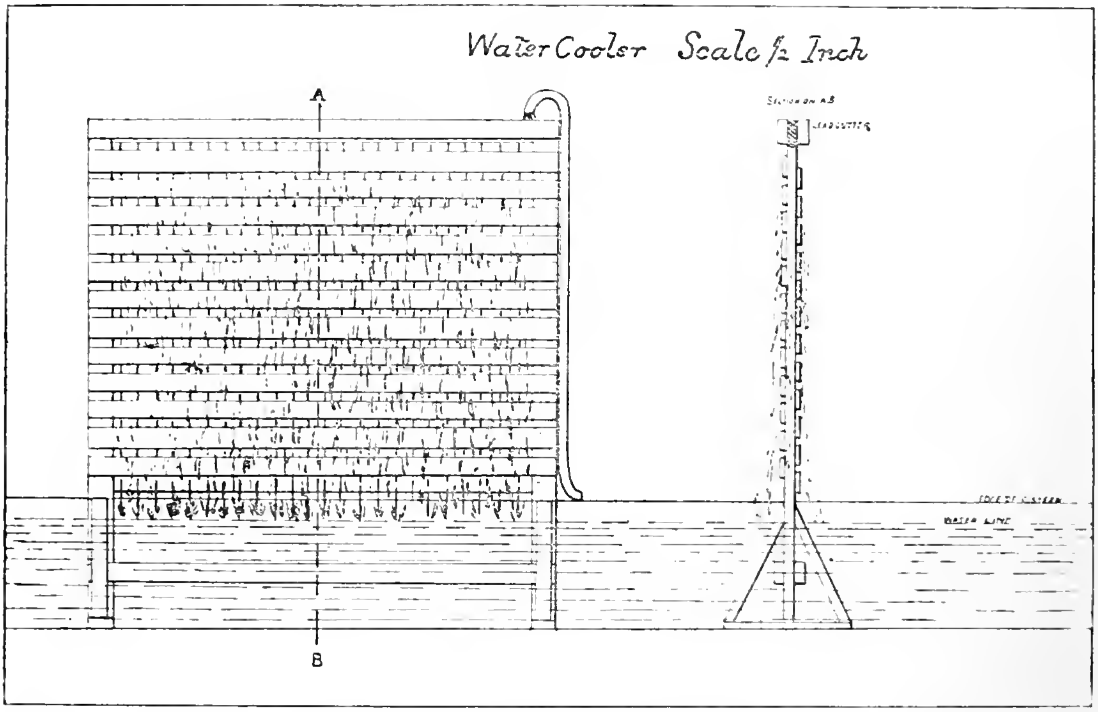
J. Carter-Bell, Bankfield, The Cliff, Higher Broughton, Manchester.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

A METHOD OF COOLING WATER FOR TECHNICAL PURPOSES.

BY PETER HART.

The consumption of 20,000 gallons of water per day for cooling purposes alone, at a rather high price per thousand, with a prospect of curtailment of quantity in consequence of continued drought, induced me to try if much of it could not be used again and again. My first effort consisted in constructing an underground reservoir, in the shape of a portion of a boiler-shell, into which the hot water was run, and from thence pumped into the ordinary high cistern from which the works obtained its supply. I thought it possible that during its travel and exposure in these cisterns it might lose sufficient heat to be again available for its original purpose, especially as it would get mixed with the water used for the steam boilers and solution purposes. This arrangement worked well for perhaps two or three days, when, in consequence of its receiving more heat than it could dissipate by its exposure, the whole works became supplied with water sufficiently hot for an ordinary warm bath. Of course, this state of things could not continue, for though well adapted for a severe frost and consequent immunity from frozen pipes, it failed to cool to the requisite degree the apparatus it was largely employed in. At this stage a compromise was entered into. As much of the hot water was pumped into the cistern as could be sufficiently cooled without deranging the works, the remainder as before being run to waste. This, though satisfactory as far as it went, was not wholly so; it was evident that could the water be sufficiently exposed to the air the object would be effected. The obvious expedient for this purpose was a shallow reservoir in which the hot water could circulate, but for this purpose no available land existed. After further consideration of the conditions, I achieved my object by means of the apparatus I am about to describe. Within the cistern itself, and which is about 20 feet square, I erected what may be aptly termed a huge gallows, the cross beam of which, placed 10 feet above the highest water level in the cistern, consisted of a wooden shoot lined with lead and firmly bolted to the uprights, which were placed 15 feet apart, the whole erection being placed so as to face the prevailing summer winds. The bottom of the shoot, was perforated with a large number of small holes along the whole length, and the delivery pipe of the pump, instead of being permitted as before to deliver its contents immediately into the cistern, was raised and compelled to empty itself into the shoot, from whence the water fell into the cistern in a series of small streams, chiefly broken into rain before reaching the cistern. Our first experiment was made in calm weather, and seemed eminently satisfactory. But winds came and found out one weak place in the scheme; a comparatively moderate one blew showers of water either into the works or into the adjoining street, unsatisfactory in either case. Fortunately this was easily obviated by the very simple expedient of nailing ⅝in. by 7in. boards horizontally from upright to upright, leaving 3in. spaces between on both sides, a space on one side being opposite a board on the other. These openings seem to be ample to permit the wind to blow through, and are otherwise an improvement, as a very gentle breeze drives the streams on to the boards, over which they trickle down, exposing thus a very large surface. The cooling power of this apparatus is very erratic, varying very much with the temperature of the air and the quantity blown through, as far as our observations go, from 20° to 35° F. of decrease of temperature. At all events it has served my purpose, but should I find next summer that it does not effect all I desire, I shall simply duplicate the arrangement and divide the pump stream into two, thus giving the water a longer exposure.



Newcastle Section.

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Notices of papers and communications for the meetings to be sent to the Local Secretary.

ON THE COMPOSITION OF CERTAIN COLLIERY WATERS.

BY PROF. P. PHILLIPS BEDSON, D.SC.,
Durham College of Science, Newcastle-on-Tyne.

The introduction to the notice of mineral brine springs contained in the volume devoted to the "Industrial Resources of the Tyne, Wear and Tees," prepared for the meeting of the British Association in 1863, may serve, with slight alteration, as a suitable introduction to my paper.

The first sentence reads as follows:—"The discovery of the bed of rock-salt at Middlesbrough lends additional interest to all the saline springs met with in the collieries of this district." After a lapse of 20 years or more, we may now read this sentence with but slight alteration, substituting for "discovery," the "*working* of the bed of rock-salt at Middlesbrough lends additional interest to all the saline springs met with in the collieries of this district."

The analyses also published by Dr. Richardson, Mr. Dunn, M.Sc., and others, of water-pipe deposits found in various collieries in this district have combined to make the investigation of the waters from the coal measures of the neighbourhood a matter of some interest, and interest sufficient to make it unnecessary for me to apologise for laying before you this evening the results of the analysis of two mineral waters obtained from collieries situated in the neighbouring county of Durham. Nor should the nature of the mineral contents of such waters fail to be of interest to those connected with the chemical industries of this district, as the history of the soda industry of the Tyne shows how intimate has been the association of one with the other; and, as you are aware, until within comparatively recent times a brine spring at the Birtley Colliery was worked for salt.

These facts then will sufficiently excuse my making the results of the analysis of two colliery waters conducted under my supervision the subject of a communication this evening.

WATER FROM THE REDHEUGH COLLIERY.

This water drains from the Brockwell seam and adjacent rock. The sample was collected from a sump on the 2nd West Way, into which the feeder is continuously running, and from which the water is siphoned to the shaft, a distance of about a quarter of a mile. A siphon pipe juts into the water about five yards from where the sample was taken. The temperature of the water was found to be 13° C. For this information, as also for the sample of water, I am indebted to Mr. T. O. Robson, the manager of the Redheugh Colliery.

The qualitative analysis of the residue left on evaporating this water shows it consists of chlorides of the metals, barium, calcium, magnesium, and sodium and lithium.

The method adopted in determining the quantities of these substances was briefly as follows:—A measured volume of water was taken, and in it the barium and calcium were precipitated as carbonates by means of ammonium carbonate; the carbonates were, after washing, subsequently dissolved in hydrochloric acid, and the barium converted into sulphate, the calcium being estimated in the filtrate from the barium sulphate by precipitating it as oxalate, the latter being converted into calcium carbonate and weighed as such.

The filtrate from the barium and calcium carbonates was evaporated to dryness and ignited; the residue thus obtained was dissolved in water, and the magnesium contained in it precipitated in the form of hydrate by means of baryta water. The precipitated magnesium hydrate, after filtering and completely washing, was dissolved in hydrochloric acid, the barium compound associated with it was removed by precipitation with sulphuric acid, and in the filtrate from the barium sulphate the magnesium precipitated as magnesium ammonium phosphate, weighing in the form of the pyrophosphate. The magnesium has not only been separated in this manner, but in some cases it was precipitated directly from a measured volume of the water by baryta water, the precipitated magnesium hydrate being ultimately converted into the phosphate, as described above.

The filtrate from the magnesium hydrate containing, in addition to baryta water, the chlorides of the metals sodium and lithium, the baryta was removed by precipitation with ammonium carbonate, and the filtrate evaporated to dryness and ignited leaves a residue of the chlorides of sodium and lithium, which was weighed as mixed chlorides.

The estimation of lithium has been attempted in various ways, and the results obtained are not such as to warrant any great confidence being placed in their accuracy. My experience shows that a method of estimating and separating lithium from sodium is still a desideratum. These reflections apply to those methods originally given for this purpose; but I have not yet had the opportunity of examining fully the method described by Gooch (*Chem. News*, 55, 1887, pp. 18, 29, 40, 56, 78), which depends upon the difference in solubility of lithium chloride and sodium chloride in amyl-alcohol. The experiments made by one of the students of the Durham College of Science, Mr. H. A. Hooper, certainly show that Gooch's method is more promising than any of the others, and I hope to be able to apply the method to this and other similar cases.

In the first attempt to determine the lithium, 100cc. of the water only were taken, and, after the removal of all the metals (save sodium), the lithium was separated from the sodium by precipitation as phosphate. A second attempt was made with a larger volume of water—viz., 1 litre. The lithium chloride was partially separated from the sodium chloride by treating the residue, left after evaporating the water to dryness, with alcohol, filtering from that insoluble in alcohol and washing with alcohol until the residue was freed from lithium salts, as tested by the spectroscope. The alcoholic filtrate and wash-water were next evaporated to dryness, the residue dissolved in water and the magnesium removed by precipitation with baryta water; and in the filtrate from the magnesium hydrate the barium and calcium were removed by precipitation with ammonium carbonate. The solution containing ammonium, sodium and lithium salts was evaporated to dryness and ignited. In the residue thus freed from ammonium salts, the lithium was precipitated as phosphate by sodium-phosphate in presence of caustic soda and ammonia. The directions given by Fresenius as to the mode of carrying out this method require repeated treatment with sodium-phosphate, owing to the solubility of lithium-phosphate.

The first of these methods gave 723mgrms. of LiCl per litre and the second gave 381·9mgrms. of LiCl. The want of agreement being far from satisfactory, a third attempt was made. For this purpose nearly two litres—viz., 1860cc.—of the water were evaporated to dryness. The lithium chloride was extracted from the residue by treating first with alcohol until the insoluble portion was freed from lithium salts. The residue left after evaporation of the alcohol was dried at 110—120°, reduced to a fine powder and digested for several hours with a mixture of alcohol and ether. The solution thus obtained was again evaporated to dryness, and the dried residue digested again with alcohol and ether. The residue left, after removal of the alcohol and ether, was dissolved in water, and thus a solution was obtained containing the lithium-salts, associated with some of the sodium, calcium and magnesium salts. The magnesium and calcium were removed in the manner already described, and finally a residue of lithium and sodium chlorides obtained. This residue was weighed and then dissolved in water, the solution made up to a quarter litre and the chlorine determined in an aliquot part of this solution by precipitation with silver nitrate in the usual way. From the weight of the mixed chlorides and the weight of chlorine in these, the lithium chloride has been estimated indirectly.

The result obtained in this case gives the amount of LiCl as 0·335grm. per litre, which is no doubt too low, as some of the lithium was found to have been precipitated by ammonium-carbonate with the barium and calcium salts. Still, the result lends some support to that obtained by the direct determination of the lithium as phosphate. The amount of chlorine as chlorides in the water was determined by taking 10cc. of the water, diluting it with distilled water to 100cc., and of the diluted water 10cc. were used for precipitation with silver nitrate.

The results obtained were as follow :—

From 100cc. of the water:—
0·15389grm. $BaSO_4$ = 0·0904 Ba.
1·897 „ $CaCO_3$ = 0·7588 Ca.
0·3656 „ $Mg_2P_2O_7$ = 0·079 Mg.
(Mean of two separate determinations).
5·9603grms. NaCl and LiCl.
(Mean of three separate determinations).
From 10cc. of the water :—
2·182grms. AgCl 0·539grm. Cl.
From one litre of the water :—
(1) 0·3475 Li_3PO_4 = 0·3819grm. LiCl.
Indirect determination giving.. 0·335 „
Mean = 0·358grm.

These results give the following as the amount of salts in this water :—

	Grms. per litre.	Grns. per gallon.
Barium chloride..........	1·372	96·04
Calcium chloride	21·058	1474·06
Magnesium chloride......	3·127	218·89
Sodium chloride	59·265	1148·55
Lithium chloride..........	0·358(?)	25·06(?)
	85·180	5962·60

Chlorine required .... 52·524grms. } per litre.
„ found .... 53·9 „ } per litre.

Water from the Wardley Colliery.

The second water is remarkable not only from its mineral constituents, but also from the fact that it contained a considerable quantity of gas dissolved in it, and amongst the gaseous constituents Marsh gas is to be reckoned. I am indebted to Mr. Walton Brown, of Newcastle, for directing my attention to this matter, and also my thanks to Messrs. John Bowes and Partners, the owners of the colliery, for permission to collect and examine the water ; as also for the facilities afforded for the examination of the gas given off from the water.

The history of the water is, briefly, the following : —In the early part of July, 1886, a borehole in exploring workings from Wardley Colliery touched a feeder of water which had accumulated in some old workings. The bore-hole was plugged and a tap inserted, so that the water might be run off as desired by means of a pipe to the sump at the bottom of the pit. It was soon noticed that inflammable gas was being continually given off from this water, as it passed over the flat sheets towards the sump.

Several samples of the water, collected as it issued from the pipe at the bottom of the shaft, were examined for their gaseous and mineral contents. A sample of the gas was collected by Mr. Saville Shaw, Demonstrator in Chemistry in this College, from the water at the same point. This was effected by allowing a stream of water to run through a horizontal branch of T piece made of tin-plate tubing, the vertical branch of which was attached to a bottle filled with water. The vertical branch of the T piece was divided into two parts by a piece of tin-plate, and in this way the stream of water passing through the horizontal tube was broken up, the gas given off passing into the bottle and displacing the water contained in it.

The qualitative examination of the residue left on evaporating the Wardley Colliery water showed it to contain chlorides and sulphates of iron, calcium, magnesium, sodium, and lithium ; also small quantities of carbonates of calcium and magnesium. When first collected, the water is perfectly clear and colourless, but on standing it first becomes opalescent, and gradually a brown precipitate, apparently of hydrated ferric oxide, separates out. On boiling, a deposit is formed, which is black at first and gradually becomes brown. This deposit appeared to consist at first of the magnetic oxide of iron. The method adopted in analysis need not be described in detail. It consisted first in evaporating a measured volume of the water to dryness. The residue after drying at 120° was weighed, next treated with water, and the soluble portion thoroughly evaporated by washing from insoluble matter. The insoluble matter contained ferric oxide and calcium and magnesium carbonates ; the amounts of which were estimated in the usual manner.

The soluble salts consisted of sulphates and chlorides of iron, calcium, magnesium, sodium, and lithium. The methods of separation and estimation were similar to those used in the previous case, with the exception that in the estimation of the sodium and lithium a measured volume of the water was taken in which the iron and magnesium were precipitated by baryta ; in the filtrate from these the barium and calcium salts were precipitated with ammonium oxalate, and from the filtrate the sodium and lithium chlorides were obtained by evaporation to dryness and ignition to expel ammonium salts. The weight of sodium and lithium chlorides was determined ; these were next converted into sulphates and the weight of mixed sulphates estimated. I have not attempted to estimate the lithium in this case, as my experience with the Redheugh water was not such as to invite a second essay. An indirect estimate has been made by determining the amount of SO_4 in the weighed sulphates, calculating this as sodium sulphate, and from the weight of mixed sulphates and the weight of sodium sulphate the lithium sulphate was calculated. The results were not satisfactory, which, no doubt, is to be explained by the fact that such methods are only applicable when there is a greater equality in the relative amounts of the two compounds than there was in this case.

Mr. Hooper has recently examined the mixed sodium and lithium chlorides by the method proposed by Gooch, and the results of his determinations show that there is about 8—9 grains per gallon of lithium chloride in this water.

RESULTS.—WARDLEY COLLIERY WATER.
(70cc. of water gave 6260mgrms. of solids, dried at 120°.)
From 70c.bc. of water were obtained :—

Residue soluble in water.

Ferric oxide .... 20·8mgrms. = 14·56mgrms. Fe.
Calcium carbonate .... 1294·4 „ = 517·76 „ Ca.
$Mg_2P_2O_7$..................... 228 „ = 49 „ Mg.

Residuum insoluble in water.

Ferric oxide.................. 19 mgrms. = 13·3mgrms. Fe.
Calcium oxide .... 5·3 „ = 9·1 „ $CaCO_3$
$Mg_2P_2O_7$ .... 2·8 „ = 1·51 „ $MgCO_3$

From 70c.bc. were obtained :—
Sodium and lithium sulphates=4590mgrms.=3775mgrms. NaCl.
Sodium and lithium chloride found= 3747·1mgrms.
Chlorine estimation gives 3332mgrms. per 70cc.
SO_4 „ „ 78·4 „ „ „

	Grains per gallon.	Grains per litre.
Ferrous sulphate	75·61	1·08
Calcium sulphate	43·42	0·62
Calcium chloride........	1401·49	20·021
Magnesium chloride	193·9	2·77
Sodium and lithium chlorides	3747·1	53·53
Calcium carbonates	9·1	0·134
Magnesium carbonate ..	1·51	0·021
	5472·43	58·176

Chlorine required .. ... 3319·7grains } per gallon.
Chlorine found .... 3332 „ } per gallon.

Gases contained in Wardley Colliery Water.

Several determinations have been made of the gases expelled from the water by boiling. The results show that the amount and composition of the gas varies with the time allowed to elapse between collection and examination. The gases evolved were examined in a Hempel's apparatus, and cannot therefore claim superior accuracy.

A sample of water collected on the 13th of July was examined on the 16th. The results obtained were as follow :—

664cc. of water gave 55·7cc. of gas at 17° C. and 29·64in.
This would represent 7·81cc, of gas N.T.P., from 100cc. of water.

The analysis of the gas showed it to have the following composition :—

Carbon dioxide	81·14
Marsh gas	5·2
Nitrogen	13·29
	99·63

A further examination of the gaseous contents of the same water, after it had already stood in the laboratory for four days in a partially-filled bottle, yielded the following results :—624cc. gave 41·4cc. gas at 19° and 29·56in., representing 38·4cc. at N.T.P., therefore 100 volumes of the water would give 6·15 vols. of gas. The gas was found to have the following composition :—

Carbon dioxide	79·7
Nitrogen	17·3
Oxygen	1·1
Marsh gas	1·4

These results show that not only does the water lose gas on standing, but also a change in the composition of the gas takes place.

Another sample of the water was collected by Mr. S. Shaw at the bottom of the colliery shaft, on the 19th July, and submitted at once to examination, with the following results :—664cc. of water gave 71·8cc. of gas at 19° and 29·8in., representing 66·8cc. of gas at normals ; or 100 vols. of the water will give 10·05 vols. of gas measured at normals. The gas was found to have the following composition :—

Carbon dioxide	85·9
Nitrogen	9·6
Marsh gas	4·17
Oxygen	0·55
	100·22

On the same occasion that this water was collected, Mr. Shaw also collected some of the gas given off by the water, in the manner I have already indicated. The result of the examination of this gas yielded the following :—

Carbon dioxide	10·8
Oxygen	4·4
Marsh gas	50·2
Nitrogen	34·6
	100·0

Supposing the oxygen here to represent air entering the bottle during the collection of the gas, then the volume of air would be 21·06 per 100 ; deducting this we should obtain by re-calculation the following as representing in all probability the composition of the gas given off by the water :—

Carbon dioxide	13·68
Marsh gas	63·59
Nitrogen	20·73
	100·00

These waters somewhat resemble in composition that of the brine spring at St. Lawrence Colliery, containing, according to Dr. Richardson, 4038 grains per gallon, of which 2938grs. consisted of common salt ("Industrial Resources of Tyne, Wear and Tees," p. 56).

Dr. Richardson has also shown that the water found at the Wallsend Colliery is somewhat similar in character, and he has pointed out that the constituents of this water vary in a most remarkable manner, as shown by the analysis of this water, made at two different periods some six years apart. The point raised by Dr. Richardson is of such interest that I shall again examine the Redheugh water, and should it be deemed of sufficient interest to the members, communicate the results at some future period, together with others obtained in the examination of other colliery waters.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS AND MACHINERY.

Steam Boiler Explosions in the German Empire during the year 1886. Chem. Zeit. **11**, 1044–1046.

During the last year sixteen steam boiler explosions took place in the German Empire. The official investigation into the causes gave the following result :—(1) Explosion of a boiler at the machine works of F. Wächter, Entin. The boiler was in a horizontal position, and provided with many heating tubes. Cause of the explosion was want of water. The taps of the water gauge were stopped up, whereby the want of water was not detected. The plates became red hot, and as soon as fresh water was pumped into the boiler, the sudden evolution of steam, which increased the pressure within the boiler rapidly from 15 to 60lb. per square inch, burst the boiler. (2 and 3) Two contiguous vertical cylindrical boilers at the iron works, Hüsten. The explosion tore one of the boilers in three pieces, one of which was completely rolled up. At the points of the fracture the iron was badly corroded, which circumstance accounts for the explosion. The second boiler was torn from its seat by the explosion of its neighbour and broke in two. (4) Explosion of a Cornish boiler at the brewery of A. Mergell. Cause of the explosion was presumably want of water. The edges at the points of fracture were porous, and had the appearance of pumice-stone. (5) Explosion of a Lancashire boiler at the Tiefbau colliery. After the explosion the second plate of the left flue was found to have burst. The fissure went right across a patch, which had been put on the second plate some two years previously. The cause of the explosion was want of water due to a strong leakage through the patch in the left flue. (6) Explosion of a Lancashire boiler at the Zocherndorf colliery. The left flue-tube was torn right across the top, at which place the iron scaled off. The right flue-tube burst only partially at the top, and was crushed somewhat flat. Corrosion of the plates, as well as an inferior quality of the iron appeared to be the cause of the explosion. (7) Explosion of a Lancashire boiler at a saw mill. The boiler burst above the

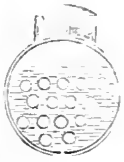
Fig. 1.

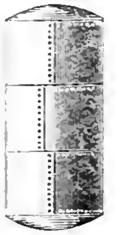
Figs. 2 and 3.


Fig. 4.


Fig. 5.


Fig. 6.


Fig. 7.


Fig. 8.

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* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows :—

If the price does not exceed 8d. .... ½d.
Above 8d., and not exceeding 1s. 6d. ... 1d.
" 1s. 6d., " " 2s. 4d. ... 1½d.
" 2s. 4d., " " 3s. 4d. ... 2d.

fireplace, and made a rent of 2·04 metres in the direction of the length of the flue-tube. Cause of the explosion, presumably the presence of scale on the plate over the fireplace, which must have attained such a thickness as to make the plate red hot (8) Explosion of a horizontal cylindrical boiler at the Zawadski Rolling Mills. Cause of the explosion was want of water, whereby the plate over the hottest part of the furnace became red hot and burst. (9) Explosion of an Elephant boiler at the Lindow Alcohol Distillery. The surface of the left tube showed a hole after the explosion, and the plate was particularly thin at this point. Near the hole were four patches, which were covered with a dirty scale, evidently produced by a leakage of water through the patches. The water trickling through gradually caused the corrosion. (10) Explosion of a Cornish boiler at the Beuthen Flour Mill. The flue-tube was crushed flat and torn in the middle. Cause of the explosion was evidently want of water. (11) Explosion of a horizontal boiler at the Glue Works of Jörg & König. The boiler contained a scale of 15mm. thickness, and the bluish appearance of the plates pointed to their having been red hot before the explosion. A leakage of the blow-off cock also caused want of water. (12) Explosion of a Lancashire boiler at the Marsberg Saw Mills. Both flue-tubes were crushed out of shape. The plates over the fire-bridge had burst. Cause of the explosion was want of water. (13) Explosion of a horizontal boiler at the Eschweiler Wire Works. The front of the upper portion of the boiler was completely torn away. Cause of the explosion was want of water, which had sunk to 40cm. below the low water level. (14) Explosion of an Elephant boiler at the Mühlhausen Flour Mill. The left tube burst, causing a fissure of 370mm. length and 300mm. width. The plate near the plug was very thin and corroded, and it is supposed that the plug, not being absolutely tight, allowed water to trickle through, which gradually caused a local corrosion. (15) Explosion of a multi-tubular boiler at a spinning mill. One of the boiling tubes in the second row burst, and the red coloration of the iron showed that it had been red hot owing to deficient circulation of the water, due to the length and cross section of the boiling tubes not having the right proportion to each other. (16) Explosion of a multi-tubular boiler at a paper works. The boiler was not yet at work, as the necessary pressure of 70lb. per square inch had not been obtained, owing to the draught being faulty. Suddenly an explosion took place, which broke all the joints of the tube in the tube-plate, and also bulged out the latter. It was then found that snow in the previous night had partially closed the chimney, and thus caused the fire to burn badly. By these means explosive gas mixtures may have been formed in the tubes, which were suddenly lighted on opening the fire-door.—S. H.

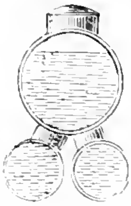


Fig. 9.

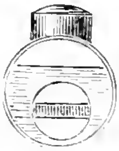


Fig. 10.

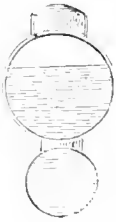


Fig. 11.


Fig. 12.

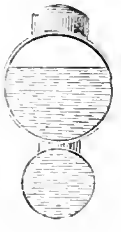


Fig. 13.

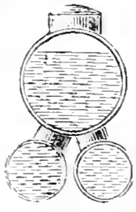


Fig. 14.

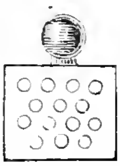


Fig. 15.

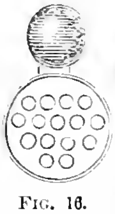


Fig. 16.

Klein, Schanzlin & Becker's Rotary Pumps. Chem. Zeit. **11**, 1046.

These pumps are pre-eminently suitable for pumping boiling hot, pulpy liquids, in which they are best suspended (see Fig. 1, next page). They are also extremely useful for lifting nearly dry and crumbling substances, as, for instance, the filling mass of sugar works. They then run the reverse way (Fig. 2); the mass is emptied into a hopper and forced from the bottom upwards to 12 metres. The pumps can also be used for draining shafts and wells (Fig. 3). They can be driven by a vertical shaft, as shown, and no harm is done if the pump is suspended below the water level.—S. H.

II.—FUEL, GAS AND LIGHT.

On the Rate of Consumption of Illuminating Agents and the Intensity of Light given out by the various Methods of Illumination. Journal für Gasbeleuchtung, 1887, **30**, 671.

C. Heim has compared various methods of illumination as regards their intensity and effective power from an economic point of view. The intensity was measured by a photometer of the usual construction and stated in normal candle units, the intensity of the various lights being examined both in horizontal direction and at an angle of 45° downwards. 1. *Petroleum Lamps.* The lamps were supplied with "Kaiser-oil" of 0·796 sp. gr. and yielded the following tests:—

TABLE I.

Description of lamp.	Diameter of burner. mm.	Angle with the horizontal plane.	Strength light in normal candles.	Con. of oil per hour. grms.	Consumption of oil per candle unit.	Remarks.
Circular burner	25	0°	16·1	54·2	3·37	Kaiser-oil
" "	"	45°	12·3	53·6	4·36	" "
Circular burner with plate (small)	30	0°	19·2	63·4	3·30	" "
" "	"	45	11·1	61·1	5·51	" "
Circular burner with plate (large).	62	0°	67·3	22·9	3·40	" "
" "	"	45°	33·9	22·8	6·72	" "
Kosmos Circular burner	30	0°	22·9	84·9	3·70	American Petroleum
" "	"	45°	17·8	85·5	4·80	" "
" "	"	0°	22·8	81·7	3·58	Kaiser-oil

The figures of this table show that the intensity of light, measured in the horizontal direction, from all the lamps examined is about equal. The effective power is not proportionately increased by an increased size of the lamp. Measured at an angle of 45 the intensity of light decreases with an increased diameter of the burner. The effective power of a petroleum lamp decreases considerably if the flame is not screwed up to its full height, as is shown by Table 1A.

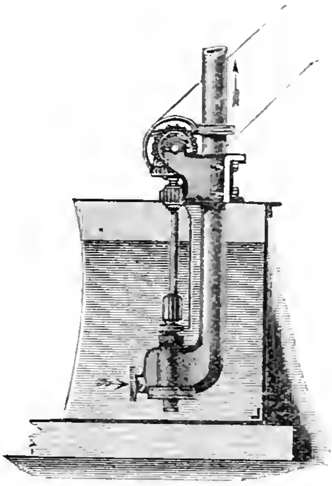


FIG. 1.

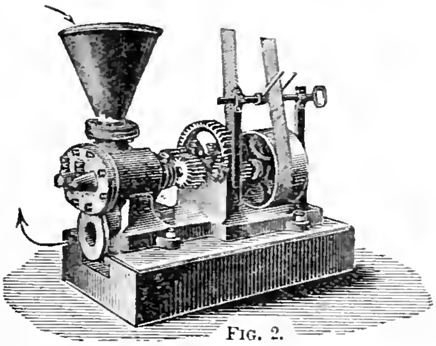


FIG. 2.

TABLE 1A.

Angle.	Intensity of Light.	Consumption of oil per hour.	Cons. per candle and hour.
0°	18·9	58·4	3·09
0°	16·8	56·0	3·33
0°	15·0	54·8	3·65
0°	12·7	50·7	3·90

Gas Lamps.—The different tests were made under equal and normal conditions. Regenerative burners were lit half an hour before testing, smaller burners a sufficient time to warm all the parts of the lamp. The combustion gases were carried away by a ventilating flue. The plane of the split burner was vertical to the photometer-axis.

It is well known that the intensity of light is considerably raised by an increase of the temperature of combustion, and the last column but one in Table II. confirms this fact. The split burner is surpassed by the Argand and the latter by the regenerative burner. Both Argand and Siemens' burner distribute the light badly, since they emit the maximum of light in the horizontal direction, whereas the Wenham lamp emits most of the light vertically downwards. The latter is therefore specially suitable for illuminating large rooms or halls, as for an equal consumption of gas its light is three and a half times as strong as that of split burners. Larger types of the Wenham lamp yielded a better result still. The Welsbach incandescent lamps are also preferable to Argand and split burners, at least as long as the incandescent body is new.

Electric Arc Lamps.—Three of the best known constructions were examined. A compound engine of 100 V. was employed as a source of the electric current. Only the tests taken at an angle of 45° can be fairly considered as representing the value of the various lamps. The intensity of light in the horizontal direction fluctuates continually, increasing and decreasing with the slightest variation in the position of the arc. By enlarging the type of lamp or increasing the strength of the current the effective power of the lamp is raised.

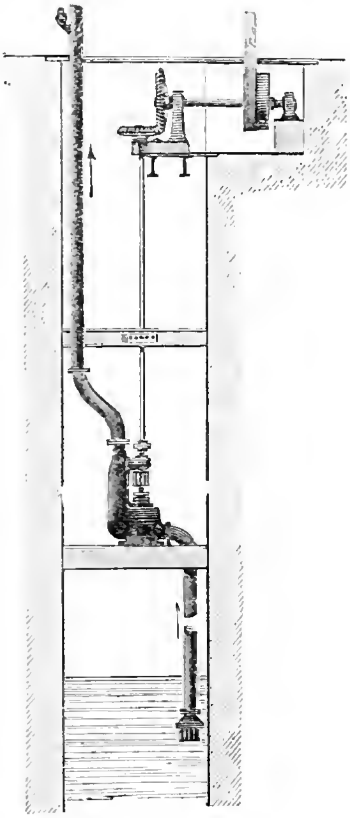


FIG. 3.

Incandescent Lamps.—Only sixteen candle power lamps were tested, as these are nearly exclusively in use. The intensity was only examined in the horizontal direction.

Magnesium Lamp.—A lamp from A. Grätzel, Hanover, was photometrically tested. It was constructed in such a manner that as many as eight magnesium ribbons of 2·5mm. width and 0·13mm. thickness could be burned at the same time. The white smoke of magnesia was carried away by a ventilating tube which was firmly connected with a reflector. To obtain the intensity of light without reflector the latter was covered with black paper. The light was measured in the horizontal direction; measurements at an angle of 33° showing a decrease in intensity of 25 per cent.

The intensity of light for one ribbon is greatest when only one ribbon is being burned; it sinks not inconsiderably if more are lit. The consumption of magnesium per hour amounts with 8 ribbons to 0·134kilo. One kilo. costs 45s., consequently, the cost of one hour's burning is about 6s.

TABLE II.

Description of Burner.	Angle with the horizontal plane.	Strength of light in normal candles.	Consumption of gas per hour in cubic metres.	Consumption of gas per candle and hour.	Remarks.
Split burner	0°	16·9	0·251	14·8	Medium size, so-called 6 cb. ft. burner.
,, ,, ...	45°	17·2	0·256	11·9	
Argand burner	0°	21·9	0·239	10·9	
,, ,, ...	45°	19·4	0·211	12·4	
Welsbach incandescent light	0°	14·4	0·0951	6·60	Latest type.
,, ,, ,,	45°	10·5	0·1037	9·88	
Siemens' regenerator No. 3 ..	0°	65·3	0·460	7·05	
,, ,, No. 3 ..	45°	46·9	0·456	9·75	
,, ,, No. 1 ..	0°	222	1·621	7·30	
,, ,, No. 1 ..	30°	162	1·614	9·96	
,, ,, No. 1 ..	45°	132	1·604	12·2	
Wenham lamp, No. 2	0°	28·4	0·219	8·77	
,, ,, No. 2	45°	44·5	0·257	5·77	
,, ,, No. 2	90°	45·8	0·256	5·58	
,, ,, No. 4	0°	99	0·685	6·92	
,, ,, No. 4	25°	152	0·686	4·51	
,, ,, No. 4	45°	170	0·677	3·98	
,, ,, No. 4	65°	200	0·685	3·42	
,, ,, No. 4	90°	202	0·671	3·33	

TABLE III.

Name of Lamp.	Diameter of carbon rod, mm.	Length of lower arc. mm.	Angle with the horizontal plane.	Intensity of light in normal candles.	Effective power in volt-ampères.	Voltampères per candle unit.	Candle units per h.p.
Pieper	at top 6·7	2	0°	126	160	1·27	433
,, ...	at bottom 5·0		45°	377	153	0·405	1360
Piette (Schuckert)........	10	4	0°	220	414	1·88	293
,, ,, ...			45°	1420	413	0·291	1890
Siemens and Halske......	14	4 to 5	0°	575	918	1·60	344
,, ,, ...			45°	3830	912	0·238	2310

TABLE IV.

Name of Incandescent Lamp.	Intensity of light in normal candles.	Efficient power in voltampères.	Voltampères per candle unit.	Candle units per h.p.	Lamps per h.p.
Edison (old type)	16	72	4·50	122	7·6
Edison (new type), German Edison Co......................	16	60	3·75	147	9·2
Swan (old type)	16	66	4·13	133	8·3
Swan (new type)	16	56	3·50	157	9·8
Siemens and Halske..............	16	52	3·25	169	10·6
Bernstein (Electro-Technical Co., Cannstatt)	16	56	3·50	157	9·8

TABLE V.

Number of Mg ribbons.	Intensity in norm. Candles.		Without Reflector.		
	Without reflector.	With reflector.	Candle units for one ribbon.	Cons. of Mg ribbon per one hour and ribbon.	Cons. of Mg ribbon per one hour and 100 candle units.
				Grms.	
1	150	3,200	150	16·7	11·11
2	287	5,880	118·7	16·7	14·10
4	450	8,000	112·5	16·7	11·80
6	700	11,300	117	16·7	14·15
8	950	17,000	119	16·7	14·03

Latterly, an improved construction of lamp reduces the cost of one hour's burning to 4s. 6d. But even at this price the light is far too expensive to enter into competition with gas or the electric light. The lamp is easily handled and carried about. It can be lit with a match and put out quickly. It is, therefore, most suitable for signalling, photographic, theatrical and similar purposes.—S. H.

Improvements in Apparatus for the Manufacture of Gas from Fluid Hydrocarbons. A. G. Meeze, Redhill. Eng. Pat. 12,340, Sept. 29, 1886. 1s. 1d.

Within an ordinary gas retort, heated by a firebox of the usual construction, is placed an inner retort of considerably less diameter and preferably of thin wrought iron, the outer one being of fireclay. Within the outer retort and attached to the doorplate, in order to be easily removable, is placed a superheating steam coil. Both retorts are packed with fireclay "deflectors" or surfaces, so arranged as to promote concussion and impact among the gaseous particles travelling through the retorts. In operation, steam from the superheater is made to drive oil through an injector into the inner retort. Here decomposition takes place, promoted by the presence of the deflectors. The gas evolved then passes from the inner to the outer retort, where, encountering a greater heat, it is fixed and rendered homogeneous, and whence it passes by an ascension-pipe in the front to the hydraulic main. The inventor's claim refers mainly to the use of the deflectors. Full drawings are attached.

—A. R. D.

An Improved Continuous Process for the Purification of Coal Gas from Sulphur Compounds, by which the Sulphur is Recovered. C. Estcourt, Manchester, H. Veevers, Dukinfield, and M. Schwab, Manchester. Eng. Pat. 15,007, Nov. 18, 1886. 8d.

The inventors propose to eliminate the sulphur compounds (chiefly sulphuretted hydrogen) from coal gas, by bringing it into contact with sulphurous acid, either alone in aqueous solution or in the presence of the carbonates, chlorides or sulphates of the alkalis or alkaline earths; or of hydrochloric acid and salts containing sulphurous acid. When any of these various salts are present, practically the whole of the sulphur is precipitated, which is far from being the case when sulphurous acid is used alone. The process is preferably carried on in a scrubber, divided into a number of chambers, so connected that the course of the gas is made as tortuous as possible. Each chamber is provided with a set of blades, brushes or other suitable contrivance, mounted on a revolving shaft. At each revolution, these dip into the washing liquid contained in the lower part of the scrubber and constantly present wet surfaces to the passing gas. The process is a continuous one, the liquor after leaving the scrubber being again charged with sulphurous acid in a coke or other absorber and used for purifying over again.—A. R. D.

Improvements in the Method of and in Apparatus for the Complete Purification of Coal Gas by Concentrated Liquid Ammonia, and in the Recovery of Sulphur and Ammonia for the Manufacture of Sulphuric Acid and Ammonium Sulphate. J Hammond, Lewes. Eng. Pat. 8348, June 24, 1886. 8d.

This specification, which is unsuited for useful abstraction, contains four sheets of drawings. The claims are (1) the use of a series of chambers, whereby the passing gas can be made alternately hot and cold in the presence of free ammonia and vapour, for the purpose of suddenly condensing therefrom much of its impurity, which may then be carried off by the strong condensed alkaline liquors; (2) the preparation and use of coke and iron, with the admission of a regulated quantity of air (carburetted or otherwise), to keep the same chemically active upon the passing gas in the presence of liquid ammonia or water.—D. B.

An Apparatus for Projecting Oil or other Fuel into Furnaces in the form of Spray. C. A. Sahlstrom, Aberdeen. Eng. Pat. 15,076, Nov. 19, 1886. 8d.

This apparatus is an improvement on that described by the patentee in the specification of Eng. Pat. 14,535 of 1886 and may be described as an injector consisting of a central passage for superheated steam, an outer annular passage for hot air and an intermediate annular passage for oil. All these deliver into a mouthpiece with a contracted throat. The apparatus is made to swing on a trunnion socket, so that it can readily be fixed in position for working and as readily allowed to fall back from the furnace firebox when not required.—A. R. D.

An Improved Method of and Apparatus for Generating Gas for Illuminating, Heating and Metallurgical Purposes from Liquid Hydrocarbons. R. B. Avery, New York, U.S.A. Eng. Pat. 8953, June 23, 1887. 11d.

This is a process for generating gas by passing oil and superheated steam through heated retorts. The retorts and superheaters are packed with cones (of iron or fireclay), having serrated or perforated flanges, and are so disposed as to present their apices to meet the current of gas. These cones have the effect of finely dividing the passing vapours and greatly economising the heating power of the retort. The use of an exhauster is recommended, both to prevent back pressure in the retorts and also to draw in a certain amount of air, which considerably improves the quality of the gas. The specification is accompanied by nine drawings.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Vaselin. G. Vulpius. Pharm. Post, 1887, 308.

The author comes to the conclusion that the German vaselin has become purer and better from year to year, whilst the quality of the American product has continually deteriorated and that quite apart from the purity, which is there never greatly aspired to, the consistency of the American article is also inferior to the German.

—G. H. M.

Occurrence of Alkaloid-like Bases in Paraffin Oil. A. Weller. Ber. 20, 2097—2099.

Bandrowski having recently established the existence of bases in Galician petroleum, the author thought it desirable to publish the results of an investigation on the so-called yellow oil, obtained in the manufacture of Saxon petroleum, from which he some time ago isolated basic substances. The separation was effected by shaking the oil with dilute sulphuric acid, precipitating with caustic soda, extracting with ether, re-dissolving and re-precipitating several times, finally subjecting the product to distillation. The bases thus obtained form a colourless oil having a sp. gr. of 0·98—0·99. They have a very unpleasant odour, assume a dark colour on exposure to the light and do not solidify at 11°. They are sparingly soluble in water, but freely soluble in alcohol, ether and chloroform. They contain nitrogen, but are free from oxygen and sulphur. Treatment with potash causes the evolution of strongly alkaline vapours, which are, however, free from ammonia. Bromine and methyl iodide react with the bases dissolved in chloroform, forming non-crystalline oily products. Unsuccessful attempts were made to isolate the bases by means of fractional distillation, the product obtained after several fractionations boiling between 220° and 260° without the temperature remaining constant at any one point. Several salts were prepared. The most characteristic salt is the oxalate, which crystallises in nacreous scales sparingly soluble in water and ether, but readily soluble in alcohol, chloroform, benzene and petroleum spirit.—D. B.

Isomeric Change in the Phenol Series. A. R. Ling. J. Chem. Soc., 1887, 147—152 and 782—794.

The first portion of the author's experiments were devoted to the action of bromine on the dibromonitrophenols, with the view of obtaining, if possible, some explanation of the isomeric change of dibrom-*ortho*-into dibromo-*para*-nitrophenol (Armstrong, *J. Chem. Soc.* 1875, 520).

When either of the dibromonitrophenols is heated with bromine and water, the chief product is tetrabromoquinone thus :—

$$C\ H_2Br_2(NO_2)OH + 4Br_2 + 2OH_2 =$$
$$C_6Br_4O_2 + 6HBr + HNO_3$$

Several 10grm. quantities of dibromonitrophenol (m.p. 117°) were heated in a water bath with one molecular proportion of bromine and about 40cc. water for several hours. The products were exhausted with potassium carbonate solution and the tetrabromoquinone separated by filtration.

From the filtrates the potassium salts of the following compounds were obtained :—

	M.P.
O-bromodinitrophenol	116°
O-bromo-para-nitrophenol	102°
Dibromo-para-nitrophenol	141°

The same compounds were obtained in a similar experiment made with dibromo-*para*-nitrophenol.

It would seem that the formation of tetrabromoquinone involves the partial debromination of the dibromonitrophenol, the resulting brom-*ortho*-nitrophenol then undergoing isomeric change: the bromo-*para*-nitrophenol thus produced is in part converted into bromodinitrophenol by the nitric acid resulting from the NO_2 displaced, and in part into dibromo-*para*-nitrophenol.

The second portion of the experiments relates to the action of bromine on the dichloronitrophenols, and on *p*-chlor-*ortho*-nitrophenol.

Dichloro-*ortho*-nitrophenol (m p. 123°) is not converted into its isomeride when heated with bromine and water under the conditions above described, but is decomposed, yielding chlorotribromoquinone in accordance with the following equation :—

$$C_6H_2Cl_2(NO_2)OH + 4Br_2 + 2OH_2 =$$
$$C_6ClBr_3O + 5HBr + HCl + HNO_3$$

Chlorotribromoquinone crystallises from glacial acetic acid in glistening yellow scales; the quinone forms colourless needles, melting at 234°; and the diacetyl compound colourless prisms, melting at 262°.

Chlorotribromoquinone treated with a 4 per cent. solution of potash is decomposed, giving rise to the potassium salt of chlorobromanilic acid ($C_6ClBr(OK)_2O_2$, $2H\ O$), described by Krause (*Ber.* **12**, 47).

Dichloro-*para*-nitrophenol (m.p. 125°) yields *m*-dichlorodibromoquinone, described by Krause (loc. cit.), when heated with bromine and water, thus :—

$$C_6H_2Cl_2(NO_2)OH + 4Br_2 + 2OH_2 =$$
$$C_6Cl_2Br_2O_2 + 6HBr + HNO_3$$

P-chlor-*ortho*-nitrophenol (m.p. 87°) was dissolved in glacial acetic acid and treated with one molecular proportion of bromine at the ordinary temperature. The resulting chlorobromonitrophenol crystallised from alcohol was found to melt at 125°. This compound, heated with four molecular proportions of bromine and water, was entirely converted into tetrabromoquinone, and was therefore *p*-chloro-*ortho*-bromo-*ortho*-nitrophenol.

$$OH : NO_2 : Cl : Br = 1 : 2 : 4 : 6.$$

The potassium salt crystallises in dark red, anhydrous needles, and the calcium salt in orange-red plates of the composition $(C_6H_2ClBrNO_3)_2Ca,3H_2O$.

P-chloro-*ortho*-nitrophenol dissolved in glacial acetic acid and the solution, after boiling for half an-hour with one molecular proportion of bromine, left for some hours to cool, yielded a compound isomeric with the above, melting at 119°, and giving a potassium salt in red anhydrous plates, and a calcium salt of a somewhat darker colour than that of *p*-chloro-*ortho*-bromo-*ortho*-nitrophenol, and containing 7mols. of H_2O. Heated with 4 molecular proportions of bromine and water, chlorotribromoquinone was obtained. The compound was therefore *o*-chloro-*para*-bromo-*ortho*-nitrophenol.

$$OH : NO_2 : Br : Cl = 1 : 2 : 4 : 6.$$

The constitution has been further proved by preparing *o*-chloro-*para*-bromo-*ortho*-nitrophenol from *p*-bromo-*ortho*-nitrophenol (m.p. 88°) and chlorine, and comparing it and its salts with the compounds last described. The melting point of pure *o* chloro-*para*-bromo-*ortho*-nitrophenol is 117°.

It has also been found possible to convert *p* chloro-*ortho* - bromo - *ortho* - nitrophenol [$OH : NO_2 : Cl : Br = 1 : 2 : 4 : 6$] (m p.125°) into *o*-chloro-*para*-bromo-*ortho*-nitrophenol [$OH : NO_2 : Br : Cl = 1 : 2 : 4 : 6$] (m.p. 117) by heating the former with a small quantity of bromine.

The change takes place, however, with much less ease in the last-named case than when *p*-chloro-*ortho*-nitrophenol is brominated at the higher temperature. This is possibly because it occurs simultaneously with the exchange of hydrogen for bromine. Di-halogen derivatives of *o*- and *p*-nitrophenol being incapable of further substitution might be expected to behave somewhat indifferently towards reagents. No other compound being formed, there can be no doubt whatever that it is a case of true intramolecular change.

Improvements in the Manufacture of Carbon and in Apparatus employed therein. A. Jacquelain, Paris, France. Eng. Pat. 2566, Nov. 11, 1859. Second Edition. 8d.

It is proposed to manufacture carbon from tars and heavy oils distilled from coal, schist, peat or other volatile organic matter. The tar is heated in a boiler and the vapours generated therein are led into a horizontal earthen retort heated to redness. The retort is connected with two vertical cast-iron receivers. The deposits in the retort are removed by means of a rake. A pipe is connected to the second receiver, by which the gas, as well as such carbon compounds as may have escaped decomposition by the heat, and the volatile products are led off to be utilised for heating purposes. The inventor also claims means for improving carbon produced in gas retorts and the preparation of a hard carbon.—D. B.

A New and Improved Method for the Distillation of Coal Tar, the Oils from Coke Ovens and other similar Fluids. H. Ellison, Cleckheaton, and G. E. Davis, Manchester. Eng. Pat. 13,929, Oct. 30, 1886. 8d.

The vapours from the tar or oil still are passed through coils of piping, placed in a closed boiler of sufficient capacity to contain at least one full charge of liquid for the still. This boiler being previously filled with cold tar or oil to be distilled, the hot vapours coming from the still will bring its contents to a state of quiet ebullition, so that by the time the working of the still is completed, the water and more volatile constituents of the tar in the boiler will have been expelled and condensed in a suitable manner. When the residual pitch has been run out from the still, the latter is immediately charged with the hot tar from the closed boiler and a heavy fire started, as there is no danger of the tar boiling over. The boiler is then filled up quickly with a fresh supply of cold tar or oil and the operation repeated.—D. B.

Improvements in the Destructive Distillation of Shale and other Minerals and in Retorts therefor. R. B. Tennent, Coatbridge. Eng. Pat. 15,772, Dec. 2, 1886. 11d.

This specification, to which two explanatory sheets of drawings are attached, has reference to an improved mode of arranging gas-heated retorts for the distillation of shale and other minerals, whereby great saving of heat is said to be obtained by utilising the heat of the waste gases, after heating the retorts, for heating the air to a very high temperature before reaching the gas, also in superheating the steam for treating the shale within the retort. The waste gases passing into the main flue leading to the chimney may also be made to heat a steam boiler erected over a continuation of the flue beyond the whole range of retorts.—D. B.

IV.—COLOURING MATTERS AND DYES.

Tabular Arrangement of the Artificial Organic Colouring Matters. Gustav Schultz and Paul Julius.

In view of the fact that the reprint of these tables is prohibited, as also the right of translation, the reader is referred to the *Chemische Industrie*, 1887, Nos. 8, 9, 10 *et seq.* The appearance in this Journal of the first part of this tabulated matter was the result of an unfortunate oversight.

Researches on the Constitution of Azo- and Diazo-derivatives. II. Diazoamido-Compounds (continued). R. Meldola and F. W. Streatfeild. J. Chem. Soc. 1887, 434—451. (See also this Journal, 1887, 283.)

In this paper the authors describe the results of their experiments upon the decomposition of dinitro-diazoamido-compounds by cold hydrochloric acid. The method adopted is to allow the diazo-compound to stand in contact with excess of the cold concentrated acid till decomposition has taken place, and the whole or nearly the whole of the substance has passed into solution. The latter then contains only a diazo-chloride and an amine, so that on dropping the acid solution into a solution kept well cooled, containing the necessary quantity of β naphthol dissolved in sufficient caustic soda to keep the whole alkaline after mixing, the diazo-chloride at once forms an azo-β-naphthol compound, while the amine is set free. A mixed precipitate of amine and azo β-naphthol compound is thus obtained, and from this dilute acid dissolves out the amine, leaving the azo-compound, which can be identified by its melting point and other characteristics. The reactions are illustrated by the following equations:—

$$(1)\ NO_2.C_6H_4.N_2.NH.C_6H_4.NO_2 + 2HCl = NO_2.C_6H_4.N_2.Cl + NO_2.C_6H_4\ NH_2,\ HCl$$

$$(2)\ NO_2.C_6H_4.N_2.Cl + NO_2.C_6H_4.NH_2,\ HCl + C_{10}H_7.ONa + NaOH = NO_2.C_6H_4.N_2.C_{10}HO_9.H + NO_2.C_6H_4.NH_2 + 2NaCl + OH_2$$

The symmetrical compound, paradinitro-diazoamidobenzene (prepared by the action of nitrous acid upon *p*-nitraniline) by this means is shown to be resolved by cold hydrochloric acid into paranitro-diazobenzene chloride and paranitraniline. The unsymmetrical compound (m.p. 211°) described by the authors in their previous paper, and prepared by the action of diazotised *para*-nitraniline on *m*-nitraniline or *vice versâ* is resolved by the cold acid into a mixture of *p*- and *m*-nitraniline and *p*- and *m*-nitro-diazobenzene chloride. The symmetrical dimetadinitrodiazoamidobenzene (m.p. 194°) obtained by the action of nitrous acid on metanitraniline is resolved into *m*-nitraniline and *m*-nitrodiazobenzene chloride. The method has also been applied to the ethyl-derivatives with the following results: The ethyl-derivative of the dipara-compound (m.p. 191—192°) gives *p*-nitrodiazobenzene chloride and ethyl *p*-nitraniline. The corresponding dimeta-compound gives *m* nitro-diazobenzene chloride and ethyl *m*-nitraniline. The ethyl-derivative (m.p. 148°) prepared by the direct ethylation of the unsymmetrical compound of m.p. 211° behaves like the latter, giving a mixture of the two nitro-diazo-chlorides and the two ethylnitranilines. The ethyl-derivative (m.p. 174—175°) obtained by the action of diazotised *m*-nitraniline on ethyl-*p*-nitraniline is resolved into *m*-nitro-diazobenzene chloride and ethyl-*p*-nitraniline. The isomeric compound (m.p. 187°) prepared by the action of diazotised *p*-nitraniline on ethyl-*m*-nitraniline is resolved into *p* nitro-diazobenzene chloride and ethyl-*m*-nitraniline. A more thorough investigation of this last ethyl-derivative has led the authors to the conclusion that it is a true diazo-amido-compound, this being shown by its decomposition by cold acid, as above described, as well as by its products of reduction (*p*-phenylenediamine and ethyl-*m* phenylenediamine). The possibility of this compound being an amido-azo-compound having been thus disproved, the authors point out that the existence of three isomeric ethyl-derivatives is quite inexplicable on the generally received formula of the diazo-amido-compounds, and they propose as an alternative expression for the *mixed* diazo-amido-compounds the formula:—

in which the aromatic radicles X and Y are triadic in function, in the same manner that phenyl is supposed to be tetradic in quinone when this compound is written according to Fittig's view as a double ketone:—

$$C_6H_4 \begin{cases} O \\ O \end{cases}$$

In the paper the authors describe a number of metallic derivatives in which the H of the NH group is replaced by silver, copper, cadmium, cobalt and nickel, the general formula of these compounds being:—

$$NO_2.C_6H_4.N_3M'.C_6H_4.NO_2.\ (NO_2.C_6H_4.N_3.C_6H_4.NO_2)_2M''.$$

Further investigations to test the generality of the conclusion as to the existence of three isomeric alkyl derivatives are in progress. The theoretical aspect of the question has been discussed in a paper published by one of the authors in the *Philosophical Magazine* for June, 1887 (p. 513).—R. M.

Two β-naphthylaminesulphonic Acids. S. Forsling. Ber. 20, 2099—2106.

In a previous communication (this Journal, 1886, 481) the author described the preparation of a β-naphthylamine-sulphonic acid by the action of concentrated sulphuric acid on β-naphthylamine. Further investigation has shown that this acid is not pure, but contaminated with two isomerides, of which one is identical with Broenner's acid, whilst the other is designated as 1 and 2, being respectively identical with Dahl's acids 1 and 3 (Ger. Pat. 29,084, March 2, 1884). A fourth acid, perhaps identical with the δ-acid (this Journal, 1887, 593), is produced in small quantity only. These acids were isolated by repeated fractional crystallisation of the calcium salt.

β-naphthylaminesulphonic Acid I.—$C_{10}H_6.NH_2SO_3H$ is almost insoluble in water and alcohol. Its salts form well-defined crystals, which are readily soluble in water, yielding solutions having blue fluorescence. They can be heated to 180° without decomposition, excepting the silver and copper salts. The corresponding *diazo-naphthalenesulphonic acid* $C_{10}H_6N_2SO_3$ forms a greenish-yellow indistinctly crystalline powder. It is converted into β-naphtholmonosulphonic acid (Bayer's acid) when boiled with acidified water. On heating its potassium salt with phosphorus pentachloride *δ-dichloronaphthalene* $C_{10}H_6Cl_2$ is obtained, melting at 61·5°.

β-naphthylaminesulphonic acid II.—$C_{10}H_6.NH_2.SO_3H$ dissolves in about 1300 parts of water, and is almost insoluble in alcohol. Its salts show great similarity in properties to the corresponding salts of the I. acid. The diazo sulphonic acid forms a green micro-crystalline powder. On boiling with strong hydrochloric acid a chloronaphthalenesulphonic acid is obtained, the potassium salt of which on treatment with phosphorus pentachloride yields *γ-dichloronaphthalene*, melting at 48°.

—D. B.

Ruberythric Acid. C. Liebermann and O. Bergami. Ber. **20**, 2241—2247.

HAVING obtained a large sample of Caucasian madder roots (of 1886 harvest), the authors repeated the investigation of the above acid, to test the accuracy of the results obtained by Rochleder, Schunck, and E. Kopp. They obtained by a process described in the abstract following this, about $\frac{1}{15}$ per cent. of the weight of the roots of pure ruberythric acid, forming lemon-yellow silky needles, melting at 258—260°. It is readily soluble in hot water, crystallising well on cooling; less soluble in alcohol, and almost insoluble in ether and benzene. On boiling with either acids or alkalis it splits up into alizarin and grape-sugar. It does not form lakes with mordants, nor does it ferment with yeast. Its Ba, Sr, and Ca salts form beautiful red precipitates from boiling aqueous solutions.

Schunck and Rochleder admitted the possibility that rubianic and ruberythric acids might be identical substances, and careful comparison of the two has proved the correctness of this theory. The authors compared their glucoside with a sample of rubianic acid prepared by the late Dr. H. Römer, in Dr. Schunck's laboratory. The results of the analysis of the free acids, and of their Ba and K salts, correspond better to the formula of Graebe and Liebermann—viz., $C_{26}H_{28}O_{14}$, than to that of Rochleder—viz., $C_{20}H_{22}O_{11}$. The latter formula is rendered more improbable, because according to his equation the decomposition of the glucoside into alizarin and sugar takes place under dehydration of the molecule: $C_{20}H_{22}O_{11} = H_2O + C_{14}H_8O_4 + C_6H_{12}O_6$, whilst usually such decompositions are effected by hydration, which also is the case in the equation proposed by Graebe and Liebermann: $C_{26}H_{28}O_{14} + 2H_2O = C_{14}H_8O_4 + 2C_6H_{12}O_6$. As further proof in favour of this equation, the ruberythric acid was dissolved in cold concentrated sulphuric acid, this solution diluted with four times its weight of water was then heated on a boiling water bath for one hour, and, after further dilution, for other two hours; the amount of alizarin obtained was 43 per cent., whilst the equation requires 42·5 per cent. However the decomposition in like manner of the *Octo-acetylruberythric acid* $C_{26}H_{20}(OC_2H_3O)_8O_6$ and quantitative determination of the alizarin, grape-sugar, and acetic acid formed proved beyond doubt the identity of the two bodies, the reaction being as follows: — $C_{26}H_{20}(OC_2H_3O)_8O_6 + 10H_2O = C_{14}H_8O_4 + 2C_6H_{12}O_6 + 8C_2H_4O_2$. The above acetyl-compound is readily formed by the usual method by means of acetic anhydride and acetate of soda; it forms bright yellow needles, soluble in cold glacial acetic acid, soluble with difficulty even in hot alcohol, and insoluble in water. It melts at 230°.

The constitution of ruberythric acid is usually expressed by the formula

$$C_{14}H_6O_2\left\langle\begin{array}{l}O.C_6H_7O.(OH)_4\\ O.C_6H_7O.(OH)_4\end{array}\right.$$

in which both phenol-hydroxyl-groups are combined with grape sugar, and which admits quite well of the formation of an octo-acetyl-compound. However, the formula

$$C_{14}H_6O_2\left\langle\begin{array}{l}O.C_{12}H_{14}O_3(OH)_7,\\ OH\end{array}\right.$$

admits this equally well, and explains better why ruberythric is a strong *mono*-basic acid, decomposing carbonates, and even, when heated, acetates of the alkalis. The fact that it does not form lakes with mordants, which might be urged in favour of the former formula, loses its significance, since one of the authors has shown that substitution in only one hydroxyl-group destroys the dyeing property of alizarin. However, it necessitates what is not yet proved thoroughly, that the sugar combined with the alizarin should be a *Diose* (C_{12} sugar-group), which on decomposition must yield grape sugar.—T. L. B.

Examination of Caucasian Madder. O. Bergami. Ber. **20**, 2247—2251.

THE madder was sun-dried, and contained about 6 per cent. of pure colouring matters (an exceptionally large amount, the average being about 2 per cent.); 10 per cent. of crude colour was obtained by extracting 200grms. of dried root with boiling alcohol (4 litres) containing a little HCl, concentrating the solution, and then precipitating the colour with water. It contained also 7 per cent. of cane sugar. The roots were first well dried at 80—90° and then pulverised. The author's object being to obtain the glucosides, he found the best method was extraction by means of alcohol, which required to be absolute, as otherwise the yield was smaller. Twenty kilos. of madder were taken and 180 litres of alcohol used. At a time, 1kilo. of the powdered roots was cohobated with 8—9 litres of absolute alcohol for 2—3 hours; the solution filtered whilst hot and evaporated to $\frac{1}{4}$—$\frac{1}{3}$ of its volume. On quickly cooling this extract 50—60grms. of a yellowish-brown crystalline body were obtained, forming the crude glucosides for subsequent treatment. On further distilling off the alcohol from the filtrates, from 15—30grms. of crude cane sugar crystallised out from the mother liquors, of which 30—40grms. of crude colouring matters were thrown down by the addition of water. The crude glucosides thus obtained were dissolved in about 5—6 times the quantity of water, the solution treated with a small excess of lead acetate and filtered from the brown precipitate of lead salts of colouring matters. On adding sugar of lead to the filtrate, a cinnabar-red precipitation took place. This precipitate after filtration and washing, was decomposed under water with SH_2 and the lead sulphide boiled out with water and filtered gave a deep yellowish-red solution of ruberythric acid. This was then again thrown down as barium salt in the form of dark cherry-red flakes, by the addition of alcohol and baryta-water. The well-washed barium salt by solution in dilute acetic acid and filtration was freed from a tarry-resinous substance, thereupon neutralised with ammonia, and the solution again precipitated with lead acetate. The now bright red precipitate on decomposition with H_2S and extraction of the lead sulphide with water gave a clean, golden-yellow solution, from which, on evaporation, the ruberythric acid crystallised in the form of fine lemon-yellow needles, melting at 258°. The yield was about $\frac{1}{15}$ per cent. of the weight of madder worked up.—T. L. B.

Galloflavin. R. Bohn and C. Graebe. Ber. **20**, 2327—2331.

THE preparation of this yellow dye-stuff is effected by subjecting gallic acid to atmospheric oxidation at a low temperature in the presence of a small amount of alkali; the best results being obtained in an alcoholic solution of potash (this Journal, 1887, 437). Galloflavin has the probable composition $C_{13}H_6O_9$. It crystallises in greenish-yellow leaflets, is sparingly soluble in water, alcohol and ether, more readily soluble in glacial acetic acid and aniline. Unsuccessful attempts were made to obtain a reduction product. The potassium salt $C_{13}H_4O_9K_2$ is a crystalline body which is insoluble in alcohol and cold water. Galloflavin yields insoluble lakes with metallic oxides. Alumina gives a greenish-yellow colour. Alumina in the presence of a salt of tin gives a yellow colour, whilst the yellow chrome lake is said to be exceedingly fast to light and soap. The acetyl compound crystallises from benzene in white needles, melting at 230°. It is freely soluble in glacial acetic acid and chloroform, but does not dissolve readily in alcohol and ether.—D. B.

Alkannin. C. Liebermann and M. Römer. Ber. **20**, 2428—2431.

THE colouring matter of the alkanna root called, "alkannin," was described by Pelletier more than seventy years ago, and has frequently been investigated, without, however, any satisfactory solution being arrived at as regards the group of colouring matters to which it belongs. Carnelutti and Nasini (*Ber.* **13**. 1514) obtained the formula $C_{15}H_{14}O_4$ from their analytical results, and stated that this body contains two hydrogen atoms which may be displaced by acetyl. As alkannin produces a variety of colours with mordants—resembling quinalizarin in this respect—and the blue solution obtained with alkali exhibits a spectrum similar to that yielded by alizarin, the authors undertook an investigation of this colouring matter. For its preparation alkanna roots were extracted with petroleum spirit, the extract was then digested with dilute alkali, filtered, and the blue solution precipitated with hydrochloric acid. The dye was further purified by solution in ether. It formed a dark red non crystalline mass. The results of analyses point to one of the following formulæ: $C_{15}H_{12}O_4$ or $C_{15}H_{14}O_4$. When alkannin is passed over zinc dust heated to redness methylanthracene is produced, a circumstance which appears to show that this compound is a derivative of methylanthracene, probably the dihydroquinone, or its dihydride. This point, however, requires further investigation.—D. B.

Azines of Chrysoquinone. C. Liebermann and O. N. Witt. Ber. **20**, 2442—2444.

THE azine reaction of the diketones and diamines being generally applicable the authors have studied its behaviour with chrysoquinone. *Chrysotoluazine* $C_{25}H_{16}N_2$ was obtained by treating chrysoquinone with orthotoluylenediamine. It crystallises in small gold-coloured needles, giving a dark violet solution with strong sulphuric acid. *Chrysonaphthazine* $C_{28}H_{16}N_2$ was prepared from chrysoquinone and orthonaphthylenediamine. It forms a yellow microcrystalline powder. The formation and properties of the azine derivatives confirm the analogy of chrysoquinone with phenanthrenequinone; chrysoquinone is therefore naphthylenephenylenediketone. Pyrene does not form azine derivatives. Pyrenequinone gives a large amount of tarry matter, in which respect it resembles β-naphthaquinone.—D. B.

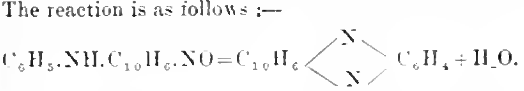
On Nitrosamines and Nitroso-bases. III. O. Fischer and E. Hepp. Ber. **20**, 2471—2478.

By the action of alcoholic HCl upon β naphthylethylnitrosamine two substances are obtained, according to the method used. (*Ber.* **20**. 1248.)

1. Equal parts by weight of β-naphthylethylnitrosamine and absolute alcohol are mixed together and cooled by ice, and then, in two portions, one part of alcoholic HCl is added, the mixture being then allowed to stand in ice, with occasional stirring, for about three hours. The solution is then poured into water, filtered from unchanged nitrosamine and the nitroso-base precipitated by ammonia. The *α-nitroso-β ethylnaphthylamine* $NO.C_{10}H_6NH.C_2H_5[NO:NH.C_2H_5=1:2]$ thus obtained forms green prisms, which crystallise from benzene in the form of flat tables, melting at 120—121°. Its salts are easily soluble, the hydrochloride and the sulphate form orange solutions, from which a yellowish white nitrosamine precipitates on the addition of a nitrite. On reduction with tin and HCl, or simply warming to 10—15° with alcoholic HCl, it is converted into the hydrochloride of the anhydro-base *ethenyl α-β-naphthylenediamine* $C_{10}H_6 <\genfrac{}{}{0pt}{}{N}{NH}> C.CH_3$.

2. This is obtained by treating six parts of the first named nitrosamine with one part of absolute alcohol and two parts of alcoholic HCl, and allowing the mixture to stand for some time at the ordinary temperature. The nitrosamine dissolves slowly, and in about four hours' time round masses of crystal appear. These consist for the most part of the hydrochloride of the anhydro-base and two by-products, separable by alcohol from each other. This hydrochloride $C_{12}H_{10}N_2HCl+2H_2O$ is soluble with difficulty in water, and forms fine colourless needles. The anhydro base is identical with that obtained by Liebermann and Jacobsen.

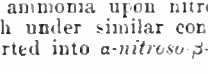
3. In a previous paper the authors hoped to obtain phenazines from certain nitroso bases by the action of dehydrating agents. They have since succeeded in obtaining Witt's naphthophenazine (this Journal, 1887, 505) by the action of alcoholic HCl on β-phenylnaphthylnitro-amine. 20grms. of finely ground nitrosamine are mixed with 200grms. of absolute alcohol, 40grms. of alcoholic HCl added whilst well cooling, and the mass allowed to stand overnight. The clear yellow solution is poured into water, the precipitated tar separated from the solution, and allowed to stand for a few hours with cold dilute sulphuric acid (1:3). The acid solution is thereupon drawn off, and the tar boiled up a few times with dilute sulphuric acid. The united acid filtrates on being poured into much water, precipitate the phenazine as a yellowish-white powder, melting at 142°. The reaction is as follows:—



$$C_6H_5.NH.C_{10}H_6.NO=C_{10}H_6<\genfrac{}{}{0pt}{}{N}{N}>C_6H_4+H_2O.$$

The yield obtained, however, was only 10 per cent. upon the nitrosamine.

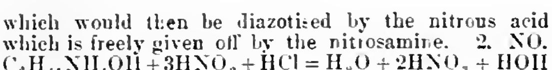
4. Experiments to produce nitrosoaniline by the action of boiling ammonia upon nitrosophenol proved fruitless, although under similar conditions nitroso-α-naphthol is converted into *α-nitroso-β-naphthylamine*—



$$C_{10}H_6\genfrac{}{}{0pt}{}{N}{NH}>O.$$

This the authors consider to be the proper constitution of Ilinski's naphthalene-α-oxime-β-imide (*Ber.* **17**, 391), obtained by the action of ammonia upon nitroso-α-naphthol, since this latter substance by treatment with ethylamine solution at 100° is converted into the same α-nitroso-β-ethylnaphthylamine, as described above. However, when one part of nitrosophenol, five parts of ammonium chloride, ten parts of dry ammonium acetate and a little ammonium carbonate, are mixed and heated together for half-an-hour upon the water bath, *nitrosoaniline* is obtained, which precipitates in the form of dark green crystals when the melt is thrown into cold water. Nitrosoaniline dissolves in water, forming a grass-green solution, which on boiling with NaOH, gives off ammonia, the soda salt of nitrosophenol being formed. It crystallises from benzene, forming beautiful steel-blue crooked needles, melting at 173—174°.

5. By the action of alcoholic HCl upon Schwebel's nitrosophenylglycin (*Ber.* **11**, 1132), a very interesting diazo compound is formed, most probably *diazo-phenylhydroxylamine*. One part of the nitrosamine is dissolved in two parts of absolute ether, and three parts of alcoholic HCl added. After twelve hours' standing, the bluish-red crystalline mass is filtered off, washed with ether, dissolved in cold alcohol, filtered and then precipitated by the addition of ether. The yellow leaflets thus obtained explode on heating, and are decomposed even by cold water, evolving two atoms of nitrogen. They dissolve without decomposition in concentrated HCl, and the platinum salt precipitates from this solution on the addition of $PtCl_4$, forming yellow leaflets, readily decomposed by water. The above reaction probably takes place in two stages, in the first of which *nitrosophenylhydroxylamine* would be formed:—



$$1.\ C_6H_4<\genfrac{}{}{0pt}{}{N.CH_2COOH}{NO}+H_2O=NO.C_6H_4.N<\genfrac{}{}{0pt}{}{H}{OH}$$

$$+C_2H_4O_2.$$

which would then be diazotised by the nitrous acid which is freely given off by the nitrosamine. 2. $NO.C_6H_4.NH.OH+3HNO_2+HCl=H_2O+2HNO_3+HOH$ $N.C_6H_4.N:N.Cl[N:N_2=1:4]$.—T. L. B.

Preparation of an Orange-red Colouring Matter. Z. Roussin. Bull. Soc. ind. de Rouen 1887, 45.

THE new colouring matter results from the action of naphthol on the azo-derivative of sulphanilic acid. An aqueous solution of an alkaline sulphanilate, mixed with a slight excess of a soluble nitrite, is decomposed in the cold by a dilute acid. A crystalline precipitate of the azo-derivative is formed; this is decomposed by boiling water and violently explodes when brought in contact with a flame. By treating, in the cold, the azo-derivative suspended in water with finely divided naphthol, with frequent stirring, the colouring matter separates after some hours without the evolution of gas. When the reaction is at an end, the mass is heated with boiling water, from which the colouring matter separates on cooling in brownish-red crystals, which can be easily washed with cold water. The colouring matter dyes wool and silk orange-red without mordants and from an acid bath. The colour is light-fast.—G. H. M.

On Azophenines and Indulines. O. Fischer and E. Hepp. Ber. **20**, 2479—2484.

THE authors dispute the correctness of the opinion expressed by Otto N. Witt (this Journal, 1887, 594), that the azophenines are simply oxidation products of aniline and not transformation products of the various amidoazo- or nitroso-compounds, by the help of which they are obtained. They hold that, as Kimich first stated, the nitroso-compounds themselves enter into the reaction, since they obtain with *p*-nitroso-diphenylamine and *p*-bromaniline a tetra-bromoazophenine, with *m*-hydroxynitrosodiphenylamine a hydroxyazophenine, and with monochloronitrosodiphenylamine a monochloroazophenine. Further, on heating dibromonitrosophenol with aniline and aniline salt, a brominated azophenine resulted.

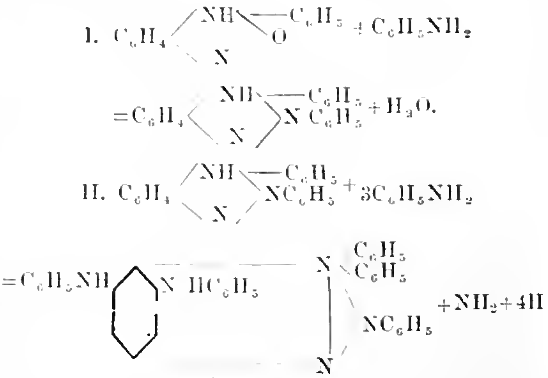
Azophenine $C_{36}H_{29}N_5$ can be produced in very many ways, besides those described by Witt and Kimich; it is easily obtained from nitroso-, mono-, methyl- or ethyl-aniline, but the best yield was obtained by heating 100 parts of *p*-nitrosodiphenylamine with 100 parts of aniline hydrochloride and 500 parts of aniline for eight to ten hours on the water bath. The yield of pure azophenine was 150 parts. As by-products were obtained a little induline, and *p*-amidodiphenylamine, melting at 66—67°. With *p*-toluidine, *p*-nitrosodiphenylamine yielded the same azotoline obtained by Kimich, melting at 249°.

Monochlorazophenine. $C_{36}H_{28}ClN_5$. The *p* chlorodiphenylamine was obtained, by Sandmeyer's method, from *p*-amidodiphenylamine; it melts at 74°, and yielded a nitrosamine, which was converted by the action of alcoholic HCl into *p*-nitroso-*p*-chlorodiphenylamine. From this substance the above azophenine was obtained; in appearance very similar to azophenine itself, but rather more soluble in benzene and toluene, and melting at 230°.

Tetra-bromo-azophenine. $C_{36}H_{25}Br_4N_5$. This substance is also very like azophenine; it melts at 243°, and is soluble in toluene or xylene. It was obtained by heating on the water bath one part of *p*-nitrosodiphenylamine with four parts of *p*-bromaniline and one part of *p*-bromaniline hydrochloride (or acetate).

Di-hydrazophenine, $C_{36}H_{31}N_5$, is obtained by heating azophenine with an alcoholic solution of ammonium sulphide under pressure to 130—140°. On cooling colourless glistening leaflets are obtained, sparingly soluble in alcohol, soluble in chloroform, and toluene. The solutions soon become red, azophenine being re-formed. It is soluble in HCl, and melts at 173—174°. When 1 part of azophenine is cohobated with 100 parts of alcohol, and 5 parts concentrated H_2SO_4 (60° B.), it gradually dissolves, forming a blue solution, from which small glittering needles settle out. These are insoluble in most solvents, crystallising from aniline in the form of silver-grey leaflets. The composition of this substance is $C_{24}H_{19}N_3O_2$, the azophenine being split up into aniline, and this substance, which contains two hydroxyl groups. $C_{36}H_{31}N_5 + H_2O = C_{24}H_{19}N_3O_2 + C_6H_5NH_2$. It dissolves in alcoholic caustic soda with a red-yellow coloration, in concentrated H_2SO_4 with a magenta coloration. Tin and HCl form a crystalline colourless reduction product. The alcoholic mother liquor from the above substance contains aniline and a small amount of a blue colouring matter.

From the above results the authors conclude that the reaction by which azophenine is obtained from nitroso-bodies may be expressed as follows:—$2C_{12}H_{10}N_2O + 4C_6H_5NH_2 = C_{36}H_{29}N_5 + 2H_2O + NH_3 + C_{12}H_{12}N_2$. Probably nitrosophenol or the nitroso-bases are first converted into *p*-nitrosodiphenylamine, owing to the ease with which they react with ammonia, anilines and amines in general (see preceding abstract). As *p*-nitrosodiphenylamine is doubtless a quinoneoxime derivative, it is probable that it will react with aniline as quinone does, which produces quinoneaniline, a substance resembling very much azophenine in its outward appearance, and therefore the reaction may be further expressed in this manner:—

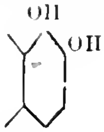


(azophenine).

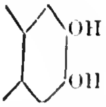
It is hoped that the above reactions will throw some light upon the constitution of the indulines, as *p*-nitrosodiphenylamine, when heated to 130—140° with 4 parts of aniline, and 1 to 2 parts of aniline salt, gives a good induline melt, containing much of the blue shade induline, and less of the red shade or azodiphenyl blue. Also azophenine when heated with equal parts of aniline and aniline salt, appears to be converted into the blue shade almost alone, it being still uncertain if any azodiphenyl blue is produced at the same time.
—T. L. B.

The Chromogenic Properties of the Oxyanthraquinones. C. Liebermann and St. v. Kostanecki. Annalen **240**, 245—304.

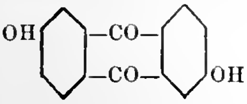
THE oxyanthraquinones may be divided into groups according to their colouring or non-colouring properties. The oxyanthraquinones, which give coloured lakes with alumina and oxide of iron, are very similar. Rufigallic acid and anthragallol form a different class of colouring matters, but possess similar shades among themselves. The mono-oxyanthraquinones possessing no chromogenic properties, yield, on fusing with potash, colouring matters formed by oxidation, in which process a second hydroxyl group is added. The colouring properties of these bodies depend upon the position of the hydroxyl group. That one hydroxyl is insufficient to produce chromogenic properties is seen from the fact that the two possible mono-oxy compounds are not colouring matters. Of the nine isomeric dioxyanthraquinones, only one, alizarin, is a colouring matter. The relative positions of the two hydroxyl groups is, therefore, an essential condition. Dioxyanthraquinones, with a hydroxyl in each benzene nucleus, may be regarded as mono-oxy compounds, and have no colouring properties. Quinizarin and xanthopurpurin have both hydroxyls in one nucleus, but possess no colouring properties. Of the four possible positions of the hydroxyls, the above two being excluded, there remain two, one of which is found in alizarin, to which the following formula has been given :—

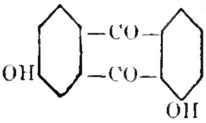


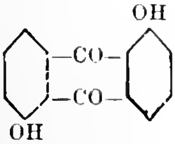
The second, with the formula—



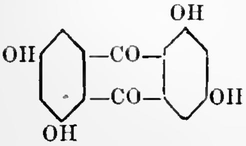
is not known. The difference of shade between alizarin and anthragallol is probably due to the second ortho-position of the third hydroxyl. That the colouring properties of these bodies is due to their acid nature, is shown by the fact that the acetyl- and methoxyl-derivatives are not chromogenic. And even the replacement of one hydrogen atom of the hydroxyl by an alcohol radicle destroys this property. This accounts also for the fact that the glucoside in freshly gathered madder root is a weak colouring matter. Of the six trioxy-compounds, two, purpurin and anthragallol, are colouring matters and have two of the hydroxyls in the same position as in alizarin; they are, therefore, mono-oxy alizarins. Purpurin is so closely related in shade to alizarin that the third hydroxyl appears to exert little influence of a chromogenic character. It is otherwise with anthragallol. Of the remaining four trioxy-compounds, one has been little studied, and the other three, flavopurpurin, anthrapurpurin, and oxychrysazin, have not had the positions of the hydroxyl groups definitely determined. It appears, however, that these are divided between the two nuclei. Both the mono-oxy anthraquinones, on fusion with potash, yield alizarin—*i.e.*, the adjacent hydrogen atom is in each case oxidised to hydroxyl. Anthraflavinic acid, benzdioxy-anthraquinone and anthrarufin, have one of the following formulæ :—



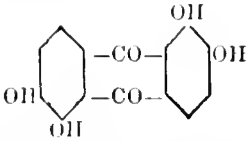




of which the last is probably that of anthrarufin. On fusion all these bodies take up oxygen, forming flavopurpurin, anthrapurpurin and oxyanthrarufin, which have much the same shade as alizarin. It is, therefore, not unlikely that the third hydroxyl takes up an adjacent position to one of the other two; and that the isolated group in the one nucleus has no influence on the chromogenic character of the body. It is a curious fact that when the alizarin hydroxyls are present, further oxidation, with the addition of more hydroxyl groups, ceases. That is to say, that no tetraoxyanthraquinones have been obtained by fusion from the trioxy-compounds. The greatest difference in properties is observed in the case of the six tetraoxyanthraquinones. Anthrachrysone, the constitution of which may be expressed by the following formula :—



has no colouring property. This is due to the absence of the alizarin hydroxyls. The constitution of rufiopin has not been completely cleared up; but, from its production from protocatechuic acid, has the following formula :—



and has chromogenic properties similar to alizarin. The two tetroxyanthraquinones, obtained from oxybenzoic acid and gallic acid, are oxyanthragallols and are colouring matters, with a shade similar to anthragallol. Finally, a new tetraoxy-compound quinalizarin has been obtained, and, from its formation, has two hydroxyls in the alizarin position in one nucleus, and two in the quinizarin, in the other. It produces a shade similar to alizarin, with a blue tinge. Of the isomeric penta- and hexa-oxyanthraquinones, only one of each has been prepared. The former, according to the manner of synthesis, is a dioxyanthragallol, and gives an anthragallol shade. Rufigallic acid, or hexaoxyanthraquinone, is a dianthragallol. From the above, it is seen that only those bodies which have the hydroxyls in the alizarin position yield colouring matters.—J. B. C.

The Manufacture of New Naphthol and Naphthylamine Monosulphonic Acids and of Dyestuffs therefrom. G. Pitt, Sutton. From Leopold Casella & Co., Frankfort-à-Maine, Germany. Eng. Pat. 12,908, Oct. 9, 1886. 6d.

THE new naphtholmonosulphonic acid (F) is prepared by fusing the α-naphthalenedisulphonic acid of Ebert and Merz (Ber. 9, 612), with alkali and stopping the fusion before both HSO_3 groups are replaced. In order to effect this, 10kilos. of the disulphonate of sodium are mixed with 40kilos. of 50% caustic soda and heated to 200° till traces of dioxynaphthalene begin to be formed (ascertained by acidulating a sample and extracting with ether, or by weighing the azo-compound formed with diazoxylene chloride). The melt is dissolved, acidulated, and boiled till free from sulphurous acid. The β-naphtholsulphonic acid F remains in solution, and can be used directly for the manufacture of azo-colours. The formation of dioxynaphthalene is best avoided by using only two molecules of caustic alkali to one of the disulphonate and heating for 16 hours in an autoclave to 250° C. The β-naphtholsulphonic acid thus formed is said to differ widely from all known isomerides: the aqueous solutions of the alkaline salts have a pure blue fluorescence; ferric chloride gives a dark blue colour in neutral solutions. The acid yields a nitroso-sulphonic acid by the action of nitrous acid and combines with all diazo-salts when these are made to act upon it in alkaline solution. The azo-colours thus formed are said to be bluer in shade than the corresponding compounds from Schaeffer's acid. The F sulphonic acid when heated with ammonia, gives a new β-naphthylamine-monosulphonic acid described in the specification as the F acid, the salts of which show a violet fluorescence. The F amidosulphonic acid can be readily diazotised, and then gives in combination with amines, phenols, and their sulphonic or carboxylic acids, a series of valuable dyestuffs. Conversely the amines or amidosulphonic acids may be diazotised and combined with the F amidosulphonicacid. As examples, the patentees mention the following azo-colours :—(1) The compounds produced by the action of diazotised aniline and its homologues, the naphthylamines, amidoazobenzene and its homologues, nitraniline and benzidine and their homologues, dianisidine and the sulphonic acids of all these bases, on the β-naphthol (F) monosulphonic acid in alkaline solution. (2) The action of the diazotised F-amidomonosulphonic acid on the foregoing amines and sulphonic acids, as well as on phenols and their sulphonic acids. (3) The action of the diazotised amines, etc., mentioned under (1) upon the F-amidosulphonic acid. Thus by the action of diazotised benzidine, etc., secondary azo-colours containing similar or dissimilar radicles (mixed tetrazo-colours) may be produced.

—R. M.

The Manufacture or Production of Colouring Compounds or Materials. C. A. Bennert, Blaydon-on-Tyne. Eng. Pat. 13,466, Oct 21, 1886. 6d.

THE colouring matters described are termed "thiamines" and are produced by the action of aromatic amines on sulphur dioxide. The following examples illustrate the process :—(1) Aniline sulphite is heated to 250° in a closed vessel for about 10 hours and the resulting mass purified by boiling with weak acid to remove by-products. Final purification may be effected by dissolving in cold strong sulphuric acid and pouring into water when the thiamine is precipitated and can be filtered off. (2) Aniline sulphite is mixed with one molecule of aniline and treated as in the last example. (3) Aniline sulphite is heated with two or more molecules of aniline as in the last example, and the excess of aniline blown off before purification. The addition of nitro-compounds, such as nitro-benzene, or of such compounds as azo, azoxy and hydrazobenzene, is said to increase the yield by diminishing the by-products. Examples of the use of these materials are given.—R. M.

Methods or Processes of Treating Oxynaphthol and Aniline or its Homologues, obtaining certain Products and utilising the same in the Manufacture of Dyes. J. Annaheim, Basel, Switzerland. Eng. Pat. 14,283, Nov. 5, 1886. 6d.

ACCORDING to this invention oxynaphthol is heated with or without condensing agents and a primary aromatic amine, such as aniline and its homologues, the naphthylamines, etc. Thus with aniline the following reactions take place :—

$$C_{10}H_6(OH)_2+C_6H_5NH =C_{10}H_6(OH).NH.C_6H_5+OH_2$$
$$C_{10}H_6(OH_2)+2C_6H_5.NH_2=C_{10}H_6(NH.C_6H_5)_2+2OH_2$$

In carrying out the process for the production of the second of these compounds (diphenylnaphthylenediamine) 16kilos. of oxynaphthol (Ebert and Merz, *Ber.* **9**, 609) are mixed with 37kilos. aniline and 13kilos. of dry aniline hydrochloride and the whole heated for several hours nearly up to the boiling point of the aniline. When purified the diphenylnaphthylenediamine is a white crystalline solid melting at 163·5° C. The corresponding compound from paratoluidine melts at 237° C. Two methods of obtaining dyes from these compounds are described :—(1) By heating the condensation product with a nitroso-compound, such as nitrosodimethylaniline hydrochloride "in conjunction with a suitable solvent." (2) By reducing the nitrosodimethylaniline to amidodimethylaniline and oxidising with potassium dichromate or ferric chloride in the presence of the condensation product. The characters of the colouring matters thus formed are not described.—R. M.

Manufacture and Treatment of a Compound of Phenyl Hydrazine with a new Ethylether. O. Imray, London. From the Society of Chemical Industry, Basle, Switzerland. Eng. Pat. 14,618, Nov. 11, 1886. 6d.

THE ethyl ether of a new acid, having the formula $C_{14}H_{24}N_2O_4$ (Eng. Pat. 14,617, 1886; this Journ. 1887, 653) is heated on the water-bath with phenyl hydrazine, when a violent reaction takes place and a yellowish crystalline mass separates. The ether may be first dissolved in boiling alcohol and then added to the phenyl hydrazine, in which case the new compound, which has the formula $C_{22}H_{28}N_6O_2$, separates on cooling either in crystals or as a crystalline powder. It melts with decomposition at 200°, is difficultly soluble in pure water or alcohol, slightly soluble in amyl alcohol and insoluble in methyl alcohol, acetic ether, chloroform, etc. Caustic potash or soda, sodium carbonate, mineral acids and acetic acid decompose it into methylhydroxyquinizine and ethylenediamine. When decomposed by heating to above 200° C. these products also result. Heated to 120—130° with methyl alcohol and methyl iodide for 12 hours the compound $C_{22}H_{28}N_6O_2$ yields antipyrine, which, after the removal of the volatile substances, is liberated by the addition of caustic soda and purified by extraction with alcohol or other suitable solvent.—C. A. K.

The Treatment of Certain Colouring Compounds or Materials for the Purpose of rendering them Soluble or more Soluble and Suitable for Dyeing and Printing. C. A. Bennert, Blaydon-on-Tyne. Eng. Pat. 13,473, Oct. 21, 1886. 6d.

THE object of this process is to convert the insoluble thiamines described in the last specification into sulphonic acids. This is effected by heating them with sulphuric acid or any appropriate sulphonating material. The details concerning the strength of acid, time, temperature, etc., are given in the specification. The thiamine-sulphonic acids are said to be colouring matters of various shades of blue suitable for dyeing and printing.

—R. M.

Improvements in the Preparation of Red Colouring Matters. J. H. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen-à-Rhine, Germany. Eng. Pat. 14,625, Nov. 11, 1886. 6d.

THESE are secondary azo-dyes possessing the property of dyeing cotton without the use of a mordant. The starting point in the manufacture of these compounds is α-naphthylene-diamine obtained by the reduction of β-dinitronaphthalene (m.p. 216° C.). The tetrazo-derivative of the diamine can only be formed in the presence of a large excess of acid, and this tetrazo-salt then combines with phenols, amines, and sulphonic acids in the usual manner. The present specification limits the claim to the compounds resulting from the action of one molecule of the tetrazo-salt upon two molecules of naphthionic acid or of the three mono-sulphonic acids of β naphthylamine. The diazotising is effected by mixing 23 parts of the finely-divided hydrochloride of the diamine in 125 parts of 35 per cent. hydrochloric acid mixed with 250 parts of water and an equal quantity of ice. The necessary quantity of sodium nitrite (14 parts) is dissolved in three times its weight of water and gradually added to the acid solution of the diamine, and when the action is complete the solution of the tetrazo-chloride is mixed with the necessary quantity of a solution of sodium naphthionate and sodium acetate. The colouring matter begins to separate at once, but the mixture must be kept agitated for several days in order to complete the reaction. The solution is finally made alkaline by sodium carbonate, boiled up and allowed to cool, when the sodium salt crystallises out. This colouring matter dyes vegetable fibre (from an alkaline bath) of a bright red shade, fast to light and moderate soaping, but becoming purple by the action of acetic acid, and dull green by strong hydrochloric acid. Isomeric compounds are obtained in a similar manner from the β-naphthylamine monosulphonic acids, the best results being given by (1) the acid obtained from Schaeffer's β-naphtholsulphonic acid ; (2) Dahl's acid obtained by sulphonating β-naphthylamine at 100° C., and (3) the δ-sulphonic acid obtained by sulphonating β-naphthylamine at a temperature above 150° C.—R. M.

The Manufacture or Production of Colouring Matters. C. A. Bennert, Hebburn-on-Tyne. Eng. Pat. 10,046, July 18, 1887. 4d.

THE colouring matters claimed in this specification are produced by the action of nitric acid on "thiamines" and their sulphonic acids. These nitrated products are termed respectively "thiamines" and "thiaminine-sulpho-acids," the latter being described as colouring matters of various shades of brown suitable for dyeing and printing. Details of the method of nitrating are illustrated by several examples in the specification.

—R. M.

VI.—DYEING, CALICO PRINTING, PAPER STAINING AND BLEACHING.

Dyeing with Turkey-red. F. Storck and G. de Coninck. Bull. Soc. Ind. de Rouen, 1887, 44.

THE cotton goods are steeped in a bath of fatty acid neutralised with caustic alkali, then dried and exposed in the open air; the fat is removed by a passage through a solution of sodium carbonate and subsequent washing. The material is then steeped in aluminium acetate, aged, dunged, and dyed with artificiat alizarin. After dyeing it is dried and steamed for half-an-hour at a low pressure, whereby the shade changes from reddish brown to a powerful red. One or two washings with soap, with the addition of tin-salt, finally produces the finest Turkey-red colour. The superiority of this procedure amongst other things consists in the production of Turkey-red by means of a single oil-bath and in the employment of steam to brighten the shade. According to the observation of the authors, light is an important agent in the production of the fatty mordant. The latter is developed best in sunlight.—G. H. M.

Turkey-red Oil. F. Storck and G. de Coninck. Bull. Soc. Ind. de Rouen, 1887, 47.

THIS concerns the preparation of a fatty substance which gives very great brightness to alizarin-red. The substance can be applied both in the pressure dyeing and also in the colour-bath and therefore makes the passage of the material through a fatty preparation (oil-emulsion, sulpholeinic acid, etc.) unnecessary. The authors prepare the substance by the treatment of oil with sulphuric acid. The product obtained is submitted to the action of an oxidising agent (chloride of lime, potassium bichromate, etc.), again taken up with an acid and neutralised.—G. H. M.

The Whitening of Wool. H. Hofmann. Chem. Zeit. **11**, 1224.

UNLIKE cotton, wool cannot be bleached to a pure white; whatever bleaching agent is used the wool always retains a slight dull-yellow tint, which cannot be completely counteracted by the application of a blue dyestuff. In order to overcome this difficulty many attempts have been made to "dye" the wool white by the deposition in the fibre of a white pigment. One method consists in adding magnesium sulphate to a bath of carbonate of soda, in which the wool is steeped; on warming, magnesium carbonate is deposited in the fibre. This process has the objection that the magnesium carbonate, although at first tolerably adherent, after a time dusts off. Very good results are obtained by soaking the wool in a solution of cotton in ammoniacal-cupric-oxide, washing with water or dilute acid to precipitate the cellulose upon the fibre and finally treating with ether to render the film opaque and white. —A. G. G.

Improvements in Apparatus for the Preparation of Bleaching Solutions by Electrolysis. E. Hermite, Paris; E. J. Paterson and G. F. Cooper, London. Eng. Pat. 14,673, Nov. 12, 1886. 11d.

THE magnesium or calcium chloride, or other suitable solution, is submitted to the action of an electric current in a tank divided into two parts by a perforated partition; contained in the tank are the electrodes, preferably of zinc and platinum, and a screw propeller, which, by revolving, maintains a constant circulation of the solution. The electrodes are so placed relatively to the openings in the partition, that the solution in its circulation always comes in contact with these electrodes. The positive electrode is made up of thin plates of platinum cast into a suitable support at the top; by means of a mechanical device knives are kept constantly moving up and down over the surface of the zinc, to prevent any deposit accumulating thereon.—B. T.

Cleansing Compound for use in the Process of Bleaching Linen and Cotton Fabrics or Yarns, and other Cleansing Purposes. A. Hodgkinson, Ballyclare. Eng. Pat. 11,981, Sept. 21, 1886. 4d.

OIL of turpentine or resin is boiled with paraffin or petroleum oil, and then about an equal weight of (*a*) common soap or (*b*) soda or potash added. Compound (*a*) is for laundry use; compound (*b*) for addition to the chemicals used in the lime and soda boils of ordinary bleaching processes. The use in the mixture of carbonate or chloride of ammonium is claimed in the provisional but abandoned in the final specification. —W. E. K.

Improvements in Dyeing Cotton, Cotton Yarns, and Cotton Fabrics. F. A. Gatty, Accrington. Eng. Pat. 13,362, Oct. 22, 1886. 6d.

FOR dyeing yellow the cloth is padded in a solution of suitable strength of tribasic acetate of lead (obtained by mixing a solution of 30lbs. of acetate of lead with 1gall. of 25 per cent. ammonia), whereby the lead becomes fixed in the fibre without further treatment. The yellow is then produced by raising in bichrome in the usual way. If a green shade is required the cloth is dyed blue before treating with the lead salt.—W. E. K.

Improvements in Aniline Black Dyeing or Printing Processes for obtaining a Fast Aniline Black in Textile Fibres and Fabrics. A. Aykroyd, W. E. Aykroyd, and J. Smith, Bradford. Eng. Pat. 13,814, Oct. 28, 1886. 6d.

AS a preliminary to the usual dyeing or printing processes, the fibre or fabric is padded in sulphated oil or other oily or soapy emulsion, or is tinted with any suitable colouring matter, or these two preliminary treatments are combined.—W. E. K.

Improvements in Preparing Grey and Black Colouring Matters to be applied to Textile Fabrics and Materials. D. Stewart, Glasgow. Eng. Pat. 15,363, Nov. 25, 1886. 4d.

EARTHY COMPOUNDS of the class of diatomite, kieselguhr, etc., are carbonised in retorts and the grey or black product, finely ground, is mixed with albumen or other medium used by calico printers for the fixation of pigment colours.—W. E. K.

Improvements in Apparatus for Cleaning and Bleaching Cotton and other Fibrous and Textile Fabrics. W. P. Thompson, Liverpool. From J. Meikle, Providence, U.S.A. Eng. Pat. 9722, July 12, 1887. 8d.

IN place of the usual alkaline boiling in kiers, the cloth (several pieces at a time) is carried forward in the open width, in a crowded or folded form, on travelling tables, operated in the manner of endless bands. On these tables the cloth is subjected to a powerful spray of the hot alkaline liquor, whilst at the same time beaters or stampers play rapidly upon the fabric. Two or more of these tables, arranged one above the other, are contained in the tank in which the operation is carried on, and the surplus liquor is drawn off at the bottom. —W. E. K.

Improvements in the Manufacture and Application of the Compounds of Fluoride of Antimony, with the Chlorides or Sulphates of Sodium, Potassium or Ammonium. W. P. Thompson, Liverpool. From C. J. E. de Haën, List, Germany. Eng. Pat. 11,500, Aug. 23, 1887. 6d.

FLUORIDE of antimony ($SbFl_3$), which is obtained by dissolving pure antimonious oxide, free from iron, in aqueous hydrofluoric acid, yields crystalline double salts with solutions of the chlorides and sulphates of sodium, potassium and ammonium. These have the composition $SbFl_3.NaCl$, etc., and $SbFl_3.Na_2SO_4$, etc. The object of the production of these compounds is their use in dyeing and cloth-printing, in place of tartar emetic; they contain a higher percentage of antimonious oxide than tartar emetic. (The compound $SbFl_3.(NH_4)_2SO_4$ contains 46·94 per cent., tartar emetic 43·46 per cent.). The mode of applying these salts in dyeing is the same as in the case of tartar emetic, except that a smaller quantity is needed. The cost of these compounds per 100 parts of antimonious oxide contained, is considerably less than that of tartar emetic or of oxalate of antimony. Mixtures of the above chlorides and sulphates may be obtained, having a different composition from the original salts.—C. A. K.

VII.—ACIDS, ALKALIS AND SALTS.

Discovery of New Deposits of Phosphorite in Tunis. P. Thomas. Compt rend. 104, 1321.

In a former paper (this Journ. 1886, 169), the author drew attention to the occurrence of phosphorite deposits in Tunis. He has now made further explorations, with the result of discovering new deposits which may perhaps be employed for agricultural purposes.—G. H. M.

The Artificial Production of Manganese-blende. H. Baubigny. Compt. rend. 104, 1372.

A solution of manganese acetate gives with sulphuretted hydrogen in the cold, a copious precipitate of manganese sulphide, which in a sealed tube at 100°, more slowly at the ordinary temperature, becomes dense and crystalline. The author dissolved 1·1grms. of normal manganese sulphate in 150cc. of water, added a slight excess of ammonium acetate, a few drops of acetic acid saturated with sulphuretted hydrogen at 0° C. and sealed up the vessel. After five years' standing very fine octahedral crystals were formed, some of which were 0·4—0·5mm. long. The crystals exhibit the same crystalline form, colour, gravity, etc., as the natural manganese blend, MnS.—G. H. M.

Affinity of Certain Hydrated Sulphates of the Metals (Vitriols) for Sulphuric Acid. R. Fink. Ber. 20, 2106—2108.

The author digests the pure oxides of the metals (Cu, Zn, Mg, Fe, Co, Ni) with metallic sulphates, of the same and of other metals, in solution. In the first case the composition of the product is independent of the amount of the solution present, provided it is always of the same strength. The metallic sulphate gives up to the hydrated oxide both a portion of the salt and the metal, in the case of Cu and Zn. In the case of Co, only a very small portion is thus decomposed and the magnesium salt remains unchanged. The hydrates of Fe and Mn behave similarly to that of Mg. The hydrates of Co and Al could not be investigated, as they dissolve in their sulphates. Where mixed oxides and salts were employed, the following results were obtained:—

No.	Hydrate or Basic Salt.	Salt.	Amount of Metal in the Precipitate.
1	Zn	Cu	All the Cu
2	Cu	Fe	60·3 p c. Fe
3	Mg	Fe	71·2 " "
4	Co	Mn	11·7 " Mn
5	Ni	Mn	12·3 " "
6	Cu	Mg	No Mg
7	Mg	Ni	60·5 p.c. Ni
8	Fe	Mn	No Mn
9	Zn	Ni	Little Ni
10	Mg	Mn	71·2 Mn

—J. B. C.

Phosphoric Acid in Chili Saltpetre. C. Ochsenius, Jahrb. f. Min. 1887, 221.

Since the principal objection to the explanation of the formation of Chili saltpetre from guano, which comes in contact with the saline solutions of the nitrate beds, is based on the absence of phosphoric acid in the nitrate, the author sent for a series of strata from the nitrate beds of the pampa, eastward of Taltal, in the Chilian province of Atacama, and tested microchemically two beds above the ordinary sodium nitrate, pure white crystalline nitrate from the surface secretion of the latter, as well as the beds below the deposit. He detected phosphoric acid in both the beds above the nitrate deposit and in the ordinary sodium nitrate, the white crystalline nitrate and the beds below the deposit gave no reaction for phosphoric acid. The author also remarks that Streng has found phosphoric acid in borocalcite from Ascotan, in Bolivia, between Atacama and Tarapacá.—G. H. M.

The Action of Chlorine on Carbon Bisulphide, and of Sulphur on Carbon Perchloride. P. Klason. Ber. 20, 2376—2385.

Chlorine acts, as is well known, but little on carbon bisulphide at common temperatures, but in the presence of chlorine-carriers, such as iodine, the chlorides of antimony and molybdenum, etc. Chlorine quickly replaces the sulphur, forming ultimately carbon perchloride. If the action of chlorine be interrupted before the complete conversion of carbon bisulphide into perchloride has taken place, intermediate compounds, so-called carbon sulpho-chlorides, are formed. This is a distinct proof that the reaction proceeds in several successive stages. On the other hand, the whole process can be reversed by reconverting carbon perchloride into bisulphide. The author undertook the examination of all the details of these reactions. Dry chlorine was allowed to act on carbon bisulphide containing a trace of iodine and the process interrupted as soon as one molecule of carbon bisulphide had absorbed 5 atoms of chlorine. The product of the reaction turned out to be trichloromethylsulphochloride, $CCl_3.SCl$, a yellow oil having an extremely unpleasant and penetrating smell. This compound, in the pure state, absorbs chlorine in considerable quantities; but if the latter contains only a trace of iodine the chlorine is not merely absorbed, but substituted, thus:—$CCl_3.SCl + Cl = CCl_4 + SCl$. If sulphur in sufficient quantities is made to act on trichloromethylsulphochloride at 220° C., the products obtained are almost exclusively carbon bisulphide and perchloride. But if the same process be repeated at lower temperatures, many intermediate products are formed, such as carbon chloride, thiophosgene, perchloromethylbisulphide and perchloromethyltrisulphide. The primary products of the reaction are undoubtedly perchloromethylbisulphide and sulphur chloride, while the other compounds are probably products of decomposition of the latter two, thus:—$2CCl_3.SCl + S_2 = CCl_3.S_2.CCl_3 + S_2Cl_2$. By the action of silver dust on trichloromethylsulphochloride the same compound, perchloromethylbisulphide, was obtained. It forms a yellow, thick oil with a turpentine-like smell and undergoes decomposition on being distilled at the ordinary barometric pressure. One of the products of decomposition is thiophosgene, CCl_2S. Sulphur, heated with perchloromethylbisulphide at 170° C., formed a trisulphide, $CCl_3S_3CCl_3$, a thickish liquid which partially crystallises on the addition of water. If trichloromethylsulphochloride be reduced with tin and hydrochloric acid, thiophosgene is formed; the reaction proceeds so smoothly that it can be recommended for the preparation of this interesting compound. This phosgene, heated with sulphur at 130° to 150° C., formed chlorothiocarbonylsulphochloride, $CClS.SCl$, which is easily acted upon by chlorine, forming trichloromethylsulphochloride, thus:—

$$CClS.SCl + Cl = CCl_2S + SCl$$
$$CCl_2S + Cl_2 = CCl_3.SCl.$$

From these reactions the author concluded that the chlorination of carbon bisulphide passed through the following four stages:—

1. $CS_2 + Cl_2 = CClS.SCl$.
2. $CClS.SCl + Cl = CCl_2S + SCl$.
3. $CCl_2S + Cl_2 = CCl_3.SCl$.
4. $CCl_3.SCl + Cl = CCl_4 + SCl$.

If the process is reversed, sulphur being made to act on carbon perchloride, the reaction does not take place below 220° C. The final products are always carbon bisulphide and chloride, whereas, only rarely intermediate products can be obtained, which, however, were recognised in all cases as thiophosgene and trichloromethylsulphochloride. It is, therefore, highly probable that the series of reactions is as follows:—

1. $CCl_4 + S = CCl_3.SCl$.
2. $2CCl_3SCl + S_2 = C_2Cl_6S_2 + S_2Cl_2$.
3. $C_2Cl_6S_2 + S = C_2Cl_6S_3$.
4. $C_2Cl_6S_3 = CCl_3.SCl + CCl_2S + S$.
5. $CCl_2S + S = CClS.SCl$.
6. $CClS.SCl + S_2 = CS_2 + S_2Cl_2$.

The author is now engaged in examining the action of bromine on carbon bisulphide.—S. H.

Improvements in and Apparatus for the Treatment of Sulphate of Soda for the Manufacture of Sulphide of Sodium therefrom. F. H. Gossage, T. T. Mathieson and J. Hawliczek, Widnes. Eng. Pat. 12,480, Oct. 1, 1886. 6d.

Sodium sulphate is mixed with carbonaceous matter, and the mixture placed in a furnace containing coke at a red heat. The mixture fuses and passes down through the coke, whereby the reduction into sulphide is effected without the latter coming into contact with the lining of the furnace, which would be destroyed by the action of the fused sulphide. The furnace used has preferably the shape of a lime-kiln, and is furnished at the bottom with discharging doors. There are air openings about midway in the height of the furnace for admitting air for combustion of the coke; air is excluded from the lower part of the furnace, in which the reduction proper takes place. The coke, saturated with sodium sulphide, is then drawn off at the end of the operation, kept from the air until cool, lixiviated and the liquor used for the manufacture of pure soda products. The remaining coke may be used over again.—S. H.

Improvements in the Manufacture of Sulphuric Acid. J. B. Hannay, Loch Long. Eng. Pat. 12,247, Nov. 5, 1886. 4d.

Sulphurous acid from any available source is passed along with nitrous acid through a condensing tower, where the gases become minutely subdivided and thoroughly mixed by passing through screens, which are kept moistened by a continual stream of water trickling on them, with the result that the sulphurous acid is converted into sulphuric acid, which dissolves in the water. The process is continually repeated until the solution acquires considerable strength, when it is drawn off and a fresh supply of water is run into the apparatus. The uncondensed gases contain oxides of nitrogen, which are recovered by well-known means.—S. H.

Improvements in Apparatus for Use in the Treatment of Sulphuretted Hydrogen for the Separation of Sulphur, or for the Production of Sulphurous Acid. J. Simpson and E. H. Parnell, Liverpool. Eng. Pat. 14,711, Nov. 13, 1886. 8d.

In burning sulphuretted hydrogen, either for the preparation of sulphur or for the production of sulphurous acid of uniform strength, there is a great difficulty in regulating the respective currents of air and sulphuretted hydrogen entering the burner or combustion chamber: air in excess causing a loss of sulphur, while a deficiency of air allows the sulphuretted hydrogen to pass away undecomposed. The object of this invention is to regulate the supply of air and gas in any desired proportions, to measure the quantity of gas consumed and to minimise the risk of explosion by firing back. For this purpose two vessels are employed, each of which is provided with an inlet and an outlet valve. Both vessels are filled and emptied simultaneously by a mechanical arrangement, such as cylinders and pistons or gasholders raised and lowered in tanks containing liquid. The inlet valves of the vessels are connected respectively with the sulphuretted hydrogen storage tank and with the atmosphere, while the outlet valves are in connection with the burner or combustion chamber. The working parts of the mechanical contrivance are so coupled that the two vessels act in conjunction, and the air or gas entering and leaving one of the vessels in a given time has a constant proportion to the quantity of air or gas entering and leaving the other vessel during the same period.—S. H.

A Process for obtaining Mother-liquors free from Magnesian Salts in the Manufacture of Carbonate of Potash by Means of the Double Carbonate of Potash and Magnesia. E. P. Alexander, London. From E. J. L. Delsol, Lot, France. Eng. Pat. 15,182, Nov. 22, 1886. 6d.

In the manufacture of potassium carbonate by Engel's process, mother liquors are obtained, which, in addition to the untransformed salts of potash, contain magnesia salts. These salts are formed at the expense of a portion of the magnesia introduced in the manufacture, which has afterwards to be replaced and it would, therefore, be of great advantage to obtain mother liquors free from magnesia. For this purpose a quantity of sodium carbonate equivalent to the quantity of potassium carbonate which it is desired to obtain, is added. The sodium carbonate precipitates the magnesia, at the moment of its going into solution and at the termination of the operation the mother liquors contain no magnesia, but the corresponding sodium salt. The addition of sodium carbonate presents the further advantage, that instead of potassium chloride and magnesia, the double salt of potassium and magnesium chloride—*e.g.*, the raw salts of Stassfurt (carnallite, kainite, etc.), may be used with perfect success.—S. H.

Improvements in the Manufacture of Bi-carbonate and Carbonate of Soda by the Ammonia Process, and in the Construction and Use of Apparatus for that Purpose. H. Burns, Leith. Eng. Pat. 15,352, Nov. 25, 1886. 8d.

A boiler is filled with a solution of ammonium salts or with gas liquor and the temperature raised to about 270° F. Ammoniacal liquor is pumped constantly into the boiler so as to keep up a regular overflow of hot liquor from the top of the boiler into steam-tight cylinders, where the liquor mixes with a shower of milk of lime, which liberates the ammonia. The latter, along with a portion of the steam, is conducted into an elevated vessel containing ground rock salt, where the steam condenses, dissolving part of the salt, and runs down into a second vessel, called the mixing vessel. This vessel is filled with a saturated solution of sodium chloride and into it a constant stream of saturated brine is pumped, while the overflow is made to run down into a condenser and thence into the decomposer. At the same time the ammonia is passing through the salt solution a regular current of carbonic acid is also forced through it. Both the vessel containing the salt solution and the decomposer contain a frame of agitating balls with cups, through which the liquor and gases are forced. The agitation produced by the rising and falling of the balls causes an intimate contact of the different compounds, with the result that a precipitate of sodium bicarbonate settles at the bottom of the precipitating vessel, while the solution of ammonium chloride collects in the decomposer. This solution is pumped back into the boiler and re-enters the cycle of operations. When crude gas liquor is used, the gases and vapours must be purified before passing them through the salt solution. The bicarbonate, after being washed and dried, is packed into drums with perforated centre-tubes, which allow the gases to escape during the subsequent heating, and the drums are placed in retorts for the conversion of the bicarbonate into carbonate.

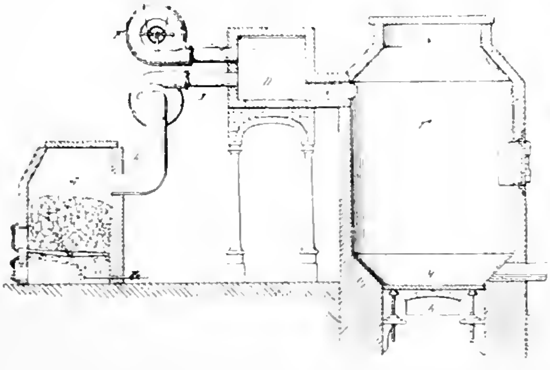
S. H.

An Improved Method or Process of Producing Muriatic Acid. H. H. Lake. From A. Kayser, H. Williams and A. B. Young, Buffalo, U.S.A. Eng. Pat. 11,494, August 23, 1887. 6d.

A SOLUTION of calcium chloride, such as is a waste product in various processes, is partly evaporated and mixed in this moist condition with silica or clay. The mixture is moulded with bricks, which after drying are placed into a converter heated to a very high temperature by gases which contain steam. At this high temperature the silica or clay decomposes the calcium chloride, forming calcium silicate or silico-calcium-aluminate and generating hydrochloric acid, which is condensed in any suitable manner. The product of the reaction left in the converter may be used for the manufacture of hydraulic lime and artificial stone. The use of clay is preferable to the use of silica alone, as the latter requires a higher temperature in the converter. The apparatus described in Eng. Pat. 11,492, 1887, is also suitable for this process.—S. H.

Improvements relating to the Production of Caustic Alkali, Carbonates of the Alkaline Metals, Muriatic Acid and other Substances. H. H. Lake, London From A. Kayser, H. Williams and A. B. Young, Buffalo, U.S.A. Eng. Pat. 11,492, Aug. 23, 1887. 8d.

CLAY, common salt and water are mixed together and the mixture moulded into bricks of convenient size. These are dried and heated in a converter by a current of hot gases superheated steam. The clay acts on the sodium chloride, generating hydrochloric acid long before visible red heat is reached, and the action increases rapidly as the temperature rises. The conversion is complete after about 24 hours' heating at a red heat. The hydrochloric acid is condensed in the usual manner. The converted material is termed "acid silico sodium aluminate." The clay and salt of the charge are mixed in such proportions that this aluminate contains about 33 per cent. of sodium oxide. It is then nearly insoluble in water and infusible even at the beginning of white heat. In order to extract sodium oxide from it, it is crushed and fused with such a quantity of soda as will raise the total percentage of soda to about 50 per cent. The resulting product, termed "basic silico sodium aluminate," is very deliquescent and yields all of its sodium compounds by lixiviation. The basic salt is, therefore, treated with water, when it yields a solution containing 80 to 90 per cent. of the total sodium as sodium hydrate, the rest being sodium carbonate and sodium silico-aluminate. The insoluble residue is regenerated clay, free from iron, and can be used over again in place of the original clay. As regards the composition of the clay, the best results are obtained when the proportion of silica to alumina is about two to one, and it is usually necessary to prepare a clay of suitable composition by adding or removing sand from it. The gases entering the converter should contain a sufficient quantity of steam to furnish hydrogen for combination with the chlorine and an excess of oxygen to prevent formation of carbon monoxide and the reducing action resulting therefrom. When it is desired to produce potassium salts, an equivalent quantity of potassium chloride should be used in place of sodium chloride. The accompanying drawing represents a section of the apparatus employed. A is the gas producer, and *a* a steam pipe supplying steam to the producer. The gas escapes at *b* and is drawn by a fan C into the combustion chamber D, while another fan E delivers a blast of air for burning the gas ; *f* connects the converter F with the combustion chamber. The converter is provided with a feed-opening G and a discharging door at H. The pipe I leads the escaping gases to the acid condensers. Two or more converters may be used in a battery; the gas exit pipe of one converter is then connected with the gas inlet of the following one.—S. H.



VIII.—GLASS, POTTERY AND EARTHENWARE.

An Improved Method or Process of Producing Silicate of Sodium or of Potassium. H. H. Lake. From A. Kayser, H. Williams and A. B. Young, Buffalo, U.S.A. Eng. Pat. 11,493, August 23, 1887. 8d.

FINELY-DIVIDED SILICA, sodium chloride and water are mixed and the mixture moulded into bricks. The quantity of sodium chloride should be so calculated that the resulting mass does not contain more than 15 per cent. of sodium oxide. The bricks are dried and placed into a converter of fire-brick heated by gases from a combustion chamber located near it. In this combustion chamber water-gas is burned by a blast of air in slight excess, forming carbon dioxide and steam under development of a high temperature. The hot gases pass through the converter and come in intimate contact with the charge, penetrating it thoroughly and causing at a bright red heat the gradual combination of silicic acid and soda, while hydrochloric acid is given off and condensed in the usual manner. When the operation is complete, the resulting mass forms an excellent material for the manufacture of glass in place of a portion of the soda and sand ordinarily employed; or by smelting the silicate with soda, water-glass is produced. The apparatus shown in the preceding abstract is also suitable for this process.—S. H.

X.—METALLURGY, Etc.

The Bending, Tensile and Compressive Strength of Samples of Magnesium.

THE following experiments were made for the Aluminium and Magnesium Manufactory in Bremen, at the Mechanical Experimental Station, in Charlottenburg. Tensile strength, limit of breaking, 23·2kilos. per 1qmm.; specific resistance to compression 27·2kilos. per 1qmm. ; bending strength 17·4kilos.

In comparison with other metals, the strength of magnesium is relatively very considerable. The breaking coefficient for tensile strain per square millimetre is :—

		Specific Gravity.
Magnesium	23·2kilos.	1·75
Aluminium	20·5 „	2·67
Brass	12·5 „	7·8–9·5
Bronze	23·0 „	8—9
Rod-iron	38·0 „	7·6—7·8
Delta-metal, poured in sand	31—36„	8·6
Delta-metal, rolled hard	53·0	—

Since the rolling of magnesium does not offer the slightest difficulty, even in such complicated forms as T I U, or as angles, round or four-cornered rods, plates or sheets of 0·1mm. thickness, and as pure magnesium is sufficiently resistant to atmospheric influences and can be polished and easily cleaned, it lends itself on account of its lightness and relative strength to the construction of apparatus, etc., required to be made of metal and also to be light—as for instance, nautical, physical and astronomical instruments. The working of magnesium requires heat. At a temperature of 450° C.

it can be rolled, pressed, worked and brought into complicated forms. Screws and threads can be made of magnesium and these are considerably sharper and more exact than those from aluminium. Owing to its cheapness, magnesium can also be used in the manufacture of a variety of useful articles; experiments in this direction are now being made.—G. H. M.

Examination of Zinc Muffles. Steger. Ztschr. f. d. Berg, Hütten- u. Salinenw. 1887, 165.

The author considers that most interesting and important results may be obtained from the study of the products remaining in zinc muffles after the distillation of zinc. The original mass may be converted into new and crystalline minerals; this would explain the formation of many crystalline minerals in volcanic rocks. The author has examined charges before and after distillation, and finds that considerable changes take place.

G. H. M.

On Germanium. C. Winkler. J. Prakt. Chem. **36**, 177—209.

In this communication (the second) on germanium, a more detailed description is given of the metal and of its compounds with the halogens, alcohol radicles, etc. Germanium is prepared from argyrodite by fusing it with equal weights of soda and sulphur. The melt is extracted with cold water, treated with an excess of sulphuric acid and the precipitate is filtered off and washed. After stirring up with water the precipitate is treated with sufficient hot caustic potash to dissolve all the soluble sulphides and the yellow alkaline liquid is separated by decantation from the insoluble sulphides of the heavy metals. Dilute sulphuric acid is added as long as it produces a precipitate and the solution containing the germanium and K_2SO_4 is filtered from the sulphides of antimony and arsenic; after adding an excess of H_2SO_4 it is evaporated down until acid fumes begin to escape. The acid mass is dissolved in water and saturated with H_2S, the precipitate filtered off, transferred to a porcelain dish, heated, moistened with HNO_3 and again heated to redness, so as to convert it into germanium oxide, which can be reduced in a current of hydrogen at a red heat. The oxide obtained as above is however impure and it is best to convert it into the insoluble potassium germanium fluoride by dissolving in hydrofluoric acid and adding potassium fluoride. This can be brought into solution by fusing with potassium carbonate and sulphur and extracting with water, when it is again treated as above. Large quantities of the oxide are best reduced to the metallic form by mixing with 10—15 per cent. of starch and hot water and heating with charcoal in a crucible. The semi-fused regulus is again melted under borax-glass, when the germanium is obtained as a partially crystalline mass.

Chlorides of Germanium.—Germanium forms with chlorine a dichloride ($GeCl_2$) and a tetrachloride ($GeCl_4$). The latter can be obtained by the direct union of its elements and also by heating a mixture of germanium sulphide and mercuric chloride, when cinnabar is left behind. The colourless fuming liquid obtained by heating powdered germanium in a current of dry HCl is not the dichloride, but germanium-chloroform, $GeHCl_3$, hydrogen being evolved during the process; the reaction which takes places is :—$Ge + 3HCl = GeHCl_3 + 2H$. The compound is very unstable, being readily oxidised with formation of an oxychloride ($GeHCl_3 + O = GeCl_2O + HCl$) and on heating it appears to decompose like silicon-chloroform according to the equation $2GeHCl_3 = Ge + GeCl_4 + 2HCl$. Victor Meyer and Mensching find that its vapour density is 5·55—the theoretical vapour density being 6·21.

Fluorides of Germanium.—Germanious fluoride, GeF_2, has not yet been prepared in a pure state, but it probably exists. The tetrafluoride (GeF_4, germanic fluoride) is formed when the oxide GeO_2 is dissolved in hydrofluoric acid; after evaporation over sulphuric acid it remains as a clear viscous liquid, which is very hygroscopic and gradually solidifies to a transparent mass having the composition $GeF_4 + 3H_2O$. This melts in its water of crystallisation when heated and on further heating becomes covered with a coating of oxide. Krüss and Nilson have recently stated that the fluoride is non-volatile. The author denies this and describes several experiments which support his views. In one of these, germanic oxide (or germanic acid, GeO_2) was gently heated with CaF_2 and H_2SO_4; penetrating acid fumes were evolved, which were readily absorbed by water, yielding a clear, colourless, acid liquid, which contained in solution hydrogen germanium fluoride H_2GeF_6 (corresponding to hydrofluosilicic acid). The potassium salt of this acid, K_2GeF_6, is prepared by dissolving GeO_2 in hydrofluoric acid and adding a concentrated solution of KCl; it forms a fine crystalline powder, similar in its properties to the fluosilicate of potassium. The existence of this salt confirms the anticipations of Mendelejeff, who predicted that Eka silicon would form double fluorides isomorphous with the corresponding salts of silicon, titanium, zirconium and tin.

Mendelejeff also stated that Eka-silicon, like Si and Sn (but unlike Ti, which belongs to an uneven series) could form volatile organic compounds such as $Es(C_2H_5)_4$, which should boil at 160° and have a density of about 0·96. This prediction has been completely verified. Germanium-ethyl, $Ge(C_2H_5)_4$, is formed by the action of zinc-ethyl upon germanic chloride :—$2Zn(C_2H_5)_2 + GeCl_4 = 2ZnCl_2 + Ge(C_2H_5)_4$. It is a colourless liquid of weak alliaceous odour, boiling at about 160°: it does not mix with water, but rises *slowly* to the surface when poured into water, thus showing that its density must be near 0·96. Its theoretical vapour-density is 6·51, but the value found by Victor Meyer and Mensching from a specimen which was shown by analysis to be pure, was 8·50.—D. E. J.

Improved Process for Extracting Gold and Antimony-Regulus from Auriferous Antimony Ore. E. R. Cummins, London. From G. P. Schweder, Porto, Portugal. Eng. Pat. 12,428, Sept. 30, 1886. 6d.

The crushed ore is roasted *per se* in a long reverberatory furnace at a gradually increasing, but always low, temperature, by continuously charging at the cooler end and working the charge up towards the fire bridge, where it is removed; it is then roasted absolutely sweet at a higher temperature and in a smaller furnace. Or it may be mixed with from 5 to 40 per cent. of lime, or of the carbonate or sulphate of magnesium, sodium or potassium, and subjected to similar treatment. Or these bodies may be mixed after the first calcination, but previous to treatment in the smaller furnace. After cooling, the gold is extracted by amalgamation or chlorination. The residue from this operation is dried and smelted for crude antimony regulus in a reverberatory furnace with powdered coal and a flux: or it is moulded into bricks with lime or clay and worked in a cupola.—W. G. M.

Improvements in the Manufacture of Aluminium Chloride and in the Extraction of Aluminium therefrom. O. M. Thowless, Newark, U.S.A. Eng. Pat. 14,407, Nov. 8, 1886. 6d.

Aluminium chloride, preferably produced by dissolving recently precipitated aluminium hydroxide in hydrochloric acid, or aluminium fluoride or other similar compound is mixed with chalk, coal or other carbonaceous material, sodium carbonate or soda ash, and cryolite. The mixture is then heated in a closed vessel at a temperature of 2000° F., cooled and washed to separate the reduced aluminium, which may then be remelted and run into ingots.—W. G. M.

An Improved Process and Apparatus for obtaining Sulphur and other Substances from Ores, for Purifying such Substances, and for similar Purposes. J. R. Francis, Swansea, and F. F. Jones, London. Eng. Pat. 14,875, Nov. 16, 1886. 8d.

The ore containing the sulphur or other volatile substance is roasted in muffles, the products of combustion being carried by a draught, induced by a flue stack, through a series of depositing chambers preceded, if desirable, by a reducing chamber packed with charcoal or a similar deoxidising substance. In these chambers, which are water-cooled, condensible products such as arsenic trioxide or sublimed sulphur are deposited; but the more volatile substances are carried on to the stack, in which they ascend over trays of limestone or magnesia and thus become absorbed. A gentle stream of water admitted at the top of the shaft dissolves such of these products as may be soluble and conveys them to a tank situated at the bottom. Two sets of condensing chambers may be used alternately, access to each being controllable by cocks in the main pipe from the muffle; the deoxidising chamber may be similarly thrown in or out of circuit at will. Thus pyrites may be treated first by distillation without access of air to the retort and the sublimed sulphur condensed in one set of chambers, when the roasting may be completed in presence of air, the products now being diverted into the other set; or ores containing two bodies which sublime at different temperatures, such as sulphur and arsenic, may be fractionated by respectively treating at the temperatures most suitable and collecting the products separately.—W. G. M.

Improvements in the Manufacture of Steel and Ingot Iron by the Basic Process. P. C. Gilchrist, London. Eng. Pat. 11,474, Aug. 23, 1887. 4d.

In the basic open-hearth process, instead of using an admixture of scrap, which requires a longer time to melt than does the accompanying pig iron, the furnace is charged in the usual way, but without the addition of the scrap and with a smaller proportion of lime than is theoretically necessary to purify the pig. Meanwhile, another portion of pig iron, preferably phosphoric, is blown with an excess of lime in a basic converter. When the charge in the open-hearth furnace is melted or is semi-fluid, that from the converter, together with its slag, is tapped in. The thoroughly liquid converter slag, containing, as it does, excess of lime, ensures a complete purification of the charge with greater rapidity than is usually possible, owing to the very gradual fluxing of the lime which ordinarily occurs; also the presence of oxides of iron in the same slag permits the use of a smaller quantity of ore during the process.—W. G. M.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

On the Composition of Rape-seed Oil. C. L. Reimer and W. Hill. Ber. **20**, 2385—2390.

The rape-seed oil, in spite of its large consumption, is, from a chemical point of view, one of the least known fat oils. There exist only a few investigations of it and these are of old date and contradictory in their results. The authors have been engaged for some time in the investigation of erucic and brassic acids, and extending their work on the acids occurring in rape-seed oil, found that, contrary to previous statements, rape-seed oil contained three different acids, one of which fusing at 75°, was only present in very small quantities, whereas the other two, erucic acid and a liquid acid occurred in about equal quantities. The liquid acid mentioned and now termed "rapic acid," had been previously observed by Websky (*J. Prakt. Chem.* **58**, 449), but he did not study it much further, probably owing to the fact that he experienced great difficulties in separating it from the erucic acid. The usual means of separation by the different solubilities of their lead salts, failed in this instance; but it was found that of erucic and rapic acids, the zinc salt of the latter is easily soluble in ether, whereas that of the former is nearly insoluble in the same solvent. Zinc rapate forms a white crystalline mass, from which the free acid is obtained by heating with tartaric acid. On analysis the rapic acid was found to have the formula $C_{18}H_{34}O_3$. It is therefore an oxyoleic acid and although isomeric to ricinoleic acid, it differs in properties. It cannot be solidified by treatment with nitrous acid nor by cooling. Fused with potassium hydrate, it is decomposed with the evolution of hydrogen. The melt dissolved in water and acidified with hydrochloric acid, precipitates a white substance, which is a mixture of two crystallisable acids, which acids can be separated by a long-continued fractional crystallisation. The acid occurring in very small quantities along with the erucic and rapic acids, is obtained by saponifying 1kilo. of rape-seed oil and precipitating the solution with 4grms. of zinc acetate. The precipitate is filtered, washed and then decomposed with hydrochloric acid. The resulting product is purified by crystallisation from alcohol. It forms silver-shining plates and on analysis was found to have the formula $C_{22}H_{44}O_2$. It was identified as behenic acid. The rape-seed oil therefore contains the glycerides of erucic, rapic and behenic acids.—S. H.

XII.—PAINTS, PIGMENTS, VARNISHES AND RESINS.

Improvements in the Manufacture of Pigments. F. M. Lyte, Putney. Eng. Pat. 11,889, Sept. 18, 1886. 6d.

This invention is an improvement in the method of manufacturing basic salts of lead for use as pigments described in Eng. Pat. 10,298, 1886. A solution of basic lead acetate, prepared by repeatedly pouring neutral lead acetate over finely-divided lead, is treated with sulphuric acid till barely acid, heated to boiling and the precipitate allowed to settle. The clear liquid is decanted off and again rendered basic by pouring over finely-divided lead. To the precipitate of lead sulphate, a known volume of basic lead acetate, containing a given amount of base, is added and the mixture boiled for a short time, when "it will be found that the sulphate has attained its right degree of basicity."—O. H.

Improved Process of Manufacturing White Lead. J. F. F. F. Löwe, Frankfort, Germany. Eng. Pat. 9122, June 27, 1887. 4d.

The carbonate of lead is first prepared from solutions of lead nitrate or acetate by precipitating with bi-carbonate of soda or potash, or with a mixture of bicarbonate and carbonate. To the carbonate of lead thus prepared is added a solution of basic acetate of lead, when white lead settles down.—E. E. B.

New Process for the Vulcanisation of Pure Caoutchouc in Sheets or in Articles made therefrom. B. J. B. Mills, London. From A. Fayaud, Paris, France. Eng. Pat. 16,775, Dec. 21, 1886. 8d.

The caoutchouc is coated with sulphur, stoved and after being dipped in pure water, placed in a reservoir containing water and provided with a movable bottom. The reservoir containing the articles is then steamed in any suitable steaming apparatus under pressure. A drawing of the reservoir is given.—E. E. B.

Improvements in Indiarubber Compositions. J. T. Griffin, Hampstead. From R. J. Henderson, New York, U.S.A. Eng. Pat. 10,457, July 27, 1887. 4d.

Asbestos fibre, asbestos powder, ground whalebone, earth wax (paraffin, ozokerite, etc.), carbon (soot, lampblack, etc.) and sulphur are incorporated with Para or similar rubber before moulding and the mass is then cured in the ordinary way. The compound is said to be unaffected by the atmosphere, by acids and by oils.
—E. E. B.

Manufacture of Soft or Spongy Material from Rubber Compound. J. T. Griffin, Hampstead. From R. J. Henderson, New York, U.S.A. Eng. Pat. 10,458, July 27, 1887. 4d.

Substitutes for rubber sponge, termed by the patentee "light," "intermediate" and "heavy" sponge respectively, are made from Para rubber by incorporating with it sulphur, alum, tungstate of soda, borax, camphor, lampblack and either carbonate of ammonium for the "light sponge" or chloride of ammonium for the other two qualities. Proportions are given in the specification.

—E. E. B.

XIII.—TANNING, LEATHER, GLUE AND SIZE.

Improvements in Machines for Unhairing and Green-shaving Hides and Skins. J. W. Vaughn, Peabody, U.S.A. Eng. Pat. 10,121, July 19, 1887. 11d.

The hide to be operated on is clamped to a semi-cylindrical table with a rotary motion and brought in contact with a roll, the periphery of which is provided with metallic flanges arranged spirally, which revolves in an opposite direction to the table. For a description of the mechanism the specification must be consulted. Drawings are given, and there are 17 claims.

—B. H.

XIV.—AGRICULTURE, MANURES, Etc.

Analysis of Brewing Barleys of different Years. L. Aubry. Ztschr. f. d. ges. Brauw. 1887, 7.

The author publishes the analyses of barleys of the years 1878—1880, of which the following are the mean, maximum and minimum values :—

Barley of the 1878 harvest—66 barleys examined :—

In 100 parts of the dry substance.

	Water.	Nitrogen.	Albuminoids.	Ash.	Phosphoric Acid.	Starch.
Maximum	17·43	2·11	13·22	3·30	1·365	—
Minimum	12·55	1·21	7·60	2·42	0·715	—
Mean	—	1·73	10·81	2·98	1·020	—
Barley of the 1879 harvest—40 barleys :—						
Maximum	19·00	2·030	12·69	3·12	1·319	—
Minimum	12·00	1·0289	8·06	2·53	0·852	—
Mean	—	1·710	10·93	—	1·100	—
Barley of the 1880 harvest—76 barleys: —						
Maximum	20·70	2·400	15·00	—	1·696	68·65
Minimum	11·76	1·337	8·36	—	0·756	61·21
Mean	—	—	10·51	—	1·056	65·42

The ash of 15 of the above barleys was analysed :—

In 100 parts of the dry substance.

	Ash.	Iron Oxide.	Lime.	Magnesia.	Potash.	Phosphoric Acid.	Sulphuric Acid.
Maximum	3·1	0·043	0·093	0·286	1·032	1·203	0·216
Minimum	2·47	0·039	0·051	0·191	0·502	0·885	0·061

—G. H. M.

Effect of Noxious Vapours on Vegetation. E. Fricke. Landw. Versuchsst. 1887, 275.

In a neighbourhood suffering from the sulphurous smoke from a zinc (blende) smelting-works, grain crops grew thin, the ears were small and the stalks weak; whilst potato leaves were wrinkled and marked with black spots. These sickly plants contained more sulphuric acid than healthy plants grown in the same neighbourhood, but at a greater distance from the works. The excess of sulphuric acid varied from 0·442 to 4·5grms. per 1000 of dry matter. Taking these quantities as representing the injurious amount of sulphuric acid in each case, the author's results support the suggestion of Schröder and Reuss, that with regard to sulphurous smoke, young meadow herbage is most susceptible, oats can resist its injurious action better than wheat, while potatoes, on the other hand, can thrive within the limits of smelting works. Leaves and needles from trees exposed to such smoke, yield ashes containing more sulphuric acid, but less carbonic acid, and of lower basicity than ashes from healthy leaves and needles. With improved furnaces and means of removing the sulphur from smoke, such as are now known, this nuisance ought to be removed. Other experiments with plants grown in the vicinity of chemical works and exposed to smoke containing both hydrochloric and sulphurous acids, show that in the case of sickly plants the ash contains more hydrochloric and sulphuric acids, less carbonic acid and lower basicity than ash from healthy plants.—D. A. L.

Assimilation and Respiration of Carbonic Anhydride by Plants. U. Kreusler. Landw. Jahrb. 1887, 711.

Temperature plays an important part in both respiration and assimilation, in fact in the former case is of primary importance. Both respiration and assimilation take place within wide ranges of temperature, but the curve representing the relation of respiration to temperature takes a very different course to the corresponding curve for assimilation. Respiration becomes more intense with elevation of temperature and is at its highest at a point not far removed from the fatal temperature; this increase in intensity is not merely proportional to the rise in temperature, but goes on at a continually increasing progression. The author's experiments confirm the assumption that, under otherwise similar conditions, plants respire more carbonic anhydride at those periods of growth when the greatest changes in form and composition are taking place; for instance, during flowering and fruition. Changes in other conditions produce comparatively little effect on the intensity of respiration. With regard to the assimilation of carbonic anhydride by plants, the amount of water in a plant and consequently the water supply also, are the most important controlling factors and hence must be taken into consideration in all measurements, etc. Shoots of different stages of devolopment show visible differences in their energy of assimilation. At a temperation of 25°, an undoubted falling off in activity of assimilation is observed with advancing age of leaves. Older leaves contain less water and probably accumulate less than younger leaves; the difference between this power of accumulating water appears to be relatively greater than the difference between the evaporating power of old and young leaves. Under otherwise favourable conditions, raising the temperature to 25° does not necessarily produce an equal change in the amount of water in comparatively young leaves. Electric light, as supposed, proved as efficient as ordinary daylight in promoting assimilation in cut shoots during the more favourable periods of vegetation.—D. A. L.

Influence of Lime as a Soil Constituent on Vegetation. E. W. Hilgard. Forschungen auf. d. Geb. d. Agriculturph. 1887, 185.

Inasmuch as a high percentage of lime in soil induces short, strong and compact growth with high yielding power, of most trees and plants, whilst absence of lime, in spite of the otherwise good composition of a soil, produces weak growth and low yielding power: the author considers that the stunted round form of trees grown in arid districts may, at least to a great extent, be attributed to the same influence.—D. A. L.

Effect of removing Leaves from the Beet-root Plant on the Amount and Composition of the Produce. J. Fittbogen and R. Schiller. Chem. Zeit. **11**, 239—240.

The removal of leaves appears to interfere with the ripening of the plant, and early removal diminishes the total yield of nutritive organic substances.—D. A. L.

XV.—SUGAR, GUMS, STARCHES, Etc.

Study of the Products of the Saccharification of Starch. J. Effront. Monit. Scient. 1887, 513.

The author draws the following conclusions from his investigations:—(1) The course of the conversion of starch into sugar and dextrin is not the same whether the saccharification is effected by malt or acid. The saccharification by malt is attended by a decomposition of the starch molecule into dextrin and maltose, whilst the saccharification by acid is characterised by the conversion of the starch into dextrin and the latter into sugar. (2) The dextrins formed by the conversion of starch by the two agents named are not identical. The dextrins formed by the action of malt are polymeric, whilst those formed by the action of acid are not. (3) All these dextrins have the same rotatory power. (4) Maltose is always formed in the saccharification of starch by means of acid. The quantity increases as the saccharification proceeds. Even in the earlier stages of the saccharification there exists an almost constant ratio between the amount of glucose and maltose formed. This is 34—38 of maltose to 100 of glucose. (5) In the saccharification of starch by malt the formation of glucose is not regular. Whilst it almost always occurs in solutions of high gravity, it is only formed in liquids of low gravity if the malt extract employed be turbid. (6) The dextrin can be obtained pure, when the sugar is destroyed by a lactic acid fermentation. (7) For the analysis of the products of saccharification, the author proposes to destroy the sugars by means of ammonium hydroxide and sodium hypochlorite, and determine the dextrin by the polariscope readings of the solution before and after treatment.—G. H. M.

XVI.—BREWING, WINES AND SPIRITS.

Fifth General Meeting and Exhibition of the Berlin Brewery Institute. Chem. Zeit. **11**, 651—652.

The papers read at the above annual meeting were :—

1. *Hops and their Constituents, by Hayduck.*—The author has separated a new resin from hops. When hops are extracted with ether and the ethereal extract submitted to examination, three distinct resins may be separated ; one of these, a soft resin, is precipitated from its alcoholic solution by lead acetate and possesses remarkable antiseptic power ; the second, also a soft resin, is not precipitable by lead acetate, but it is soluble in petroleum ether and appears to be identical with the oxidation product of Bungener's acid from hops (this Journal, 1885, 543) and may be obtained from lupulin ; it possesses a much feebler antiseptic action than the former ; the third, which is a hard resin, is insoluble in petroleum ether, has only very slight antiseptic power, a less intense bitter taste and a pleasant smell. Both of the soft resins give a yellow coloration when treated with magnesium oxide in alcoholic solution ; under the same conditions the solid resin gives an orange-coloured precipitate. All the resins, when shaken in ethereal solution with copper sulphate solution, give a beautiful grass-green colour to the ethereal liquid. All the resins are soluble in water to the extent of about 0·042—0·058 per cent. The antiseptic action of the soft resins is very considerable on the lactic acid ferment, but it is very slight on sarcina and the acetic acid ferment. The solubility of the resin in water decreases on boiling (therefore the repeated use of hops is not to be recommended) and the presence of lactic acid in wort also reduces the solubility. This fact accounts for the formation of a film of resin on fermenting worts, since traces of lactic acid are always present in beer-wort.

2. *The Consumption of Fuel in Breweries, by Goslich.*—The author referred to the waste of heat in copper boiling and recommended boiling by steam, a discussion following on the relative merits of direct firing and steam boiling.

3. *The Influence of Carbonic Acid on the Fermentation and Keeping Properties of Beer, by Delbrück.*—Pressure of carbonic acid prolongs the fermentation and also checks the yeast-turbidity in the finished beer. The author, in conjunction with Foth, allowed beer to remain in bottle under a pressure of 2—4 atmospheres of carbonic acid and compared the results with those of beer bottled under ordinary conditions. The results were in favour of that bottled under pressure, the beer remaining bright for a much longer time. Pressure of carbonic acid does not check the growth of bacteria or sarcina. Enzinger considered that the prolonged influence of carbonic acid on beer improved it. V. de Planitz considered that air-pressure is preferable to carbonic acid pressure during the pasteurisation of beer.

4. *The Yield of Mashing Materials, by O. Reinke.*—The author determines the extract of a malt by analysing the malt and, after the mashing process is over, the grains, instead of by the usual methods of examining the wort. Under the most favourable conditions the yield of extract is equal to the theoretical, but various factors usually cause a loss of less than 12 per cent. of the theoretical yield. Normal grains contain on the absolute dry substance about 8 per cent. of extract, yielding 26 per cent. of starch and 45 per cent. of substances free from nitrogen. The high value of grains as fodder must therefore depend greatly on the easy digestibility and solubility of the altered cellulose of the malt, quite apart from the high percentage of proteïns.—G. H. M.

XVIII.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Obtaining Zinc in a Metallic Form from Alkaline Solutions of Zinc Oxide. W. S. Squire and S. C. C. Currie, London. Eng. Pat. 12,249, Sept. 27, 1886. 4d.

The solution is electrolysed with an anode of iron or carbon and a cathode of mercury. The resulting zinc amalgam is distilled to separate the mercury.

—W. G. M.

Obtaining Metallic Zinc from its Ores. W. S. Squire and S. C. C. Currie, London. Eng. Pat. 12,[illegible]0. Oct. 5, 1886. 4d.

The ore is dressed, obtained as oxide, if not already in this form, by roasting, dissolved in potassium or sodium hydroxide and electrolysed with a mercury cathode. The zinc is obtained by the subsequent distillation of the amalgam. (See Eng. Pat. 12,249 of 1886.)—W. G. M.

An Improvement in Electrolysis. C. D. Abel, London. From Messrs. Siemens and Halske, Berlin, Germany. Eng. Pat. 14,033, Nov. 1, 1886. 8d.

A solution of copper sulphate and ferrous sulphate with sulphuric acid, enters at the cathode (near the bottom of the cell) on which its copper is deposited by the electric current. It then passes over a non-metallic partition and falls along the surface of an insoluble carbon anode, the ferrous sulphate being meantime converted into ferric sulphate and acting, therefore, as a depolariser. This solution then flows from the cell over roasted copper pyrites, acting on the cuprous sulphide and copper oxide to form sulphate of copper, but not touching the iron oxide. In this process the ferric sulphate is again reduced to ferrous sulphate and the solution, thus brought to the same condition as before, passed again through the cells. Similar processes may be used employing zinc and other metals. If chlorides of the metals are used, ferrous sulphate is replaced by iron protochloride. The patent also relates to arranging several such cells in series. By these methods a lower counter E.M.F. is produced and the current is not wasted in reducing iron salts ; the anode also remains untouched.

—E. T.

Improvements in Apparatus for the Preparation of Bleaching Solutions by Electrolysis. E. Hermite, Paris, E. J. Paterson and G. F. Cooper, London. Eng. Pat. 14,673, Nov. 12, 1886. 11d.

See under VI., page 727.

Improvements in Holders or Supports for Incandescent Electric Lamps. J. H. Holmes, Newcastle-on-Tyne. Eng. Pat. 15,094, Nov. 20, 1886. 8d.

To obtain an even distribution of pressure between both of the platinum loops of electric lamps and the hooks of the holder, a spring is caused to act on the part of the lamp midway between the loops.—B. T.

Improvements in the Manufacture of Incandescent Electric Lamps. W. Maxwell, London. Eng. Pat. 15,165, Nov. 22, 1886. 8d.

WHEN the filaments have been attached to the connecting wires in the usual manner, they are placed upon a refractory conductor contained in an air-tight case, from which the air has been exhausted, and the conductor is electrically heated until carbonisation of the mount is complete. Sealing the glass stem of the bulb is accomplished by a similarly heated adjacent conductor. The bulbs are sometimes filled with nitrogen or hydrogen, which gases are maintained at any desired pressure or temperature in order to facilitate their purification. The gas-holder is connected with the lamps by inverted syphon tubes, preferably of steel, in which the mercury acts as a seal against admission of air. The mercury of the exhausting apparatus passes through a refrigerating chamber and the parts of the apparatus are connected together by inverted syphons as above.—B. T.

Improvements in Apparatus for Amalgamating Gold and other Precious Metals. B. C. Molloy, London. Eng. Pat. 15,206, Nov. 22, 1886. 11d.

WITHIN a shallow circular tray and floating freely upon the mercury contained in it, is a disc with sides higher than those of the outer tray, with a central aperture carrying a hopper for the introduction of the ore, and a cross-bar through which passes a spindle required for the rotation of the disc. Attached to the spindle and to the circumference of the disc are wires dipping into the mercury for the purpose of preventing the aggregation of ore at any point. The spindle runs in a socket on the floor of the tray, and is supported by a cross-head above; it is rotated at about 10 revolutions per minute. The finely-crushed ore is fed in suitable quantities into the hopper, either dry or as pulp. It thence gradually finds its way spirally over the mercury in the bath, being impelled forward by the motion of the disc and the resulting centrifugal wave, until on reaching the circumference it deposits any mercury particles caught in it and overflows into such receptacle as may be provided to receive it. Thus each particle will remain in contact with the mercury for the space of about 15 seconds. If desired, a porous diaphragm may be provided, having a lead, carbon or other anode packed in sand, wetted with soda or dilute sulphuric acid, or any suitable electrolyte, beneath it; the mercury itself acts as cathode to a weak current of electricity and is thus preserved from "sickening."—W. G. M.

Improvements in Electrical Batteries, and in the Manufacture of Depolarising Bodies to be used therein. E. Barbier and M. Leclanché, Paris, France. Eng. Pat. 16,823, Dec. 22, 1886. 8d.

IN agglomerated depolarisers the agglomerating substance is usually a non-conductor of electricity, such as gum-lac. The inventors use a combination of a peroxide, such as peroxide of lead, manganese, etc., with graphite, pitch, sulphur and water. These are intimately mixed and compressed cold. The block obtained is heated slowly to about 350° C. The water and volatile oils of the pitch are driven off and, finally, the sulphur acting on the remnant of the pitch converts it into an unalterable conductor of electricity. The inventors also claim a sealed form of battery, containing a centre cylinder of zinc surrounded by a cylinder agglomerated as described.—E. T.

An Improved Insulating Material especially adapted for Covering Electrical Conductors. R. W. Eddison, Leeds. From J. Tatham, Philadelphia, U.S.A. Eng. Pat. 10,092, July 19, 1887. 4d.

THE claims are for an insulating material made of resin and cottonseed oil (to render the former tough), to which other materials may be added. Four to six parts of resin to one of the oil make a good mixture, but other proportions may be used.—E. E. B.

New and Improved Process and Apparatus for Procuring Aluminium. W. P. Thompson, Liverpool. From M. G. Farmer, Eliot, U.S.A. Eng. Pat. 10,815, Aug. 6, 1887. 8d.

AN aluminous material is either made into a paste with a suitable quantity of carbon, by means of molasses or other similar body, and moulded into rods of convenient size (¾in. in diameter by 2ft. long), or it is packed within a carbon tube by itself or mixed with a reducing substance. At one end of each rod is a projecting portion, which for convenience of connection will fit into a corresponding socket at the reverse end of any other rod. These rods are then so passed through the opposite side walls of a furnace, constructed of refractory material, that they meet in the centre. Beneath this point is an aperture communicating with a crucible beneath; above it is a similar vent for the discharge of waste gases into the air, whilst at the side, midway between the rods, is an opening for the admission of a jet of gas or of petroleum spray injected by steam or air, the combustion of which will cause a flame to play continuously on the points of the compound carbons. An electric arc is then formed between these two poles, with the result that as they are consumed the aluminium is reduced and falls in molten drops into the crucible. A suitable arrangement of shunt, solenoid and motor maintains the points at the right distance apart and gives the necessary feed to the rods. Several furnaces may be arranged in series and the current may be continuous or alternating.—W. G. M.

Improvements relating to the Conversion of Chemical Energy into Electrical Energy, and to Apparatus therefor. H. H. Lake, London. From W. E. Case, New York, U.S.A. Eng. Pat. 11,188, Aug. 16, 1887. 8d.

THE soluble element is either free carbon, or a compound reducible to free carbon which must be a conductor of electricity. The solution contains oxygen in unstable equilibrium and is preferably peroxide of chlorine. An anode such as platinum is used. The cell is charged with peroxide of chlorine by pouring in first sulphuric acid and then adding chlorate of potash.—E. T.

XIX.—PAPER, PASTEBOARD, Etc.

Improvements Relating to the Treatment of the Spent Lyes used in the Manufacture of Cellulose by means of Sulphites, for the Recovery of Sulphurous Acid therefrom, and to the Utilisation of the said Lyes after such Treatment. A. Frank, Charlottenburg, Prussia. Eng. Pat. 13,286, Oct. 18, 1886. 6d.

THE lyes resulting from the manufacture of cellulose, paper pulp, textile fibres, etc., by the sulphite process contain sulphurous acid, some of which is free, while some is in the form of sulphites and bisulphites. The present invention relates to the removal and recovery of the sulphites from the lyes, so that the remaining solution can be utilised for forage and manuring purposes. When the lyes contain lime or magnesia as a base, a quantity of caustic lime is added equivalent to the proportion of sulphurous acid present. When the lyes contain the sulphite or bisulphite of soda or potash, a mixture of calcium chloride and lime is added, so that the amount of calcium chloride is equivalent to the alkali, while the lime is in proportion to the sulphurous acid present. In every case the sulphurous acid is precipitated as calcium monosulphite, which is separated from the lyes by filter-presses. The organic matter still adhering to this precipitate is removed by elutriation with water, to which neutral salts (sodium or calcium chloride) can be added to increase the specific gravity. The calcium monosulphite, owing to its greater specific weight, thereby separates from the lighter organic substances. Or the purification may be effected by washing the precipitate with a highly-diluted solution of sulphurous acid or with a solution of calcium bisulphite, in either of which solutions the organic substances are soluble.

The purified calcium monosulphite is worked up for producing fresh solutions of bisulphites by either of the following processes:—(1) It is stirred up in an aqueous solution of sulphurous acid or (2) the monosulphite is treated with sufficient dilute sulphuric acid to combine with a part of the lime, the lime forming calcium sulphate (annalin, pearl hardening), whilst the sulphurous acid, which has thus become free, changes the undecomposed monosulphite into a solution of bisulphite of the desired composition; or (3) the monosulphite is introduced into a solution of sodium bisulphate, whereby a precipitate of calcium sulphate and a solution of sodium bisulphite is obtained. Owing to the use of caustic lime for the precipitation of the monosulphite from the lyes, these solutions will have an alkaline reaction, which makes them unfit for use as forage and manure. It is, therefore, of advantage to pass carbonic acid and air through the solution to precipitate the caustic lime and oxidise the last traces of sulphite still dissolved. If the use as manure be intended, a quantity of acid phosphate of lime is added sufficient for forming a basic phosphate with the caustic lime present.—S. H.

Improvements in Means or Apparatus for use in effecting the Recovery of Chemicals from Spent Liquors of Pulp Digesters. J. E. Warren and F. A. Cloudman, Maine, U.S.A. Eng. Pat. 11,610, Aug. 26, 1887. 8d.

THIS invention relates to an apparatus for recovering chemicals from the spent liquors of pulp digesters. The apparatus consists of an evaporating chamber, a combustion furnace and a rotary calcining furnace between the evaporator and combustion furnace The evaporator is provided with a series of screw conveyors placed near the hearth of the chamber, by means of which the liquid, which is in a syrupy condition, may be fed towards the inlet of the rotary calcining furnace. The latter is furnished with an agitator for detaching the chemicals from the sides of the furnace. The combustion furnace, near the outlet of the calcining furnace, is provided with a hollow throat, through which the spent liquor circulates before entering the evaporator. By this arrangement the throat is always kept cool and can be made of iron, which is the most desirable material. The throat projects into the outlet of the rotary furnace.

—S. H.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Sparteine. F. Ahrens. Ber. **20**, 2218—2222.

SPARTEINE is reducible with Sn and HCl, yielding a tin double salt, from which the base can be separated. The latter forms a nitroso-compound, which is decomposed with HCl and on distilling with potash in steam an oil passes into the receiver. This gives a platinum double salt of the formula $C_{15}H_{28}N_2(HCl)_2.PtCl_4$. On oxidising sparteine with $KMnO_4$ in an acid solution, formic acid is formed but no acid of the pyridine series. Sparteine dissolves in H_2O_2 and a violent reaction occurs with the formation of a white precipitate. This is filtered, the filtrate neutralised with H_2SO_4 and evaporated. To get rid of H_2SO_4, barium hydrate is added and excess of the latter subsequently precipitated with CO_2. On evaporation, an alkaline syrup remains which gives a double platinum salt of the formula $C_{15}H_{26}N_2O_2 2HCl.PtCl_4$.—J. B. C.

Addition Products of the Cinchona Alkaloids. W. J. Comstock and W. Koenigs. Ber. **20**, 2510—2527.

CINCHONINE $C_{19}H_{22}N.O$ and cinchene $C_{19}H_{22}N_2$ yield with bromine, cinchoninedibromide and cinchenedibromide. These split off HBr on treating with KOH, and give dehydrocinchonine $C_{19}H_{20}N_2O$ and dehydrocinchene $C_{19}H_{18}N_2$. In brominating cinchene two dibromides α and β are formed. Chinene also forms a dibromide $C_{20}H_{22}Br_2N_2O$ and by elimination of HBr yields dehydrochinene $C_{20}H_{20}N_2O$. Quinine, cinchonine, cinchene and dehydrocinchonine absorb the hydracids at −17° and form compounds analogous to the dibromo-compounds enumerated above. Quinine yields hydrochlorquinine; cinchonine, hydrochlorcinchonine, etc. The dibromides are obtained by acting upon the alkaloid with bromine in $CHCl_3$ solution. Cinchenedibromide may be distinguished from the β-compound as it crystallises with one molecule water. Dehydrochinene, obtained by boiling dry chinenedibromide with alcoholic potash, is a colourless crystalline body almost insoluble in water. Hydrochlorquinine $C_{20}H_{25}ClN_2O_2$, obtained by leaving the hydrochloride of the alkaloid in contact with an aqueous solution of HCl, saturated at −17°, for several weeks, is a crystalline substance. By the action of potash quinine is regenerated. The hydrobromide has the formula $C_{20}H_{25}BrN_2O_2.2HBr$ and dissolves completely in dilute KOH solution with a yellow colour. CO_2 precipitates the bromide again from this solution. It appears that by the action of HBr at a higher temperature, not only is an addition product formed, but the methoxy-group is also split off Cinchonine also takes up 1 molecule of HCl and HBr, forming hydrochlorcinchonine and hydrobromcinchonine.

When hydrobromcinchonine is boiled with alcoholic potash for 12 hours a considerable quantity of cinchonine is regenerated. In addition to this a second product remains in the ethereal mother-liquors from the cinchonine and has the formula $C_{19}H_{22}N_2O$. The authors give to this body the name isocinchonine. Hydrobromcinchene is a crystalline compound. Dehydrocinchonine absorbs concentrated HBr in the cold with the formation of hydrobromdehydrocinchonine. Neither the pyridine and quinoline bases nor the tetra- or hexahydrides of these absorb the hydracids at the ordinary temperature. Experiments with Fischer's base obtained by heating methylketol and methyliodide gave the same result, and the same with methyllepidone. The different action of the natural and the artificial bases therefore points to a difference in constitution, and it is little likely that the quinoline nucleus in the former compounds are hydrogenated either in the benzene or pyridine nucleus. As, moreover, cinchonine gives a nearly theoretical yield of cinchonic acid (Py-3-quinoline carboxylic acid), cinchonine probably contains the non-saturated group $C_{10}H_{16}NO$, in addition to the quinoline nucleus with which the hydracids form addition products. This group contains probably a partly hydrogenated benzene nucleus. At present sufficient facts are not forthcoming whereby it is possible to state if this second benzene nucleus in quinine and cinchonine is hydrogenated or is a non-saturated fatty group.

—J. B. C.

Therapeutic Value of Quinine Salts. Boymond. Arch. de Pharm. 1887, 145.

THE author publishes in a tabular form the various recipes for quinine salts in the different Pharmacopœias, their formula, equivalent numbers, solubilities, water percentage and the percentage composition of acid and base. According to these tables the amount of pure alkaloid in the hydrate is 85·72 per cent.; in the acetate 84·37; in the hydrochloride 81·71; in the lactate 78·26; in the basic hydrobromide 76·60; in the valerianate 76·06; in the basic sulphate 74·31; in the neutral sulphovinate, 71·20; in the arseniate 69·38; in the basic salicylate, 68·79; in the citrate, 67·08; in the neutral hydrobromide 60·57; in the neutral sulphate (bisulphate) 59·12; in the hydroferrocyanide 56·52; in the hydriodide 55·95; and in the tannate 22·60 per cent.—G. H. M.

Emetine. H. Kunz. Arch. Pharm. 1887, 461.

EMETINE has hitherto been very little studied on account of the difficulty of obtaining it in a form sufficiently pure for analysis. The author now obtains it by a modification of Podwissotzky's method as a pure white, amorphous, electrical powder, which rapidly becomes yellow or brown on exposure to the light; it has a bitter and harsh taste. The *Emetinum purum* of commerce is a whitish-grey to greyish-brown powder. An examination of emetine, which, like quinine, is obtained from a Rubiaceæ, gave the following results:—

1. Emetine possesses the molecular formula $C_{30}H_{40}N_2O_5$ and gives a platinochloride with the composition $C_{30}H_{40}N_2O_5.H_2PtCl_6$. It is a diatomic base and also a tertiary diamine like quinine, since it yields by the addition of methyl an ammonium base *methyl-emetonium hydrate*, $C_{30}H_{40}CH_3N_2O_5OH$.

2. Emetine is very probably a derivative of quinoline, like quinine.

3. In addition to emetine the *Radix ipecacuanhæ* also contains bilineurin or choline.—G. H. M.

Ineïne from Strophanthus Hispidus. J. L. Soubeiran. Jour. Pharm. Chim. 1887, 593.

When the seeds are macerated with acidified alcohol a crystalline glucoside, *strophanthine*, is obtained, which by treatment with sulphuric acid is decomposed into glucose and *strophanthidine*. The latter is insoluble in water, easily soluble in alcohol and is particularly bitter. The tufts of hair of the seeds give, when treated with acidified alcohol, a crystalline substance of alkaloidal character, to which Hardy and Gallois have given the name *ineïne*. According to the author ineïne does not possess the physiological properties of strophanthine; he does not state, however, what properties it actually possesses. Helbing and Elborne could not find ineïne in the seeds.—G. H. M.

A False Kola-nut. E. Heckel and F. Schlagdenhauffen. Nouv. Remèd. 1887, 123.

According to the investigation of the authors, the fruit of *Heritiera littoralis Wight et Arn* is found mixed with kola-nuts. This substitution possesses a double interest, since both the plants named belong to the same family (*Sterculiaceæ*) as those which give the kola-nuts, and the fruits in question also serve as a food-stuff in India, and they possess exactly the same waste-repairing properties as the kola-nut. *Heritiera littoralis* is a large tree which grows in India, in the Philippines, Molucca, and other islands of the South Coast of Africa. The form of the nut is oval-pointed, it weighs 20—25grms. and is of a white colour, similar to the so-called Kola blanca. The cotyledons have, when chewed, at first an astringent, then a sweet, and, finally, a slightly bitter taste. The chemical examination of the fruit showed a complete absence of caffeïne in the nuts of *Heritiera littoralis*.—G. H. M.

Pterocarpin and Homopterocarpin. Cazeneuve and Hugounenq. Compt. Rend. **104**, 1722.

Cazeneuve showed in 1874 that there occurred in sandal-wood (*Pterocarpus santalinus*), in addition to santalin and santol, a beautiful crystalline substance, which he called pterocarpin. The authors have now extracted a second substance, which appears to be a close homologue of the first, and they now give the name pterocarpin to the new substance and call the earlier substance homopterocarpin. Powdered sandal-wood is intimately heated with an equal weight of slaked lime, moistened with water, dried in the water-bath and extracted with ether. The lime forms, with the colouring matter, a lake insoluble in ether, and, with the resin, a slightly soluble body. The ethereal extract is evaporated, the residue taken up with boiling alcohol of 93°, from which pterocarpin and homopterocarpin separate on cooling. They are again crystallised from alcohol, then from ether, and finally separated by cold carbon bisulphide, in which homopterocarpin is very easily soluble, and pterocarpin almost insoluble. 1kilo. of sandal-wood contains about 5grms. of homopterocarpin and 1grm. of pterocarpin.

Pterocarpin, $C_1H_8O_3$, is insoluble in water and cold alcohol, soluble in boiling alcohol, less soluble in ether and crystallises from chloroform in clino-rhombic prisms, which melt at 152°. The substance is neutral, is insoluble in acids and even in boiling concentrated potash solution, but it is decomposed by fused potash with the evolution of a coumarin-like odour. With conc. HNO_3 it gives a green coloration.

Homopterocarpin, $C_{12}H_{12}O_3$, is soluble in ether, chloroform, benzene and carbon bisulphide, less soluble in cold, more easily soluble in boiling alcohol. It crystallises from ether in beautiful long needles. It softens at 70°, begins to melt at 82°, completely melts at 86°, and, once melted, remains pasty for several days. It withstands boiling concentrated potash solution, but, when fused with potash, it yields carbonic anhydride and phloroglucinol and evolves an odour of coumarin. When heated for 10 hours with concentrated hydrochloric acid it yields a substance which appears to be a resorcinol ether $(C_6H_4.OH)_2O$, and, by further action, a strongly fluorescent substance and methyl chloride. This admits of the conclusion that homopterocarpin contains the resorcinol group and one or more methyl groups. It appears to resemble the internal anhydrides of the aromatic series, and particularly coumarin.—G. H. M.

Percentage of Essential Oil in Certain Drugs and Parts of Plants. Result obtained at the Works of Messrs. Schimmel & Co., Leipzig.

Name of Plant.	Average yield from 100kilos. In kilos.
Seed of Ptychotis Ajowan	3·000
Root of Inula Helenium	0·600
Seed of Archangelica officinalis	1·150
Root of Thuringian } Archang. officinalis	0·750
,, Saxonian	1·000
Seed of Russian } Pimpinella Anisum	2·800
,, Thuringian	2·400
,, Chilian	2·400
,, Spanish	3·000
,, Levantian	1·300
Flowers of Arnica montana	0·040
Root of ,, ,,	1·100
Ferula Assafœtida	3·250
Uva Ursi	0·010
Root of German } Valeriana officinalis	0·950
,, Dutch	1·000
Ocimum Basilicum	0·040
Leaves of Pimenta Acris	2·300— 2·600
,, Artemisia Abrotanum	0·040
Root of ,, ,,	0·100
Leaves of Piper Betle	0·550
Betula alba	20·000
Leaves of Barosma crenulata	2·600
Root of Acorus Calamus	2·800
Ceylon } Elettaria cardamomum	4·000— 6·000
Madras	5·000
Malabar	4·250
Siam	4·300
Bark of Croton Eluteria	1·750
Flowers of Cinnamomum Cassiæ	1·350
Wood of Juniperum Virginiana	3·500
German Matricaria Chamomilla	0·285
Roman Anthemis nobilis	0·700— 1·000
Leaves of Myrtus Chekan	1·000
Copaifera officinalis	45·000
Dipterocarpus turbinatus	65·000
Thuringian } Coriandrum sativum	0·800
Russian	0·900
Dutch	0·600
East Indian	0·150
Italian	0·700
Piper Cubeba	12·000—16·000
Bark of Laurus Culilawan	3·400
,, Maltesian } Cuminum Cyminum	3·900
Seed of Syrian	4·200
,, East Indian	2·250
Root of Curcuma longa	5·200
Seed of German } Anethum graveolens	3·800
,, Russian	4·000
Seed of East Indian Anethum Sowa	2·000
Icica Abilo	17·000
Dried leaves of Eucalyptus Globulus	3·000
Thymus Serpyllum	0·200
Seed of Saxonian } Anethum Foeniculum	5·000— 5·600
,, Galician	6·000
Seed of East Indian Panmorium Foeniculum	2·200
Flowers of Sambucus nigra	0·025
Galbanum officinale	6·500
Root of Alpinia Galanga	0·750
Root of Asarum Europæum	1·100
Root of Heracleum Sphondylium	1·000
Humulus Lupulus	0·700— 2·250
Root of African } Zingiber officinalis	2·600
,, Bengal	2·000
,, Japanese	1·800
,, Cochin China	1·900
Root of Iris Florentina	0·100
Hyssopus officinalis	0·400
Iva moschata	0·400

Name of Plant.	Average yield from 100kilos. In kilos.
Mentha crispa	1·000
Seed of Carum carvi	4·000— 7·000
Lavandula vera	2·900
Root of Levisticum officinale	0·600
Wood of Elaphrium graveolens	5·000
Laurus nobilis	1·001
Leaves of Laurus nobilis	2·400
Oreodaphne Californica	7·600
Flowers of Myristica moschata	11·000—16·000
Origanum Majorana	0·350
" " dried	0·900
Amygdalus amara	0·400— 0·700
Matricaria Parthenium	0·030
Leaves of Piper augustifolium	2·400
Root of Imperatoria Ostruthium	0·800
Melissa officinalis	0·100
Bark of Michelia Nilagirica	0·300
Seed of Daucus Carota	1·650
Seed of Hibiscus Abelmoschus	0·200
Root of Ferula Sumbul	0·300
Myristica moschata	8·000—10·000
Balsamodendron Myrrha	2·500— 6·500
Caryaphyllus aromaticus	17·000—19·000
Geum urbanum	0·040
Olibanus thurifera	6·300
Pastinaca Opoponax	6·600
Populus nigra	0·500
Seed of Pastinaca sativa	2·400
Pogostemon Patchouli	1·500— 4·000
Myroxylon Pereirae	0·400
Oil of Tussilago Petosites	0·056
Apium Petroselinum	0·300
Seed of Apium Petroselinum	3·500
Piper nigrum	2·200
Mentha piperita	0·300
" " dried	1·000— 1·250
Amygdalus Persica	0·800— 1·000
Myrtus Pimenta	3·500
Root of Pimpinella Saxifraga	0·025
Oil of Ledum palustre	0·350
Tanacetum vulgare	0·150
Ruta graveolens	0·180
Wood of Convolvulus Scoparius	0·040
Flowers of Rosa Centifolia	0·050
Juniperus Sabina	3·750
German Salvia officinalis	1·400
Italian	1·700
East Indian Saotalum album	4·500
Macassar	2·500
Wood of Laurus Sassafras	2·600
Achillea Millefolium	0·080
Root of Canadian Asarum canadense	2·800 —3·250
Virginian Aristolochia serpentaria	2·000
Seed of Nigella sativa	0·300
Apium graveolens	0·200
Seed of Apium graveolens	3·000
" Dutch Sioapis nigra	0·850
" German	0·750
" East Indian	0·590
" Sinapis Juncia	0·500
" Priganem creticum	3·500
Root of Valerinia celtica	1·000
" Illicium anisatum	5·000
" Illicium religiosum	1·000
" Liquidambar orientalis	1·000
" Andropogon Nuricatis	0·200 —0·350
" German Juniperuacommunis	0·500 —0·700
" Italian	1·100 —1·200
" Hungarian	1·000 —1·100
Seed of Phellandrium aquaticum	1.300
Artemisia absynthium	0·300 —0·400
Cinnamomum zeylanicum	0·900 —1·250
Canella alba	1·000
Artemisia maritima	2·000
Curuma Zedoariae	1·300

—S. H.

On Peptones and the so called Peptones of Commerce. Gerlach. Chem. Zeit. **11**, 1246.

Peptones are the final active products of digestion. They are soluble in water and dilute acids, and diffuse through membranes. They appear to melt on the water-bath, but this apparent melting is owing to water, which they hold tenaciously enclosed. Peptones injected into the blood of dogs gradually cause narcose, and the blood loses for some time its power of coagulating. The peptones used as food therefore do not pass unaltered into the blood, but are changed in the cells of the intestines. They can be classed in three groups—pepsine-peptones, pancreas-peptones and peptones derived from vegetable ferments (*Carica papaia*, *Agave Americ.*). Whereas those of the first group have a pleasant taste, those of the second class of peptones taste and smell very disagreeably; the last has no practical value yet. As to the peptones of commerce, more especially the well-known preparations of Grübler, Sanders, Ezn, Witte, Kemmerichs and Koch, their name is a misnomer, since they contain scarcely any peptone but easily soluble albumen. Nevertheless, all these preparations are easily digestible and, therefore, a food which can be highly recommended to persons with a sluggish digestion and to convalescents.—S. H.

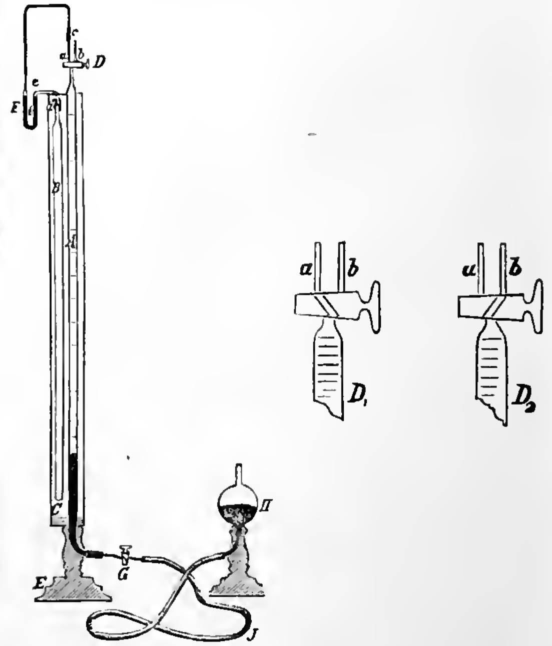
Improvements in Apparatus for Drying or Curing Fruit, Tobacco and other Substances. H. H. Lake, London. From H. C. Andrews, New York, U.S.A. Eng. Pat. 10,915, Aug. 9, 1887. 6d.

This apparatus consists of a closed chamber, in the lower portion of which is situated a hot-air pipe or heating flue. Above and parallel to this is another pipe provided with perforations and communicating with the exterior of the chamber. Cold air enters this latter pipe and escaping by the perforations mingles with the up current of hot air rising from the neighbourhood of the heating flue. The substance to be dried is contained in the upper portion of the chamber.—A. R. D.

XXII.—ANALYTICAL CHEMISTRY.

A Gas Burette Working Independently of Temperature and Pressure. W. Hempel. Ber. **20**, 2340—2343.

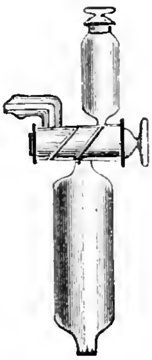
A is an ordinary 100cc. gas burette, fixed to a foot E, and closed above by a Greiner-Friedrich's three-way cock. The burette is connected by caoutchouc tubing with the gauge F and the tube B. The latter is a simple glass tube, which is closed below and communicates with F. The whole is contained in the vessel of water C. The tube C is open above and closed below by an indiarubber stopper with a single bore. The gauge tube F is about 6mm. wide at the bend; from *e* to *c* it is capillary if mercury is used, or 3mm. wide if water is the liquid employed. The burette is in connection with the tap G and the vessel H for adjusting the level. If the gas is measured in the moist state, a drop of water is introduced into B. The volume of the gauge tube between *f* and *c* must be measured once for all previous to use. This is done by drawing a given volume of gas into the burette, then placing the three-way cock in the position D_2, so that it communicates with the gauge. By raising or lowering the vessel H the pressure can be brought to that of the gas in B. When the pressure is equal the level of the mercury in both limbs of F is the same. The cock G is closed and the volume read off.



If G is again opened and H lowered, the liquid in the gauge can be brought to *e*. If the cock D is closed and the volume of gas again read off on the scale subsequently to adjusting the liquid in the vessel H, the difference of the two readings gives the volume between *f* and *e*. The operation of measuring gases is as follows:—The burette is first filled with the liquid, and is then connected by a capillary tube with the vessel, which contains the gas for analysis. The three-way tap must be in position D_2, so that the gas passes into the tube *b*. For measuring, the cock is put in position D. By raising or lowering the vessel H the liquid in both limbs of the V tube is adjusted to one level, the cock G is closed, and the volume read off. After measuring, the gas is withdrawn from the gauge tube.—J. B. C.

Improvement of Bunte's Gas Burette. Chem. Zeit. 11, 1225.

THIS very useful form of gas burette is greatly improved by the application to it of the new cock introduced by Greiner and Friedrichs (*Chem. Zeit.* 11, 53). The working of the apparatus is sufficiently illustrated by the figures.—A. G. G.



Congo-red as an Indicator. G. Vulpius. Ztschr. österr. Apoth.-Ver. 1887, 286.

TEST PAPERS prepared with Congo-red are sensitive not only to ordinary inorganic bases, but also to aniline and similar bodies and also to quinine, brucine, morphine, etc.; and are useful in cases where both litmus and phenolphthalein are unsuitable. The author, however, considers that its delicacy towards acid is not so great as that of carefully prepared litmus paper, since the latter will show slight traces of acid much quicker than the Congo-red paper. It is, therefore, not to be recommended for all pharmaceutical purposes.—G. H. M.

Detection of Indigo in Dyed Fabrics. W. Lenz. Zeits. Anal. Chem. 1887, 535—555.

THE following different qualities of indigo of undoubted genuineness were used in these experiments:—

1. Fine Bengal indigo.
2. Bengal indigo.
3. Oude indigo.
4. Kurpah indigo (violet).
5. Kurpah indigo (red violet).
6. Kurpah indigo.
7. Madras indigo (medium).
8. Madras indigo (ordinary).
9. Guatemala indigo (fine).
10. Bengal indigo (in powder).
11. Java indigo (fine).
12. Java indigo (common).

In the dyeing, a bath containing zinc dust and dilute soda solution was employed, as the property of the dye prepared by this method shows no abnormal action with reagents. In addition to these, fabrics dyed with commercial indigo carmine, Prussian blue, logwood extracts, and mixtures of these were also examined. The results are found in the following table This table shows an abnormality with indigo No. 11. It colours acidified alcohol similarly to cloth raised in logwood. As this property was only indicated when the cloth was dyed under certain conditions, the author considers that it is due to the presence of a colouring matter formed from the indigo. The other properties of the alcoholic extract do not, however, allow of any confusion. The test with concentrated sulphuric acid cannot be regarded as absolutely safe. If it is desired to test the dyed cloth instead of the extract, a sample is gently heated with an acid solution of stannous chloride. Prussian blue remains unchanged; indigo blue, indigo carmine and cotton blue are acted upon, and the cloth becomes bleached, whilst the solution is coloured yellow. Logwood is also discharged, and the solution acquires a pink colour. If hydrogen peroxide is added in excess to the stannous chloride extract, cotton blue gives a blue coloration and the pink colour with logwood is destroyed.

The indigo colour is not regenerated under these conditions. A more rational method, however, is to dissolve the colouring matter from the fibre, and for this purpose alcohol, which dissolves the aniline colours especially, and acidified alcohol, which indicates the presence of logwood colours, is used. The test with acidified alcohol is of considerable value. It must be borne in mind, however, that not all the aniline colours can be dissolved from the fibre with alcohol and, on the other hand, that indigo and indigo carmine are somewhat soluble. The action of acidified alcohol is still more complicated. The red reaction with logwood is produced in sufficiently concentrated solution, but changes on boiling to reddish yellow, a property which may be overlooked in testing indigo and indigo carmine with a hot solution of alcohol.

In such cases boiling glacial acetic acid, or concentrated formic acid, may be employed. Logwood colours the acid in the cold, pink, which, on heating, changes to yellowish red, but this colour is very rapidly masked by the indigo which subsequently dissolves.

These two solvents dissolve all the blue organic colours, with the exception of indigo carmine and Prussian blue, the first extract containing the largest quantity of logwood blue when present. If the acetic acid solution is mixed with ether and water added till the ether separates, the indigo remains in the ethereal solution, either dissolved or suspended. If, in addition to indigo, only logwood was present, the aqueous solution is coloured reddish yellow, and on the addition of concentrated HCl the aqueous solution becomes red. In presence of indigo carmine and cotton blue, logwood cannot be detected. In this case the ethereal solution is separated, and the aqueous solution shaken with chloroform or amyl alcohol, which dissolves out cotton blue. After separating the amyl alcohol the aqueous solution is shaken with an equal volume of dilute sulphuric acid, and if indigo carmine is present it now dissolves in amyl alcohol. If after treatment with glacial acetic acid insoluble blue colouring matter remains on the cloth, it may consist of indigo carmine or Prussian blue, which may be treated for and separated by one of the well-known reagents. Another method for separating the different blues is to treat the 4 sq. cm. of the cloth with 4cc. boiling hot borax solution. In this way logwood, indigo carmine and Prussian blue are dissolved, while cotton blue and indigo remain undissolved. To detect logwood in presence of indigo the cloth may be boiled with hydrochloric acid, in which case a red solution is obtained, or white alum with the formation of a blue solution, whereas indigo is undissolved. The examination of the absorption spectrum is also a useful guide for distinguishing these two colours. If the cloth is dyed with pure indigo it should give the following reactions:—Boiling water should not dissolve any colouring matter, nor spirits of wine (50—95 per cent.). Cold saturated solutions of oxalic acid, borax, alum, etc., should take up no colouring matter, nor should the borax solution on acidifying with HCl give a red colour, turning blue with Fe_2Cl_6. Stannous chloride and Fe_2Cl_6 should destroy the blue colouring matter on heating, and glacial acetic acid should dissolve the colour completely. No H_2S should be evolved on heating the cloth with concentrated HCl, nor should the carbamine reaction be given on heating the fabric with KOH and $CHCl_3$.

No.	Method of Testing.	Linen Strips dyed in the vat with various kinds of Indigo (already enumerated) and subsequently washed.		Cotton Yarn dyed with Indigo vat only, (*a*) Dark shade, (*b*) Light shade, both in an unfinished and finished sample.	Linen dyed with commercial Indigo Carmine (extract), with addition of Alum.	Linen dyed without Mordant in solution of Logwood, extracted by boiling.	Linen dyed with Logwood solution, and mordanted with Alum.	Linen dyed with Logwood solution, and mordanted with Copper Sulphate.
		Nos. I.—X., and XII.	No. XI.					
a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*
1	The colour of the sample showed by daylight	Deep blue.	Deep blue.	(*a*) Deep blue. (*b*) Light blue.	Deep blue.	Yellow (reddish on washing with water).	Bluish red.	Blue.
2	About 1 sq. cm. of the dyed fabric, representing about 1 metre of the yarn threads, were treated for half-an-hour at the ordinary temperature with about 4cc. of 80 % spirits of wine, to which 1 % of HCl had been added. The solution appeared	Colourless.	Purple red to cherry red. Dilute ammonia gave a yellowish cloudiness. Ether removed the yellow colour from both the acid and alkaline solution. On adding HCl the layer of ether became red, but yellow again on shaking if too much HCl had not been added; the ether gave, however, no colour to the strongly acid solution.	Colourless.	Faint blue.	Red, solution changing to yellow on warming; red again on further addition of HCl, and purple red with ammonia; the latter colour was not permanent. Separation of a lake did not take place, even when ether was added.	Red, on warming the solution yellow, with more HCl red again. Ammonia precipitated a violet blue lake. A previous addition of tartaric acid hindered the separation of the lake; the solution appeared violet, but the colour soon changed. Ether also, without addition of ammonia, separated a lake of a red violet colour, which was changed to violet blue by ammonia.	As under 2*g*. Here also no lake was separated on addition of ammonia in excess, nor on the further addition of ether.
3	The samples of cloth (as in 2) were boiled with alcohol (80 %) to which 1 % of HCl had been added. The resulting extract separated from the cloth appeared	Light blue. Ammonia did not change the colour. Ether was coloured blue on being shaken up with the diluted solution; the solution itself became colourless.	Rather more of a blue-red than the foregoing sample, otherwise similar to 2*d*.	Light blue. Ammonia did not change the colour; ether was coloured blue on being shaken up with the diluted acid solution; the solution itself was thereby decolorised.	Light blue.	Yellow, but red with a further addition of HCl, otherwise as under 2*g*.	Yellow, but red with a further addition of HCl: otherwise as under 2*h*.	As under 3*g*.
4	The samples were with alcohol 80 % (as under 3) but with the addition of 4 % HCl. The solution appeared	As under 3*c*.	Decolorised, almost yellow brown, likewise the ether added to diluted solution; the latter did not appear red on addition of HCl. The solubility of the brown colouring matter in ether, the absorption spectrum of the solution, and the precipitation by water from an acid alcoholic solution, indicated a resinous product. This was found to be most readily obtained by reduction of indigo for 12 hours with zinc and caustic soda (isolated by means of mercury), and subsequent precipitation from the acidified and diluted alcohol by shaking up with ether.	As under 3*e*.	As under 3*f*.	As under 3*g*.	As under 3*h*. Ether, however, did not separate any lake from the acid solution.	As under 3*g*.

Linen dyed in the vat with Indigo and (*a*) topped with Logwood (*b*) same as (*a*), but mordanted with Alum (*c*) bottomed with Logwood.	Cotton Yarn vat-dyed blue and topped with Logwood, along with strip dyed with the vat employed both in an unfinished and finished sample.	Threads from the fabric of blue and white strips, which was to be tested for purity of Dyeing.		Cotton Yarn dyed with a cotton blue. (*a*) Light shade. (*b*) Dark shade. Each of the same in both raw and finished sample.	Linen treated alternately with solution of ferric acetate, and acid solution of potassium ferrocyanide—thus dyed with Berlin blue produced on the fibre.	REMARKS.
		Light blue threads.	Dark blue threads.			
k	*l*	*m*	*n*	o	*p*	*q*
(*a*) Dark blue. (*b*) Blue. (*c*) Dark blue.	Dark blue.	Light blue.	Dark blue.	(*a*) Light blue. (*b*) Dark blue (with a reddish copper glitter).	Deep blue.	
Purple red. Ammonia separated in (*b*) a violet dye-lake — hastened by diluting the solution with water and shaking with ether. In (*a*) and (*c*) ammonia produced no separation of lake, but only an alteration of the colour to bluish red.	Purple red, on warming yellowish red, and on addition of more HCl red again. Ammonia changes the colour to violet blue ; subsequent addition of ether facilitated the separation of a blue violet dye-lake, so that the lower solution appeared colourless.	Colourless.	Purple red, changing to yellow on warming, and red again on addition of HCl. Ammonia separated a violet lake, and more quickly when the diluted solution was treated with ether. Ether also separated a reddish violet lake from the acid solution ; an addition of ammonia changed the colour of the separated lake to a dirty violet.	Colourless.	Colourless.	On treatment with spirits of wine of 90 % strength, all the objects under examination imparted slight but not characteristic colourings, with the exception of the linen dyed with No. XI. indigo, described in column (*d*). This gave a red colour to the spirits of wine.
Blue red ; when shaken up with ether, the latter receives a distinct blue colour. Otherwise as under 2*k*.	More blue red than under 2*l*, owing to the indigo which is taken up by ether with a blue colour after previous addition of water. The solution mixed with the ether was coloured more distinctly red on further addition of HCl.	Light blue. On shaking, ether abstracted from the solution (previously diluted with water), its blue colour.	Blue red. The ether used for shaking with appears of a decided blue colour; the solution mixed with the ether acts towards HCl and ammonia in a similar manner to that described under 2*n*.	The solution appeared blue, but the yarn ceased parting with its colouring matter after a time, as shown when the solution was renewed.	Yellowish in consequence of a slight excess of iron oxide, which went into solution as chloride.	
As under 3*k*.	As under 3*l*.	As under 3*m*.	Without addition of ammonia, ether did not effect any separation of lake in the solution ; otherwise, the solution behaved as described under 3*n* and 2*n* respectively.	As under 3o.	As under 3*p*.	

No	Method of Testing.	Linen Strips dyed in the vat with various kinds of Indigo (already enumerated) and subsequently washed.		Cotton Yarn dyed with Indigo vat only. (*a*) Dark shade, (*b*) Light shade, both in an unfinished and finished sample.	Linen dyed with commercial Indigo Carmine (extract), with addition of Alum.	Linen dyed without mordant, in solution of Logwood, extracted by boiling.	Linen dyed with Logwood solution, and mordanted with Alum.	Linen dyed with Logwood solution, and mordanted with Copper Sulphate.
		Nos. I.–X. and XII.	No. XI.					
a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*
5	The samples (as under 2) were boiled with about 4cc. of 20 % acetic acid.	The solution appeared blue, and gave up its colour to ether on being shaken with the same.	The solution became blue; ether absorbed the blue colour. the solution then appeared brownish. but more yellow on addition of HCl.	As under 5*c*.	The solution became blue (remained almost colourless when wool, dyed in a weak solution of H_2SO_4, was used instead of linen); ether, chloroform, and amylic alcohol did not take up any colour from either acid or alkaline solution. If, however, an equal volume of dilute H_2SO_4 was added, the colour was taken up by shaking with amylic alcohol (not with chloroform or ether).	The solution was coloured a yellowish red, and red on addition of HCl.	As under 5*g*.	As under 5*g*.
6	The samples (as under 3) were boiled with glacial acetic acid, and if a complete separation of the colouring matter from the fibre was desired, fresh quantities of glacial acetic acid were added, and the solution kept at the boil.	The samples were completely decolorised, and the acid coloured blue. Ether absorbed this blue colouring matter completely on dilution with water; chloroform, and amyl alcohol behaved in a similar manner to ether. The solution evaporated down with one of these solvents was neither coloured by HCl nor by ammonia, nor by alum solution after neutralising with ammonia. It gave, in fact, none of the reactions which are employed to indicate the presence of Campeachy, nor any reaction which could in any way interfere with the search for this colouring matter. The fibres, when completely decolorised by glacial acetic acid, did not give any red colour with HCl.	The samples were completely decolorised; the solution behaved as under 5*d*. After removing the blue colour by means of ether, the latter was coloured by HCl in a manner not characteristic, as described under 5*d*. The characteristic reactions for Campeachy would not be materially affected by the behaviour of this solution. When completely decolorised by glacial acetic acid the fibres did not give any red colour with HCl.	As under 6*c*.	The solution was slowly coloured blue on using linen which had been dyed the day previous, but which was quite dry. On using wool dyed at the same time in a weak solution of H_2SO_4, instead of linen, the acid remained colourless. Glacial acetic thus abstracted less colour than dilute acetic acid. On shaking up the diluted solution with ether, chloroform, and amyl alcohol, it behaved as described under 5*f*.	As under 5*g*.	As under 5*g*.	As under 5*g*.

Linen dyed in the vat with Indigo and (*a*) topped with Logwood (*b*) same as (*a*), but mordanted with Alum (*c*) bottomed with Logwood.	Cotton Yarn vat-dyed blue and topped with Logwood, along with a strip dyed with the vat employed, both in an unfinished and finished sample.	Threads from the fabric of blue and white stripes which was to be tested for purity of Dyeing.		Cotton Yarn dyed with a cotton blue, (*a*) Light shade, (*b*) Dark shade each of the same in both raw and finished sample.	Linen treated alternately with solution of ferric acetate, and acid solution of potassium ferrocyanide—thus dyed with Berlin blue produced on the fibre.	REMARKS.
		Light blue threads.	Dark blue threads.			
k	*l*	*m*	*n*	o	*p*	*q*
The solution appeared discoloured; ether abstracted from it blue colouring matter. The solution appeared then but slightly characteristic, but became red on application of HCl.	As under 5*k*.	The solution became blue, ether took up the colouring matter, thus decolorising the solution. The latter was not coloured even on addition of HCl.	The solution was coloured a dirty blue, and ether extracted from the same its blue colouring matter, and on shaking with ether and adding HCl, the solution was coloured red.	The solution was coloured blue with both samples, but ether did not abstract any colouring matter from the acid solution. On addition of caustic soda the solution was clouded brownish red, and ether took up the colouring matter with a yellow coloration. From an acetic acid solution the blue colouring matter could be abstracted by shaking with ether, chloroform, or amyl-alcohol.	The colour of the dyed sample remained unchanged, and the acid colourless.	
The solution became blue, and the sample decolorised after lengthy boiling; otherwise as under 5*k*.	As under 6*k*.	As under 5*m*.	By prolonged boiling the sample was completely decolorised; the solution behaved as described under 5*n*. A brownish-red colour of the sample was the longest to remain, but on removing the acetic acid by washing with water and heat-with dilute HCl, it disappeared at once, colouring the HCl red.	The sample of yarn was completely decolorised. On diluting with water ether only abstracted traces of a red colouring matter (presumably present as impurity) from the blue solution, whilst the whole of the blue colouring matter remained dissolved in the diluted acetic acid; it was, however, completely abstracted by chloroform, and with more certainty by amylic alcohol with a blue colour. The acid solution of the blue colouring matter separated, on addition of caustic soda in excess, a brownish-red colouring matter with a bluish glitter, which dissolves in ether with a yellowish brown, more easily in amylic-alcohol with a somewhat redder, and more easily still in chloroform with a red colour. If the ether, amyl-alcohol and chloroform were separated from the alkaline solution, acetic acid added to each, and the mixtures shaken with water, ether gave up the colouring matter again changed to blue, whilst chloroform and amyl-alcohol retained it in solution with a blue colour.	The sample and the solution were unaltered. On addition of 3 HCl to the acetic acid the material was decolorised on boiling, and the solution yellowish. On dilution with water, the solution was coloured blue.	

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		Nos. I—X., and XII.	No. XI.					
a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*
7	A sample of the object under examination (as under 2) was covered with concentrated formic acid of sp.g. 1·2, heated and extracted as in 6.	The acid was not coloured in the cold; on heating to the boil indigo was dissolved, and on repeated digestion completely extracted from the fibre.	As under 7*c*.	As under 7*c*.	The solution was coloured blue on being gently warmed; otherwise as under 7*c*.	The solution was coloured a beautiful red in the cold, and became yellowish-red on heating.	As under 7*g*.	As under 7*g*.
8	A small sample was boiled with 1·2cc. of cold saturated solution of oxalic acid.	The solution remained colourless, and was not changed by HCl.	As under 8*c*.	As under 8*c*.	The solution was coloured blue. The colouring matter was taken up by wool except for traces; more easily by linen.	The solution became reddish when cold, yellowish on heating, red on addition of HCl, red on addition of 0·05 — 0·1gr. crystallised ammonium molybdate, and violet if a quantity was added.	As under 8*g*.	As under 8*g*.
9	The samples (as under 2) were boiled with about 4cc. phosphoric acid.	The solution appeared colourless.	As under 9*c*.	As under 9*c*.	As under 5*f*.	At the commencement of warming the solution was coloured red, then yellowish-red. HCl effected a red coloration in the same manner as in the acetic acid solution.	As under 9*g*.	As under 9*g*.
10	A small sample was covered in a small porcelain dish with concentrated H_2SO_4.	The acid was coloured bluish-green, and became blue on dilution with water.	As under 10*c*.	As under 10*c*.	As under 10*c*.	The acid was coloured reddish-yellow.	As under 10*g*.	As under 10*g*.
11	A sample (as under 2) was boiled with about 4cc. of a 10% solution of pure potash alum in water.	The solution remained uncoloured.	As under 11*c*.	As under 11*c*.	The wool was coloured slightly blue. If wool was used instead of linen the solution was coloured even when the samples, after once boiling with alum solution, did not impart any further colour to boiling water.	The solution appeared of a purple-violet colour, and gave a purple-blue precipitate on addition of ammonia. Caustic soda produced a blue deposition which was soluble in excess (contrary to the statement in Dammer's "Lexicon der Verfaelschungen," p. 730).	As under 11*g*.	As under 11*g*.

Linen dyed in the vat with Indigo and (*a*) topped with Logwood, (*b*) same as (*a*) but mordanted with alum, (*c*) bottomed with Logwood.	Cotton Yarn vat-dyed blue, and topped with Logwood, along with a strip dyed with the vat employed, both in an unfinished and finished sample.	Threads from the fabric of blue and white strips, which was to be tested for purity of dyeing.		Cotton Yarn dyed with a cotton blue, (*a*) Light shade, (*b*) Dark shade, each of the same in both raw and finished sample.	Linen treated alternately with solution of ferric acetate and acid solution of potassium ferrocyanide — thus dyed with Berlin blue produced on the fibre.	Remarks
		Light blue threads.	Dark blue threads.			
k	*l*	*m*	*n*	*o*	*p*	*q*
The solution was coloured a beautiful red in the cold; on heating this became rather lighter, but was immediately concealed by the indigo blue going into solution. If the cold red solution was poured off and heated by itself, it assumed a yellowish red colour.	As under 7*k*.	As under 7*c*.	As under 7*k*.	The solution turned blue in the cold, and extracted the colouring matter easily and completely on warming. Ether extracted traces of a red colouring matter from the acid solution diluted with water; amyl alcohol extracted the blue colouring matter from the same.	The solution dissolved the colouring matter even on warming, and was not coloured blue on addition of chloroform. Even on addition of a little HCl, only a small quantity of Berlin blue was dissolved.	
As under 8*g*.	As under 8*g*.	The solution remained colourless and unchanged on addition of HCl.	As under 8*g*.	The colouring matter was easily and completely extracted from the fibre; the blue coloured solution did not impart the same to ether, though it did so to amyl alcohol.	The solution became distinctly blue, and the fabric of a brighter colour. On rubbing with water, it gave up some of its colouring matter mechanically.	
As under 9*g*.	As under 9*g*.	The solution remained colourless	The solution became coloured in quick succession red, and then yellowish red; likewise on using threads which had been previously extracted for 70 hours with boiling chloroform, HCl coloured the solution very distinctly red. On using phosphoric acid of 1 % strength, and then adding phosphoric acid of 20 % strength, the colours became very weak.	The solution remained colourless.	The sample and the solution remained unchanged.	
The acid was coloured green and became blue on dilution with water.	As under 10*k*.	As under 10*c*.	The acid was coloured green and blue on dilution with water.	The acid was coloured green, and on dilution with water blue.	The acid was coloured brownish green, and became blue on dilution with water.	The change of colour in the fabric could not be properly estimated, since the same was considerably influenced by mordants, especially iron.
As under 11*g*.	As under 11*g*.	The solution remained colourless	The solution was coloured purple red and gave a violet blue precipitate with ammonia; caustic soda also produced a blue precipitate. Much HCl coloured the solution red. If the solution of alum was treated with tartaric acid previous to addition of ammonia, no precipitate was caused by ammonia, but a very slightly constant, bluish red coloration.	The solution remained colourless.	The solution remained colourless.	

No.	Method of Testing.	Linen Strips dyed in the vat with various kinds of Indigo (already enumerated) and subsequently washed.		Cotton yarn dyed with Indigo vat only. (a) Dark shade; (b) Light shade; both in an unfinished and finished sample.	Linen dyed with commercial Indigo Carmine (extract) with addition of Alum.	Linen dyed without mordant in solution of Logwood extracted by boiling.	Linen dyed with Logwood solution and mordanted with alum.	Linen dyed with Logwood solution and mordanted with Copper Sulphate
		Nos. I.–X., and XII.	No. XI.					
a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*
12	A sample (as under 2) was boiled with a solution of 1 part crystallised ammonium molybdate in 2 parts water.	The solution remained colourless.	As under 12*c*.	As under 12*c*.	The solution was coloured blue. The colouring matter was abstracted by wool except for traces—not so easily by linen.	The solution was coloured deep blue-violet.	As under 12*g*.	As under 12*g*.
13	A sample of the stuff (as under 2) was boiled with about 4cc. of a solution of borax. The borax solution employed was prepared by allowing a concentrated boiling solution of borax to cool and stand for several days at the temperature of the room, and then pouring off from the salt which had separated out.	The solution was colourless after filtration.	As under 13*c*.	As under 13*c*.	The sample was decolorised and the solution coloured blue. Ether chloroform and amylic alcohol did not take up the colouring matter even when acidified with acetic acid. Amylic alcohol, however, took up the indigosulphoacid with a bluish-green colour on addition of a quantity of dilute sulphuric acid.	The solution appeared yellowish, and was coloured red by HCl. The addition of 10% alum solution in excess first produced a colourless gelatinous precipitate, and a few minutes later a purple-violet coloration. This was changed to blue on the addition of ammonia.	As under 13*g*.	The reactions described under 13*g* were noticed here also, but with somewhat less distinctness.
14	A sample was gently warmed with an acid solution (1 in 10) of tin chloride.	The sample of stuff was decolorised and the solution became yellowish. On addition of hydroxyl in excess no change was perceptible in the colour of the liquid.	As under 14*c*.	As under 14*c*.	As under 14c.	The solution was coloured a beautiful rose-red, the fabric being decolorised. The rose-red colour was completely destroyed on warming with hydroxyl in excess.	As under 14*g*.	As under 14*g*.
15	Single untwisted and dissevered threads of the cloth or yarn in consideration were boiled with several cc. of a mixture of 10cc. iron chloride solution, 90cc. water, and 10 drops HCl.	The threads were decolorised.	As under 15*c*.	As under 15*c*.	As under 15*c*.	The threads were coloured gray, the solution blackish-green.	As under 15*g*.	

Various Reactions of Vanadates, and their employment in Analytical Chemistry. A. Carnot. Compt. rend. **104**, 1803.

The determination of vanadic acid in its alkaline and ammonium salts is very easily performed in the form of barium vanadate (see this Journal, 1887, 679). If the solution be acid, it is neutralised with ammonia, the solution at first remains yellow but on boiling it quickly becomes colourless. Barium chloride is then added, the liquid stirred, allowed to settle and tested with a little more reagent; there should be only a very slight smell of ammonia. The flask is then corked and quickly cooled. All the vanadic acid separates, as barium vanadate, $Ba_2V_2O_7$. If the liquid is boiled for some minutes after precipitation, the precipitate becomes denser and can be easily separated by decantation. Strontium salts give no precipitate in slightly ammoniacal solutions of vanadates, which have been saturated with ammonium chloride (provided that the solutions contain no carbonate and are not exposed to the air), although phosphates and arseniates are precipitated by strontium salts under these conditions. On this is based the separation of vanadic acid from phosphoric and arsenic

Linen dyed in the vat with Indigo and (*a*) topped with Logwood, (*b*) same as (*a*) but mordanted with alum, (*c*) bottomed with Logwood.	Cotton Yarn vat-dyed blue, and topped with Logwood, along with a strip dyed with the vat employed, both in an unfinished and finished sample.	Threads from the fabric of blue and white strips, which was to be tested for purity of dyeing.		Cotton Yarn dyed with a cotton blue (*a*) Light shade, (*b*) Dark shade, each of the same in both raw and finished sample.	Linen treated alternately with solution of ferric acetate and acid solution of potassium ferrocyanide — thus dyed with Berlin blue produced on the fibre.	REMARKS.
		Light blue threads.	Dark blue threads.			
k	*l*	*m*	*n*	o	*p*	*q*
As under 12*g*.	As under 12*g*.	The solution remained colourless	As under 12*g*.	The solution remained colourless, or assumed a rather brownish tint.	The solution remained colourless, and was not coloured blue on addition of ferric chloride.	
As under 13*g*.	As under 13*g*.	The solution appeared colourless after filtration.	The solution was coloured rather yellow, and became red on addition of HCl. Alum solution (of 10 % strength) in excess produced in addition to gelatinous precipitate, a purple violet coloration, which was changed to a blue precipitate on addition of ammonia.	The solution showed a slight reddish cloudiness, and appeared colourless after filtration.	The sample was decolorised to a rusty red condition. The solution was coloured slightly blue if a few drops of HCl were added (if filtered before the addition of HCl it remained colourless), and became deep blue on addition of ferric chloride.	
As under 14*g*.	As under 14*g*.	As under 14c.	The solution was coloured rosy red with decolorisation of the fibres. Hydroxyl destroyed the colour, with formation of an inconsiderable brownish cloudiness.	The solution was coloured yellow, whilst the yarn became colourless. Hydroxyl in excess coloured the solution blue.	The blue colour of the sample remained unchanged.	
No characteristic difference from 15c.	As under 15*k*.	As under 15c.	As under 15*k*.	On using about 3m. threads and 5cc. solution, the latter was coloured a bluish red; on dilution with three times the volume of water more blue; on addition of spirits of wine light green. The threads however were not decolorised on lengthy boiling. Ether did not extract any blue colouring matter from the coloured solution; chloroform extracted a little, and amyl-alcohol a quantity. Chloroform absorbed the colouring matter from the extract treated with alcohol.	Threads and solution remained unchanged.	

—J. B. C.

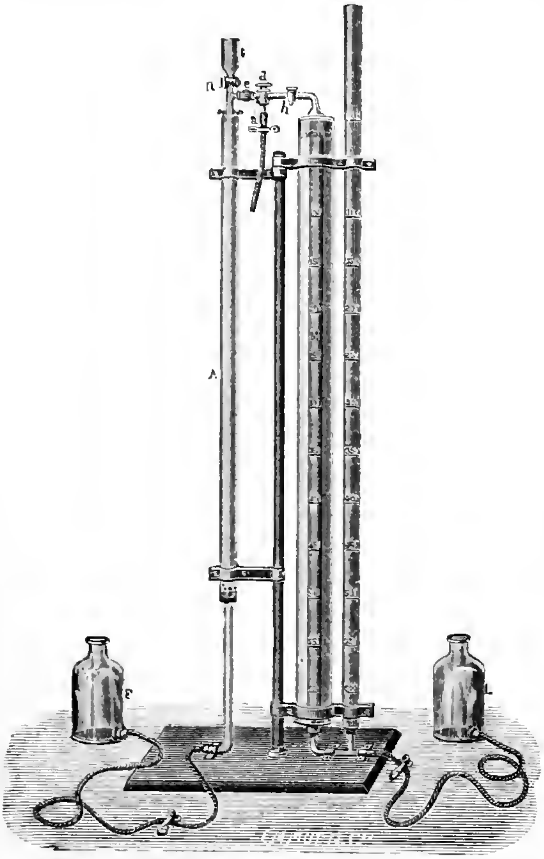
acids. The same reaction also serves for the very close separation of vanadic acid from molybdic and tungstic acids, since both these acids are almost completely precipitated by strontium salts in weak ammoniacal solutions, in presence of ammonium chloride. This reaction also admits of application for the separation and estimation of barium and strontium. Ammonium chloride is added to the solution and then ammonia free from carbonate, a dilute solution of ammonium vanadate is now added and the solution boiled for some minutes, when the barium is completely precipitated, whilst the strontium remains in solution. The liquid is cooled out of contact with air, decanted, the precipitate washed with cold water and the strontium precipitated in the filtrate by means of ammonia and ammonium carbonate, and weighed as strontium carbonate. The barium vanadate is dissolved in dilute hydrochloric acid, precipitated and weighed as sulphate. The method gives good results.—G. H. M.

An Error in Gas Analysis. W. Hempel. Ber. **20**, 2344.

CUPROUS CHLORIDE absorbs ethylene gas; it is therefore necessary to absorb the hydrocarbons in generator gases previously to determining carbon monoxide. If this is not done the carbon monoxide liberates the previously absorbed ethylene, and the volume of gas when passed back to the burette is often found to increase instead of diminish.—J. B. C.

Apparatus for Testing Producer-Gas and Water-Gas. F. Fischer. Ber. **20**, 2551—2553.

FOR the accurate testing of producer or water-gas, the author strongly recommends the apparatus shown in the diagram. The tube M is filled with mercury by raising the mercury bottle L and opening the taps *h* and *d*. *h* is then shut off, and *d* so regulated that it connects A and the indiarubber tube *a*. The mercury is then made to rise through A to the tube *e* by raising F; the funnel *t* is filled with water, which is allowed to flow out through tap *n* and tube *a*, so that the latter remains full of water when shut by the clip. The sample of the gas to be tested is collected in a glass sphere with capillary ends. The indiarubber tube *a* is drawn over one end, while the other is placed in water. Both points are then broken off and the gas is aspirated into A. The taps *d* and *h* are turned 90°: the required quantity of gas is forced into M; *h* is then shut off and the rest of the gas and water in A is driven out through *h*. About 1cc. of potassium hydrate solution is introduced into A, the measured gas then forced from M into A and after being here deprived of its carbonic acid, is again measured in M. In the same manner, any oxygen present is absorbed by pyrogallic acid. In order to determine the combustible gases, the tube A is cleaned with water and pure oxygen introduced into A through *a*. The necessary quantity of oxygen is then driven over from A into M, while the rest of the oxygen in A is removed through *d* and *a*. After measuring, the mixture of gases in M is returned to A, to be there submitted to the electric spark. The contraction is read off, the carbonic acid formed determined by absorption and from these data the composition of the gas may be calculated. Producer-gas, from coal and wood, and water-gas tested by this apparatus, had the following composition:—



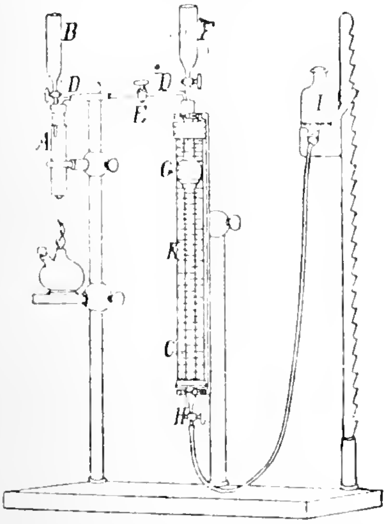
	Gas from Coal.	Gas from Wood.	Water-Gas.
CO_2	5·06	6·95	2·74
CO	21·58	28·60	43·75
CH_4	2·94	2·20	0·34
H	5·66	8·54	49·17
N	64·79	53·74	4·06
	100·00	100·00	100·00

—S. H.

A Volumetric Method for the Determination of Carbon in Iron. Dingl. Polyt. J. **265**, 502—507.

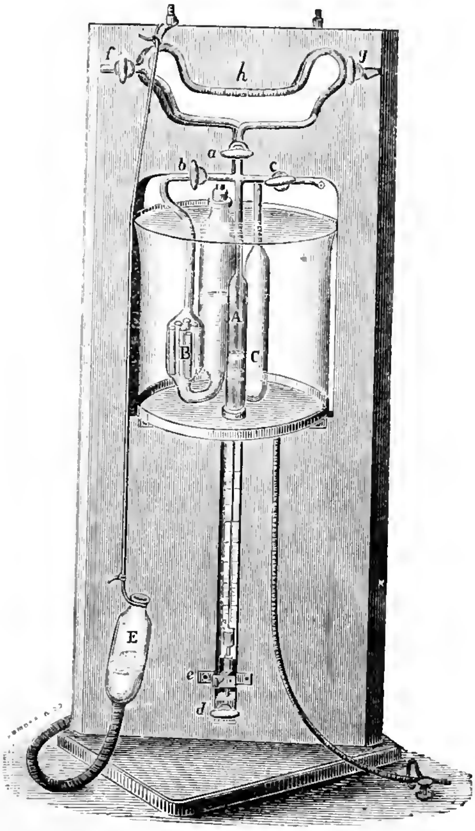
THIS method, which is due to J. Wiborgh, of Stockholm, differs from existing processes, in which the sample is treated first with copper sulphate and afterwards with a mixture of chromic and sulphuric acids, chiefly in measuring the volume rather than the weight of carbon dioxide produced. A considerable economy in time, labour and apparatus is thus effected, and a more delicate measurement obtained—*e.g.*, $\frac{1}{20}$cc. of CO_2 from 0·2grm. of iron represents 0·014 per cent. of carbon, but weighs only 0·0001grm. It is essential that the carbon shall be completely burnt to dioxide and in view of this the following three points must be borne in mind:—(1) Solutions of copper sulphate, even though neutral, cause an evolution of hydrocarbon from the metal and consequently a loss of carbon; but this occurs in appreciable quantity only when steel, cooled from a red heat without working, or grey cast iron are treated. In such cases the solution in the sulphate should not be urged to completion. (2) Hydrocarbons will be evolved even in the chromic acid solution, unless the iron has been sufficiently coated with a protecting film of copper in the first stage of the process. This is due to the fact that the sulphuric acid attacks the iron vigorously, even in the cold, but the hydrocarbons produced cannot be oxidised by the chromic acid except the liquid is nearly at a boiling temperature; thus they must escape until the solution has attained the necessary temperature for their oxidation. But since the deposited copper also resists solution until the same point is reached, it will protect any kernel of undissolved iron until such time as complete oxidation of the carbon is ensured. (3) The iron must ultimately be completely dissolved; the metal should therefore be sufficiently finely divided to pass a sieve with 1·5mm. perforations.

The apparatus required is shown in the accompanying block. A test tube A, 140mm. long by 20mm. internal diameter, is surrounded by a cage of brass wire gauze, and fitted with a good caoutchouc cork with two perforations. Through one perforation passes the narrow end of the stop-cock funnel B, which should project for about 15—20mm. beneath the cork; through the other, but not projecting beneath the stopper, passes the connecting tube D. The latter tube (D) consists of two portions, united by india-rubber tubing; the part more remote from A and carrying the stop-cock E, is bent to pass through one of the perforations of another caoutchouc stopper in the graduated tube C, the other perforation serving to connect the latter with a stop-cock funnel F. The tube C should for the distance of 70mm. downwards have an internal diameter of 16mm.; it should then be widened to a bulb G of about 25cc. capacity, and be finally reduced for the remaining 200 mm. to about 9mm., this narrow portion being graduated into $\frac{1}{10}$ths or, preferably, $\frac{1}{20}$ths of a cc. divisions denoting in each case the capacity of the whole of that portion of the tube above the respective graduations. Beneath this tube is the stop-cock H, communicating by flexible tubing with the movable water reservoir I. The test tube A is warmed by a gas or spirit lamp and the whole apparatus should be mounted on a suitable stand. The measuring tube is surrounded with a water jacket K to preserve an even temperature. To conduct an analysis, 0·2grm. of finely divided wrought iron or steel, or 0·1grm. of cast iron are introduced carefully into the open test tube A, taking care that none of the filings adhere to its sides; 4cc. of a saturated solution of pure crystallised copper sulphate are then introduced and allowed to act with frequent stirring during ten minutes, unless an appreciable smell of hydrocarbon be observed, when the action must be suspended after three or four minutes. 1·2grms. of crystallised chromic acid are added to the solution, when considerable heat will be evolved, which will necessitate cooling the liquid by plunging the tube into cold water. Meanwhile the tube C must have been filled with water by raising the reservoir I until the liquid has risen above the bulb G, the remaining space up to the cock being filled by water introduced through F. The test tube is now corked and connected with the burette C. 8cc. of sulphuric acid (1·7 sp. gr.) are introduced drop by drop into A through B, the cock of the latter is closed, that marked E opened and the liquid in the test tube gradually raised to boiling, the pressure having been diminished by previously lowering the water reservoir I. After ten minutes' boiling, during which the reservoir has been still further lowered, if necessary, to maintain the diminished pressure, the tube is cooled somewhat and together with the connecting tube D is carefully filled with water introduced through B. The cock E is then closed and the total volume of air and carbon dioxide read off after levelling with the reservoir. I is then once more lowered and the cock H closed, in order to draw in a quantity of a 10 per cent. hydrate solution through F. After the carbon dioxide has been completely absorbed, H is reopened, the liquid levelled again and a reading of the amount of residual air is taken. The difference between the two readings will be the volume of carbon dioxide evolved from the carbon in the iron. Evidently if 0·2grm. of substance were used, each cc. of CO_2 will correspond to 0·253 per cent. of C, and the factor 0·253 multiplied by the number of cc. of gas should give a direct reading of the percentage of carbon. But this is not quite correct, since a certain quantity of CO_2 (to be found only by experiment) is absorbed by the water in the tube. By treating pure anhydrous sodium carbonate in the apparatus instead of iron and comparing the actual with the theoretical yield of carbon dioxide the factor may be corrected. Thus the true factor was found to be 0·28 and this was universally correct for cast irons; but for wrought irons or steel, which contain less carbon, it should be 0·29. When 0·1grm. of iron is used the factor must, of course, be doubled. Where the temperature of the operation differs much from the normal 18°, correction must be made by multiplying or dividing by $(1 + 0{\cdot}00367 \times t)$ where t is the variation in temperature, according as the solution is cooler or warmer than the normal. A table of results obtained with many irons and steels, estimated both by this and other processes, shows a striking agreement in each case between the old and the new methods.—W. G. M.



Portable Apparatus for Determining Carbon Dioxide in Air. O. Petterson and A. Palmquist. Ber. **20**, 2129—2134.

The apparatus is shown in the diagram. An oblong wooden box, not given in the figure, is screwed to the wooden stand. The sample of air enters A, and is measured off here by means of the graduated scale both before and after absorption of the CO_2. The absorption of CO_2 is carried out in B. By raising or lowering E, which contains mercury, the measuring pipette may be filled with either mercury or air. A drop of water is always kept on the surface of the mercury. In adjusting the meniscus of the mercury previous to reading off, the pressure in A is made equal to that in C. A differential gauge containing a drop of coloured liquid (azobenzene dissolved in petroleum) communicates on the one hand with A and on the other with C by means of a capillary tube *h*. By moving the reservoir E and finally (after closing the cock *d*) the screw *e*, the level of mercury in A is adjusted, so that the drop of liquid in the gauge remains at zero. In this way, as the air in A and C is shut off from outside throughout the experiment, and as the temperature is maintained constant by means of the water in the surrounding vessel, temperature and pressure may be neglected. The correction for saturation of the air with moisture may also be neglected. In the analysis three operations are necessary:—(1) Air is drawn in by adjusting the mercury level to zero on the scale. The cocks *f*, *g*, *b*, *c*, *d* are closed. (2) The cocks *d* and *b* are opened, *a* is closed and the air driven into A from B. In one or two



minutes the CO_2 is absorbed: the air is passed back into A, *b* is closed, *a* opened, and the mercury level in A adjusted so that the index of the gauge is normal. The diminution in volume is then read off on the scale.
—J. B. C.

Estimation of Calcium in Thomas-slag, as well as in Phosphorite and Similar Minerals. H. Immendorff. Landwr. Versuchsst. 1887, 377.

The following method is recommended for the rapid estimation of calcium in presence of iron and phosphoric acid. The substance is dissolved in hydrochloric acid, excess of ammonia added, the mass neutralised and made just acid to litmus. It is then warmed, precipitated by ammonium oxalate, diluted considerably and when cold, filtered, etc. The precipitate is dissolved in dilute sulphuric acid, titrated with potassium permanganate and the quantity of calcium calculated from the numbers obtained.—D. A. L.

The Examination of Ether. G. Vulpius. Chem. Zeit. 11, 1246.

Previous to the last rectification the ether should always be treated with some fused potassium hydrate. Ether thus prepared and kept in the dark will not liberate iodine from potassium iodide. In examining ether as to its purity, the following tests should be made:—(1) 5cc. of ether are allowed to evaporate until the residue only amounts to 0·1cc. This residue should be neutral to litmus paper. (2) 10cc. of ether shaken with some water and 0·1cc. of decinormal potassium hydrate and a trace of phenol-phthaleïn should turn red. (3) Potassium hydrate treated with the ether in question should not turn yellow within one hour. (4) 10cc. of ether shaken with 1cc. of a 10 per cent. potassium iodide solution in a small glass-stoppered bottle must show no coloration within one hour.—S. H.

On the Estimation of Paratoluidine in Aniline-for-red. C. Haüsserman. Chem. Zeit. 11, 1223.

Of the various analytical methods which have up to the present been proposed for the estimation of the constituents of aniline-for-red, not a single one is capable of yielding even approximately correct results. The method of Schoop (*Chem. Zeit.* 9, 1785), which depends upon the separation of the paratoluidine as the acetyl-derivative, has of late been much employed for the commercial valuation of aniline oils. The great discrepancies which have arisen have led the author to make a critical examination of the method with known mixtures of pure aniline, orthotoluidine and paratoluidine. The extremely incorrect results obtained show that the method is utterly unreliable.

Mixture.	Paratoluidine found.
21 per cent. paratoluidine 42 per cent. orthotoluidine 34 per cent. aniline	19 per cent.
6 per cent. paratoluidine 44 per cent. orthotoluidine 50 per cent. aniline	0 per cent.
10 per cent. orthotoluidine 90 per cent. aniline	22 per cent.

The numbers found are the mean of several determinations.—A. G. G.

Examination of Narcotic Extracts. H. Beckurts. Chem. Zeit. 11, 1245.

The author examined the different methods published for the determination of alkaloids. None of them could be considered accurate or simple. He therefore, in conjunction with Holst, worked out another process, as follows:—(1) For extracting strychnine 2grms. of the finely-powdered extract are shaken with 5cc. of water, 5cc. of ammonia and 10cc. of alcohol until all is dissolved. The solution is thrice shaken with 20, 10 and 10cc. of chloroform respectively. The chloroformic extract is collected and deprived of the solvent by distillation. The residue is dissolved in 15cc. of decinormal hydrochloric acid and filtered; after washing the filter with water, the filtrate is titrated with normal sodium hydrate solution, cochineal being used as indicator. The number of cc. of sodium hydrate required deducted from 150 and the rest multiplied by 0·00364, yields the amount of alkaloids in grms., which figure multiplied by 50 gives the percentage of strychnine and brucine in the solid extract. (2) For Extr. Hyoscyami, Belladonnae, Aconiti, 2·5grms. of the extract are dissolved in 3cc. of alcohol and 6cc. of water. 1cc. of ammonia is added to the solution and the latter shaken thrice as above with 20, 10, and 10cc. of chloroform. After distilling off the solvent the residue is dissolved in 5cc. of decinormal hydrochloric acid, filtered and the filtrate titrated back with centinormal sodium hydrate. The number of cc. of sodium hydrate used, deducted from 50, yields the number of cc. of hydrochloric acid required for neutralising the alkaloids.

$$1\text{cc. of centinormal HCl} = \begin{cases} 0{\cdot}00289 \text{ atropine.} \\ 0{\cdot}00289 \text{ hyoscyamine.} \\ 0{\cdot}00533 \text{ aconitine.} \end{cases}$$

The same method is not suitable for *Extr. Conii* owing to the volatility of coneïne. The titrated solutions may be further examined for the different alkaloids, after making them alkaline with sodium hydrate, extracting with chloroform and driving off the latter.—S. H.

Action of Oils on Polarised Light. W. Bishop. Jour. Pharm. Chim. 1887, 300.

Vegetable oils, with the exception of castor and resin oils, are generally supposed to be optically inactive. The author, however, has obtained the following results from filtered oils, using a Laurent saccharometer, with a tube 20cm., at a temperature of 13 to 15 degrees:—

Nature of Oil.	Rotation in Saccharometer-Degrees.
Sweet Almond	—0·7°
Earth-nut	—0·4
Colza (German)	—2·1
Colza (Japanese)	—1·6
Linseed (not German)	—0·3
Nut	—0·3
Poppy	—0·0
Olive	+0·6
Sesame (various samples)	from +3·1 to + 9·0

Hence, if a sample of oil, linseed oil for example, has a right-handed rotation, this may be due to adulteration with either resin oil or sesame oil, or a mixture of the two. Therefore it is important to test for the sesame oil in such cases.—D. A. L.

Estimation of Sugar in Beets. Böhm. Ztschr. f. Zuckerind, 11, 531.

A convenient quantity of beet-magma is weighed and placed in a graduated flask, allowing 100cc. for every half of the normal quantity of beet-magma taken; the flask is filled to the mark with water at 70 degrees, air-bubbles being brought to the surface by whirling and these broken down with ether. After fifteen minutes' standing, the mass is cooled and the flask re-filled to the mark with lead acetate. The filtrate is polarised in a 40cm. tube. To correct for volume of the beet marc, multiply result by 0·997, or add beforehand 0·3cc. for every half of the normal quantity of beet magma taken. According to Herles, results by this method agree very closely with those from alcohol extraction and other methods. Lead acetate must not be added earlier in the operation, nor must the mass be heated with lead acetate, otherwise the results will be incorrect.—D. A. L.

Presence of Copper in Coal and Coke. B. Platz. Stahl. and Eisen 1887, 258.

The author states that copper occurs in all the varieties of Westphalian coal. The mean of twelve analyses gave 0.032 per cent. The quantity, however, is too small to affect the iron smelted with this coal and the coke prepared from the coal.—G. H. M.

Improved Method of and Apparatus for Testing Gases drawn from Mines, and Signalling or Indicating the Result thereof, and for General Signalling in Mines. T. Shaw, Philadelphia, U.S.A. Eng. Pat. 3531, March 8, 1887.

The purpose of the patent is to draw off gases from the mine for testing and indicating the result by signal. The following apparatus is used. A pipe communicates from the ceiling of the mine with the top of the shaft. This pipe is in communication with an exhaust pump, and a small pipe leads from the exhaust pump to a metallic cylinder having a contracted opening on one side opposite a flame and at one end a loose piston valve opposite a gong with a spring for retracting this piston valve. If the gases from the mine which are driven into the cylinder form an explosive mixture, they will explode on coming in contact with a flame, and the piston will be driven against the gong. Each gun is provided with means to prevent the flame from travelling back to the mine. The construction of the apparatus may be seen from the diagram. It consists of a cylinder *p* closed at one end by a piston *s*, which also serves as a valve, and is pressed against the cylinder by a bow spring *t*. The gas is pumped in through *b*. The explosion forces the piston against the gong and at the same time raises the valve *a* to the position indicated by the dotted lines, so that when several gongs are sounded, the attendant may know with which mine to communicate. To prevent the flame from travelling back, the valve *y* (Fig. 2) is placed in front of the pipe communicating with the mine. The valve is hinged at the bottom and opens inside the cylinder, so that the pressure of the explosion causes it to close. The pipe is provided at the mine end with a whistle, so that by reversing the exhaust-engine, air is blown into the mine and the whistle sounded.

—J. B. C.

FIG. 1.

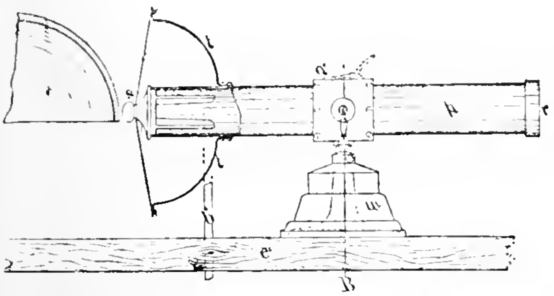
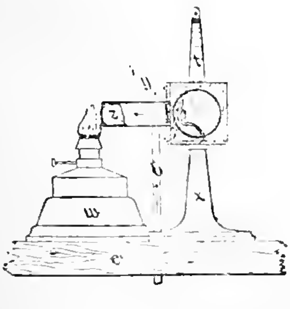


FIG. 2.



New Books.

A Short Manual of Analytical Chemistry, Qualitative and Quantitative—Inorganic and Organic. By John Muter, M.A., Ph.D., F.R.S.E., etc. Third Edition. Illustrated. London: W. Baxter, Secretary. At the Offices of the School of Pharmacy, 325, Kennington Road. Simkin, Marshall & Co., Stationers' Hall Court, E.C.

8vo volume, bound in cloth, containing Preface, Table of Contents, 195 pages of subject matter, and an Alphabetical Index. Interspersed with the text are 46 wood engravings. As might be expected from a man with the author's reputation, special attention is given to the important subjects of the analyses of Water, Air and Food, and especially of Drugs, Alkaloids, Urine and Urinary Calculi. This fact will justify the confidence of medical students and those engaged in pharmacy. Of particular interest is the portion devoted to the Micro-Chemical Identification of Drugs, with the tabulated engravings showing the crystalline appearances of the same under the microscope. The work as a whole is embodied as follows:—Part I. treats of Qualitative Analysis, which is again subdivided and headed thus: Processes employed by practical chemists; Detection and Separation of the Metals; Detection and Separation of Acidulous Radicals; Qualitative Analysis, as applied to the Detection of Unknown Salts; Qualitative Analysis of Alkaloids and of the so called "Scale" Medicinal Preparations containing them, with a General Sketch of Toxicological Analysis. Part II.—Quantitative Analysis. Weighing, Measuring, and Specific Gravity; Volumetric Quantitative Analysis and Use of the "Nitrometer"; Gravimetric Quantitative Analysis of Metals and Acids; Ultimate Organic Analysis; Special Processes for the Analysis of Water, Air, and Food; Special Processes for the Analysis of Drugs, Urine, and Urinary Calculi; Analysis of Gases, Polarisation, and Spectrum Analysis. The published price of this work is 6s. 6d., that for students and those outside the trade 5s. 6d.

Exercises in Quantitative Chemical Analysis, with a short Treatise on Gas Analysis. By William Dittmar, LL.D., F.R.S., Professor of Chemistry in the Glasgow and West of Scotland Technical College. Glasgow: William Hodge & Co., 123, Hope Street. 1887.

This excellent treatise takes the form of an 8vo volume bound in cloth, with preface, tables of contents and of the atomic weights and 313 pages of subject matter. The work terminates with an alphabetical index. It may also be noted that the last twelve pages of subject matter are devoted to notes on the matter of the preceding text, the whole of which is divided into "exercises" which are individually numbered and definitely headed. These notes are somewhat similar to those found at the end of Fresenius' large "Treatise on Quantitative Analysis," but they are even more usefully conceived and clearly stated. The work is illustrated with 61 well-executed wood engravings. As regards the division of text into exercises, the principal divisions or groups are the following:—Exercises in Exact Weighing and Measuring; Exercises in Analytical Methods; Elementary Analysis of Combustible Carbon Compounds; Gas Analysis; Promiscuous Exercises in Applied Analysis; Notes.

Einfachere Gewichtsanalytische Uebungsaufgaben in Besonderer Anordnung Nebst Einleitung: als Vorwort: Einiges uber Unterricht in Chemischen Laboratorien Von Dr. F. Muck. Mit 17 Textabbildungen. Breslau: Verlag von Edward Trewendt. 1887.

This little book, bound in cloth, and of 8vo size, contains 69 pages of subject matter illustrated with 17 woodcuts. The text is subdivided into thirteen chapters, each devoted to the treatment and examination analytically of characteristic salts and compounds of the following metals and metalloids:—Sodium, potassium, calcium, copper, lead, iron, aluminium, manganese, magnesium, silicon, cobalt, nickel, antimony, arsenic. With regard to the treatment referred to, this consists of a series of exercises in the conversion by the best methods of the above elements into well-known and most characteristic compounds, with a view especially to throw light upon the usual analytical processes adopted in the separation from other and similar bodies, or in the absolute gravimetric determination. The little work might be designated an introduction to qualitative and quantitative chemical analysis for beginners. A book on this pattern might be of great service in schools.

Modern American Methods of Copper Smelting. By Edward D. Peters, jun., M.E., M.D. New York: Scientific Publishing Company, 27, Park Place. 1887.

8vo volume bound in cloth, containing preface, table of contents and 335 pages of subject matter, terminating with an alphabetical index. With the text are interspersed numerous woodcuts. In this work the processes of "wet extraction" are not treated of, but merely methods of smelting. The text is sub-divided into the following chapters:—Distribution of the Ores of Copper; Description of the Ores of Copper: Methods of Copper Assaying: The Roasting of Copper Ores in Lump

Form; Stall Roasting; Kiln Roasting; Calcination of Fine Ore and Matte; Chemistry of the Calcining Process; Smelting of Copper; Blast Furnaces of Brick; Blast Furnace Smelting; Reverberatory Furnaces; Treatment of Gold- and Silver-bearing Copper Ores; Bessemerising Copper Mattes.

Trade Report.

(From the Board of Trade and other Journals.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

FRANCE.

Regulations respecting the Importation of Toys coloured with Poisonous Substances.

The following rules are to be observed on the importation of toys coloured with poisonous substances into France:—

1. It is forbidden to import toys coloured with arsenical colours (Scheele green, Schweinfurt green, metis green, &c.); salts of lead soluble in water and acids, as ceruse, read lead, massicot, chrome orange; salts of copper, such as blue ashes.
2. The following colours are allowed to be employed: Vermilion, neuter chromate of lead (yellow chromate of lead, chrome yellow), painted on with spirit or oil varnish.
3. White lead is admissible if applied with oil varnish for the manufacture of indiarubber balloons or tin toys.

Importation of Antipyrine.

The following is a recent decision of the Customs authorities:—

An article known as "antipyrine" is included in the category of "Chemical products not enumerated," duty 5 per cent *ad valorem*.

SPAIN.

Regulations respecting the Importation of Alcoholic Liquors.

See *Board of Trade Journal* for November, p. 169 *et seq.*

UNITED STATES.

Customs Decisions.

An article called *Soufre raffiné en masse*, which consists of the residue obtained in the process of sublimation in producing the substance known as "flowers of sulphur," and which is imported generally in the ground condition, is held to be exempt from duty, under the provision in the free list, section 632, for "sulphur or brimstone, not specially enumerated or provided for," the article being neither "sulphur, refined, in rolls," nor "sublimed, or flowers of sulphur," which are specially provided for in sections 77 and 78.

Certain so-called "recovered manganese," which is understood to consist of the product of manganese recovered from manganese after it has been used in the manufacture of chlorine, and which is, in fact, an oxide of that article, is held to be free of duty, under the provisions in the free-list, section 621, for "manganese, oxide, and ore of."

TRADE BETWEEN SPAIN AND THE UNITED KINGDOM.

Imports into the United Kingdom from Spain.

PRINCIPAL ARTICLES.	Sept. 1886.	Sept. 1887.
Chemical products unenumerated ....Value	£3,829	£5,918
Copper ore and regulus ..Tons	2,852	1,896
Value	£56,231	£36,758
Manganese ore ....Tons	..	4
Value	..	£15
Pyrites of iron or copper...Tons	32,727	11,712
Value	£61,021	£71,779
Quicksilver ....lb.	..	..
Value	..	..
Rags, Esparto ....Tons	1,707	2,626
Value	£27,908	£16,337
Total Value	1886.	1887.
September	£719,560	£710,363
October	£910,778	£1131,399

Exports of British and Irish Produce from the United Kingdom to Spain.

PRINCIPAL ARTICLES.	Sept. 1886.	Sept. 1887.
Alkali ....Cwt.	23,660	27,522
Value	£8,677	£9,053
Caoutchouc manufactures Value	£1,656	£2,553
Cement ....Tons	1,330	250
Value	£2,378	£169
Chemical products and preparations (including dyestuffs) Value	£3,871	£1,268
Coal products (including naphtha and petroleum ....Value	£1,510	£351
Manure ....Value	£11,300	£3,627
Painters' colours and materials Value	£2,122	£2,111
Soap ....Cwt.	653	619
Value	£500	£187
Total Value	1886.	1887.
September......	£328,166	£301,001
October	£301,133	£262,039

MISCELLANEOUS TRADE NOTICES.

THE INLAND REVENUE AND METHYLATED SPIRIT.

A new regulation has been issued by the Inland Revenue Board. Any person authorised to receive methylated spirit for use in any art or manufacture, will in future be restricted to purchasing the same from a licensed maker of the spirit — *B. and C. D.*, November 5, 1887.

ADULTERATION OF WINE IN SPAIN.

See *Board of Trade Journal* for November, p. 527 *et seq.*

SYNDICATE OF THE RHENISH-WESTPHALIAN SULPHURIC ACID MANUFACTURERS.

The price of sulphuric acid having sunk to a very low figure, the manufacturers of the northern part of the Rhine province and Westphalia have formed an association, with the object of raising the price of sulphuric acid on the 1st of January, 1888.—S. H.

COMMERCIAL RELATIONS BETWEEN RUSSIA AND ROUMANIA.

The Russian *Journal de St. Pétersbourg* for the 11th October last, quotes from the Roumanian *Express Orient*, of Bucharest, an article on the subject of the commercial relations between Russia and Roumania. The *Express Orient* considers that in the absence of any commercial convention with Austria, the present is a very opportune moment for cementing the commercial relations between Roumania and Russia. The recent Exhibition at Craiova was particularly rich in exhibits which proved the interest felt by Russian merchants, in favourably impressing the Roumanian market, and those exhibits were received with extraordinary favour. There is, in particular, an increasing demand in Roumania for Russian refined sugar, toilet soap, candles, naphthaline, and cigarette-paper. Each of these articles, the Roumanians are now finding, can be bought cheaper in Russia than in Austria. The *Express Orient* also believes that Russian merchants would find a ready sale for other exports, and especially for hardware and for chemical products, such as sulphuric acid. It believes that in Roumania there exists an immense field, hitherto almost unworked, for Russian commercial enterprise, and that a very little energy on the part of the Russians would be sufficient to persuade the Roumanians to purchase from Russia almost all the articles which are at present brought to them at great trouble and expense from western Europe.

ZINC FIELDS OF MISSOURI.

The following information, respecting the zinc fields of Missouri, was contained in *Bradstreet's* for the 8th October last:—

"The St. Louis *Globe-Democrat* states that in 1885 the world's production of zinc amounted to 291,609 tons of 2240 pounds each, 255,270 of which were obtained in Europe, and 36,339 in the United States. The principal zinc-producing states in this country are Illinois, Kansas, and Missouri, which stood in this order in volume of output in 1885. The production of Missouri was about one-ninth of that of the whole country in that year. In the order of importance, Missouri towns, in the Ozark zinc region, are Webb City and Carterville, Zincite, Joplin and Lehigh. The area of the zinc region, however, 'covers many counties and includes millions of acres of territory.' The zinc ores of Missouri are of every variety of carbonates, silicates, and sulphurets. The sulphurets are most abundant in Jasper and Newton counties. Other varieties are found in that region, but in small quantities. Zinc and lead ores crop out on the surface of the ground in Washington county, especially in the neighbourhood of Londale and Hopwell. These metals are plainly exposed to view above soil over many miles in that region."

THE CINCHONA TRADE OF CEYLON.

The following is a copy of extracts from the annual report of the Planter's Association of Ceylon for the years 1885—6 and 1886—7 :—

" *Year* 1885—86. *Cinchona.*—Notwithstanding the growing feeling that in a few years' time this product will again become of great value, there has been practically no furthur planting of cinchona. The need for money to plant tea, the slow growth of tea when covered by growing cinchona, as well as the dying off of the trees themselves are causes which have led to the enormous export of 13,736,171lb. for the past year against 11,865 280lb. for 1884. While a rise in price during the current year would lead to a considerable export there can be no doubt that the maximum production has been reached, and that ere long there will be a great reduction in the quantity exported. It may be doubted whether the acreage under cinchona is now one-fourth of what it nominally was four years ago.

" *Year* 1886—87. *Cinchona.*—The same causes which led to the large export during 1885, have occasioned a similar export during 1886, and consequently prices have fallen to a barely profitable point. It is impossible to say for how many months this export may continue, but it is unlikely to be for long, and it is maintained entirely at the expense of the future.

" The exports for 1886 were 14,675,663lb., against 13 736,171lb. in 1885."

SILK CONFERENCE AT THE MANCHESTER EXHIBITION.

The following is a summary of a report by Mr. Bateman, of the Commercial Department of the Board of Trade, upon the proceedings at the Conference of the Silk Section of the Manchester Exhibition for the promotion of the silk industries of the United Kingdom, which was held on the 21st of October last. Mr. Bateman attended the Conference with the sanction of the Board of Trade, and at the request of the Executive Committee of the Exhibition.

The object of the Conference, consisting of a very representative gathering of spinners, dyers, manufacturers, merchants, and retailers, to the number of three or four hundred, was to discuss the present depression in the silk industry, and to propose remedies for the same.

After the discussion of papers dealing with the various phases of the question, the chairman proposed what was to be the practical outcome of the meeting, namely, a resolution for the establishment of a silk guild.

The majority of the meeting appeared to favour the re-establishment of duties on silk manufactures, but did not submit any formal resolution to that effect.

Technical education in dyeing, design, and mechanism, and information as to new sources of supply of the raw material and of new markets for silk manufactures abroad, were among the objects which it was considered the proposed guild should assist, and a suggestion by Mr. Bateman that the association should include merchants and retailers as well as manufacturers, so as to bring the latter into closer touch with the consumers who use their goods, was very favourably received by the meeting, and ultimately adopted.

A resolution was finally passed that a committee of the exhibition, with certain names added, should form an association for the purposes described, and draw up rules.

As the result of a discussion on the subject of weighting silks, a further resolution was passed in favour of stamping the amount of dye in silks on the piece on importation into the country, or on leaving the manufactory. It was pointed out that this would be a most difficult and expensive regulation to enforce, since only very skilled analysts can distinguish the percentage of loading.

Other resolutions were adopted in favour of a Minister of Commerce and Agriculture being appointed, and of the Technical Education Bill of last session being passed. The Merchandise Marks Act appeared to be appreciated by most speakers.

THE DEVELOPMENT OF THE AMERICAN CHEMICAL INDUSTRY.

This is the title of a series of articles in course of contribution to the *Engineering and Mining Journal* by Dr. Francis Wyatt, and dealing thus far with the sulphuric acid manufacture in general, and the utilisation of pyrites for this purpose in particular.

Pyrites deposits are found in almost all the States of the Union, but only those in New Hampshire, Massachusetts and Virginia are actually worked to any extent. The following analyses give a good idea of the quality of these ores :—

	Sulphur.	Iron.	Copper	Zinc.	Arsenic	Silica.
Milan Mines, New Hampshire, No. 1..	46·0	40·0	3·7	4·0	trace	6·25
Milan Mines, New Hampshire, No. 2	35·0	30·5	5·0	8·0	nil	21·5
Davis Mines, Massachusetts	49·27	15·3	1·47	—	trace	3·83
Arminius Mines, Virginia..........	46·0	44·5	2·1	—	trace	7·40

The total domestic extraction used for acid-making in 1886 was estimated at 55,000 tons. This was supplemented by an importation of 57,000 tons, making altogether 112,000 tons, or rather less than one-tenth of the total quantity of pyrites consumed in the manufacture of sulphuric acid throughout the world, a fact which in itself indicates a lamentably backward condition of chemical industry, and one that is far from harmonising with the brilliant progress of the States in other departments of the arts and manufactures. Below are some interesting figures with regard to the distribution of the consumption :—

District.	Actu'l numb'r works	1881.	1882	1883.	1884.	1885.	1886.
Boston & E's't'n District	5	0	2 500	7,500	14,500	25,800	26,900
New York District	6	7,000	23,900	29,500	39,000	44,600	55,700
Philadelphia District	2	0	5,000	5,000	3,500	11,500	23,600
Baltimore and Southern States......	3	0	2,000	2,000	4,000	7,500	4,300
W'st'rn District	1	0	1,000	1,000	2,000	2,000	1,500
Total	17	7,000	28,900	45,000	65,000	91,400	112,000

It must, of course, be taken into consideration that in many cases the railway rates are so heavy that there is little difference in cost at consumers' works between pyrites sulphur and pure brimstone.

The following table, showing the comparative costs of producing one ton of 50° B. sulphuric acid from sulphur and pyrites in the district of New York or Philadelphia, will be interesting to English makers :—

BRIMSTONE (*short tons*).

1 ton brimstone thirds (98 % S) at $19	$19.00
50lb. nitrate of soda at 2½ cents per lb.	1.25
5 cwts. of coals, at say $4 per ton	1.00
Workmen's wages................................	2.25
Superintendence and management..............	2.00
General jobbing repairs..........................	0.50
Interest on capital of $75,000	4.60
Total	$30.60

Product = 4½ tons 50° B.—cost per ton, $6.80.

PYRITES (*short tons*).

2½ tons pyrites, 46 % sulphur, at 10 cents per unit..	$11.50
60lb. nitrate of soda, at 2½ cents per lb.	1.50
5 cwts. of coals, at say $4 per ton	1.00
Superintendence and management..............	3.00
Workmen's wages................................	2.00
General jobbing repairs	0.60
Interest on capital of $100,000	6.15
Total..................................	$25.75

Product = 4½ tons 50° B.—cost per ton, $5.5.

The concentration of chamber acid to brown oil of vitriol and rectified oil of vitriol is carried on pretty much as in England. The author is by no means favourably disposed towards concentration in platinum ; in fact, he estimates it to cost between 60 and 70 per cent. more than in glass. He says, however, that near New York a rectifying plant is at work upon a new principle, wherein cast iron is made to replace glass and platinum, and which bids fair to create as great a sensation as the introduction of the Glover tower.

The cupreous cinders are treated for the extraction of the copper by both wet and dry methods. The non-cupreous residues—especially from *smalls*—are often sufficiently low in sulphur to permit of their direct use in the manufacture of Bessemer pigs At the Lancashire Hill Chemical Works, Long Island, New York, where a Canadian ore containing about 3½ per cent. of copper and 13—14 per cent. silica is used, the residues are smelted (with the admixture of a small quantity of green smalls) in a Herreshoff water-jacket furnace, and a matte of 50—60 per cent. copper obtained with a loss of less than half a per cent. of copper in the slag. The average daily charges are :—

	48in. Furnace.	60in. Round Furnace.	Rectangular Furnace.
Pyrites cinders ..	51·7 tons	76·0 tons	76·8 tons
Green smalls	4·3 ,,	8·0 ,,	13 2 ,,
Sand..............	2·8 ,,	12·0 ,,	5·3 ,,
Iron slag	—	9·0 ,,	—
	50·8 tons	105·5 tons	95 3 tons
Coke	11·5 tons = 20%	17 tons = 16%	17·4 tons = 18%

Of the various wet methods in vogue, the author prefers that of Hunt and Douglas, wherein the copper is precipitated as sub-chloride by the agency of sulphurous acid gas.

Besides the 112,000 tons, pyrite, above mentioned, there was also used for acid-making in 1886, 90,200 tons of brimstone. Of the sulphuric acid produced four fifths were used in the manufacture of fertilisers or in petroleum refining, the remainder being distributed among the various smaller channels of consumption. —*Engineering and Mining Journal*, New York, Aug., Sept. and Oct. 1887. A. R. D.

STATISTICS.

ITALIAN CHEMICAL STATISTICS.

Official returns have been published relating to the Italian trade in chemical products during the first six months of 1887. In that period 1827 tons boracic acid were exported from Italy, against 1722 tons in the first half year of 1886 Of Italian refined borax 341 tons were exported. Formerly nearly the whole of the boracic acid produced in Italy was exported, but recently large works have been established in the country by the firm of Larderel, and a considerable part of the acid is now treated at these works. The export of cinchona salts from the Milan and Genoa works rose from 5000 to 10,000kilos. (176,500oz. to 353 000oz.). This includes, besides quinine sulphate, all the minor cinchona salts. The export of the latter bas been much assisted by the establishment of drawback on shipments abroad. The importation of soda nitrate, which is principally used in the manufacture of nitrate of potash by boiling with chloride of potash, rose from 2600 to 6100 tons. The cause of this advance is due to the increased requirements of gunpowder by the War Department. Soda imports rose from 910 to 1160 tons, caustic soda from 3800 to 4000 tons, oxides of iron and lead from 1100 to 1700 tons. The alum works of Civita Vecchia have not been so successful as was expected, it being found preferable to export the crude mineral. The shipments of winelees and argols rose from 3500 tons to no less than 11,200 tons. More lemon-juice was also exported—viz., 503 tons raw and 1892 tons concentrated juice, against 220 and 782 tons respectively. This enormous increase in the shipments is due to the large crop of "agrumi" and the cheapness of the lemons; but it seems inexplicable that under these favourable circumstances the manufacture of citric acid in Italy should still be so much neglected. Of common soaps, 1959 tons were exported in the first six months of 1887 and of medicinal preparations, 834cwt in the first half-year of 1886. The total value of the imports of chemical and medicinal products, resins and perfumery, was £1,000,000, the exports £1,160,000.

BOARD OF TRADE RETURNS.

Exports.

		Oct. 1885.	Oct. 1886.	Oct. 1887.
British and Irish produce:—				
Drugs and medicinal preparations (unenumerated)	value £	80,983	70,484	77,528
Other chemicals and medicinal preparations	value £	188,170	186,654	190,796
Painters' colours and materials	value £	106,479	107,924	116,573
Alkali	cwt.	590,544	601,753	520,468
,,	value £	179,582	175,247	150,889
Bleaching materials	cwt.	107,012	157,574	165,972
,, ,,	value £	36,411	53,117	62,245
Oil (seed)	tons	6,153	6,584	7,588
,,	value £	146,246	138,521	159,361
Soap	cwt.	27,017	43,692	37,295
,,	value £	33,561	42,167	36,511
Foreign and Colonial merchandise:—				
Chemicals (unenumerated)	value £	19,397	10,007	18,087
Bark, Cinchona	cwt.	13,192	11,177	10,556
,, ,,	value £	91,939	42,558	29,778
Cochineal	cwt.	1,530	812	847
,,	value £	9,402	5,294	5,374
Cutch and gambier	tons	925	943	1,165
,, ,,	value £	20,326	23,618	31,815
Gum Arabic	cwt.	4,497	4,524	4,765
,,	value £	15,189	18,414	17,907
Indigo	cwt.	4,092	4,032	2,766
,,	value £	73,071	81,152	55,021
Lac seed, shell, stick and dye	cwt.	7,702	8,522	4,743
,, ,, ,, ,,	value £	25,023	25,557	12,706
Oils, cocoa-nut	cwt.	15,162	9,078	9,229
,, ,,	value £	22,416	12,111	12,865
,, olive	tuns	193	202	155
,, ,,	value £	9,619	8,147	6,998
,, palm	cwt.	32,125	28,486	59,732
,, ,,	value £	44,486	29,154	59,619
,, petroleum	gals.	52,366	91,328	69,416
,, ,,	value £	1,971	3 071	3,232
Quicksilver	lb.	173,769	190,645	223,993
,,	value £	13,611	18,342	31,859
Nitre (nitrate of potash)	cwt.	6,876	259	2,540
,, ,,	value £	5,171	271	2,181

Imports.

		Oct. 1885.	Oct 1886.	Oct. 1887.
Drugs, unenumerated	value £	75,015	49,501	59,923
Chemical manufactures and Products, unenumerated—	value £	108,779	102,722	102,749
Chemical and Dyestuffs, unenumerated	value £	151,158	121,855	131,011
Oils, not enumerated	value £	95,986	97,828	105,231
Alkali	cwt.	6,187	7,511	4,211
,,	value £	5,014	4,578	3,201
Brimstone	cwt.	16,824	20,321	68,947
,,	value £	4,559	5,907	19,016
Nitre (nitrate of soda)	cwt.	291,350	78,987	192,871
,, ,,	value £	149,767	34,697	86,597
,, (nitrate of potash)	cwt.	31,759	23,038	33,878
,, ,,	value £	26,099	20,060	27,811
Quicksilver	lb.	154,286	90,075	97,327
,,	value £	11,382	8,060	8,620
Bark (Cinchona)	cwt.	12,523	9,700	11,378
,,	value £	74,251	47,390	47,792
Gum Arabic	cwt.	7,893	6,353	7,561
,,	value £	29,166	29,961	25,805
Lac, seed, shell, stick, and dye	cwt.	9,768	11,124	4,771
Lac, seed, shell, stick, and dye	value £	31,289	29,515	11,203
Barks and tanning materials—				
Bark (for tanners' or dyers' use)	cwt.	10,818	42,202	17,887
Bark (for tanners' or dyers' use)	value £	2,765	18,506	5,816
Aniline dyes	value £	22,374	21,649	26,624
Alizarin & other coal-tar dyes	value £	26,137	19,778	28,629
Cochineal	cwt.	1,128	1,384	950
,,	value £	6,988	8,880	5,971
Cutch and gambier	tons	1,767	2,873	2,236
,,	value £	36,708	65,899	56,682
Indigo	cwt.	1,367	817	1,203
,,	value £	26,584	11,484	11,699
Madder, madder root, garancine, and munjeet	cwt.	3,031	1,333	2,429
Madder, madder root, garancine, and munjeet	value £	5,184	1,672	2,801
Oils—				
Cocoa-nut	cwt.	8,680	26,117	39,433
,,	value £	12,094	36,139	52,870
Olive	tuns	1,418	1,418	784
,,	value £	57,049	54,014	29,436
Palm	cwt.	86,991	84,811	90,100
,,	value £	112,291	84,764	87,756
Petroleum	gals.	8,230,606	5,427,095	6,897,747
,,	value £	245,877	158,194	186,537
Seed, of all kinds	tuns	1,669	1,589	1,540
,,	value £	43,491	38,595	37,764
Turpentine	cwt.	29,604	36,292	20,831
,,	value £	35,930	50,432	26,389

JAPAN.

Growing Drug Imports.

Hyogo imported in 1866, £72,036 worth of drugs, against £11,838 in 1885; of aniline dyes and paints, £12,934, and of other dyes, £28,912 were imported in 1886, against £25,085 in 1885.

Drug Exports.

The exports from Hyogo in 1886 show the following results as compared with the preceding year:—

	1886.			1885.	
	tons	£		tons	£
Antimony	1,928	25,513	..	2,195	35,764
Camphor	2,328	114,789	..	1,393	59,082
Soap (washing)	1,871	8,567	..	1,991	10,890
Vegetable wax	1,199	51,643	..	1,183	57,003

Drug Statistics.

The following figures relate to the imports of drugs, etc., into Yokohama:—

	1886.		1885.
			£
Mercury lbs.	112,731	10,413	..
Drugs and medicines ,,	..	102,920	60,002
Dyes, aniline cwts.	1,468	25,044	19,185
Dyes and paints	..	26,020	29,441
Indigo cwts.	797	17,514	..
Logwood extract lbs.	944,123	13,418	..
Eastern drugs and medicines lbs.	..	20,744	15,186

The Exports include:—

	1886.		1885.	
			£	£
Drugs and medicines	..	16,180	..	26,613
Fish oil ......gall.	373,810	13,967	gal. 408,533	16,893
Peppermint oil ,,	9,040	9,678	..	..

Medicine Imports.

Amongst the miscellaneous foreign imports not considerable enough in value to rank as staples, the most noteworthy item during the past year was undoubtedly drugs and medicines, of which over £100,000 worth were imported, as against only £60,000 worth in 1885.

Other Drugs.

Of antimony Japan exported 3 298,549 catties in 1886, and 3,795,610 in 1885. Great Britain receives by far the largest part of the export of fish wax (exports, 2,126,922 catties in 1886 and 3,150,122 in 1885). France and Germany receive the largest shipments, while sulphur (exports, 7,939,296 catties in 1886 and 12,466,616 the year before) is mostly sent to the United States, and a little to Australia.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

NEW METHOD FOR THE PRODUCTION OF IRON AND STEEL DIRECT FROM THE ORE.

According to a report, dated the 11th October last, of the British Vice-Consul at Moscow, a new process for producing iron and steel direct from the ore has been recently invented and patented by a Russian engineer. The Vice Consul says:—

"The whole secret of the process lies in the construction of the furnace, which is simple and inexpensive.

"It will be difficult for our ironmasters to believe that, under the new process, iron ore, after submitting it to the ordinary smelting process is taken direct from the furnace to the rolling-mill and turned into thin sheets of the finest charcoal iron, yet such is certainly the case, there being to my positive knowledge three such furnaces in this country working with perfect success.

"There can be but little doubt that the new invention will create quite a revolution in the manufacture of charcoal iron. Whether the process can be applied with equal success where coke is the fuel I cannot positively assert, as the furnaces I refer to are fired with charcoal. I am, however, assured that an experiment has been made with coke and was crowned with equal success."

DISCOVERY OF INFUSORIAL EARTH AT STAVANGER.

The following is an extract from a report by Mr. T. Michell, Her Majesty's Consul-General at Christiana, dated the 20th October last, with reference to the discovery of infusorial earth pits at Stavanger:—

"A considerable number of pits of 'infusiorial earth,' containing 85 to 95 per cent. of silica, have been discovered in the neighbourhood of Stavanger, and capital is being sought for the purpose of working those deposits, which are estimated to be capable of yielding 400,000 cubic metres of that rare product.

"It is affirmed that while similar deposits at Lyneberg, in Hanover, are mixed with sand and gravel, those now discovered are so pure in quality as to be available, for most purposes, merely after desiccation."

TRADE OF CHILI FOR THE YEAR 1886.

See *Board of Trade Journal* for November, p. 517 *et seq.*

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS AND MACHINERY.

APPLICATIONS.

14120 W. Bergh, London. Improvements in centrifugal apparatus for separation of fluids of different specific gravities. October 18

14153 E. N. Henwood, London. Improvements in the arrangements and construction of apparatus for injecting liquid hydrocarbons into furnaces. October 18

14169 J. J. Hicks, London. Hydrometers and saccharometers. October 18

14182 T. Kirk, Birmingham. Bye-pass cocks and valves for gas and other fluids. October 19

14209 W. H. Rusden, London. Electrical apparatus for prevention of corrosion and incrustation in steam boilers. Complete specification. October 19

14231 H. H. Lake—From O. S. Andersen, Valby. Centrifugal apparatus for separating liquids of different density or specific gravity. October 19

14251 F. Hazlett and H. McCrudden, London. Furnaces. October 20

14457 J. C. Ghest, London. The application of superheated steam to the furnaces of steam-boilers, retort-furnaces, puddling-furnaces glass-furnaces and the like, and the construction of furnaces for that purpose. October 21. Antedated April 27, under International Convention.

14500 A. Stevenson, Liverpool. Improvements in grinding or pulverising sugar, salt, and other like material, and in apparatus or machinery therefor. October 25

14539 W. L. Horne, London. Improvements in vacuum apparatus. Complete specification. October 25

14621 P. Birchall and W. Bainbridge, Longport. Nozzles, and mode of connecting same to stand or press pipes for charging filter-presses. October 27

14686 A. M. Crossley, Glasgow. Refractory or materials for lining furnaces, etc. October 28

14706 J. Nicholas and H. H. Fanshawe, London. Mode of and apparatus for carbonisation, calcination, and decomposition of organic and inorganic matter. October 28

14758 A. Schreiber, London. Smokeless furnaces. Complete specification. October 29

14931 J. J. Miller, G. J. Tupp and H. G. A. Rouse, London. Airtight furnace and retort doors and mouth-pieces. Nov. 2

15003 J. G. Hawkins and J. Barton, London. Gas retort lids, and materials and method for ensuring gas-tight joints between the lids and mouth-pieces. Complete specification. Nov. 3

15009 H. W. P. Nugent, London. Gas retort and other furnaces. Complete specification. November 3

15094 H. M. Thomas, London. Pumps for exhausting to a high state of vacuum, and for compressing air or gases to high pressures. November 5

15198 G. Pinnington, Chester. A combination of revolving pumps for raising liquids. November 8

15238 E. A. Cowper, London. Filter-presses. Complete specification. November 8

15322 H. E. Newton—From The Maschinenbau Actiengesellschaft, Austria. Filter-presses. November 9

15429 T. Newman, London. Filters. November 11

15590 W. Creswick, London. Apparatus for drying, heating, or cooling substances. Complete specification. November 14

15615 F. Goddard, Nottingham. Furnaces. November 15

15688 A. Anderson, Monkwearmouth. Appliance for consuming smoke and utilising waste heat of boilers and furnaces. November 16

15743 T. Carter, Monkwearmouth. Firebars for combined assisted and forced draughts for furnaces. November 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

12384 J. Gilmore and J. F. Gilmore, and W. R. Clark. Steam generating apparatus. November 2

1887.

560 W. Whittaker. Mechanical stokers. October 26

686 A. Boulouse. Self-acting air valve for heating apparatus. November 2

991 W. Land. Steam generators. November 2

1914 E. Green. Fire-bars for furnaces. October 29

6287 W. Bevitt. Amalgamating apparatus. October 29

7815 T. Taylor. Consuming smoke in steam boilers. Oct. 26

12074 J. von Ehrenwerth. Regenerative gas furnaces with periodical action. October 26

II.—FUEL, GAS AND LIGHT.

APPLICATIONS.

14108 J. Mitchell, Glasgow. Improvements in the manufacture or construction of firelighters. October 18

14305 W. Weller, jun., London. Improvements in the construction of firelighters. October 21

14325 H. C. Bull & Co., Limited, and H. Clay Bull, London. Improvements in or connected with apparatus for producing and utilising "producer gas." October 21

14531 J. G. Johnson—From G. Mülheims and R. Zimmermann, France. Improvements in presses or apparatus for moulding blocks of artificial fuel. Complete specification. October 25

14589 R. H. Courtenay, Battersea. Improvements in gas apparatus, or lamps for generating gas from volatile hydrocarbons, which apparatus may also be applied to oxy-hydrogen gas incandescence and ordinary gas or other burners for lighting and heating purposes. October 26

14626 J. W. Newall, London. A method of making gas for heating purposes from tar or oil. October 27

14688 A. M. Crossley, Glasgow. Improvements in making coal briquettes or fuel blocks. October 28

14805 J. Marlow and W. Marlow, London. A fire-lighter of an improved construction. October 31

11976 R. H. Quine, Manchester. Supplying pure hot air by means of specially constructed stoves or grates to burn coal, gas, oil, or other fuel.

15067 J. C. Krayenbuhl, H. C. Peterson, and C. C. Burmeister, London. A new or improved process for the cleaning or separation of tar from ammoniacal liquor or other matters. November 4.

15082 A. Denoon, R. Jameson and A. Reid, Newcastle-on-Tyne. Utilising waste heat in coke manufacture. Nov. 5

15161 O. Knublauch, London. Improvements in production or recovery of cyanogen compounds from coal gas and other gases. Complete specification. November 7

15256 S. Pitt—From T. G. Hall, United States. Process of refining hydrocarbon oils. Complete specification. Nov. 8

15552 D. Clan Alpine Thatcher, London. A liquid fuel cartridge. November 14

15561 J. H. Glew and J. Hayes, London. Improved means and apparatus for feeding, compressing, and delivering composition firelighters. November 15

15571 G. Porter, London. Improvements relating to apparatus and fittings for enriching and burning illuminating gas. November 15

15581 J. A. Yeadon and R. Middleton, Leeds. An improved mode of moulding lumps of fuel or materials for smelting and analogous purposes, and machinery therefor. November 16

15738 J. A. Yeadon, R. Middleton and H. T. Nodin, Leeds. An improved method and appliance for cleaving blocks or briquettes of fuel, or materials for smelting and analogous purposes. November 17

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

34 J. A. Yeadon and R. Middleton. Machinery for manufacturing blocks or briquettes of fuel, etc., for smelting purposes. November 2

670 J. Broad, J. W. Broad, G. P. Broad, and H. J. Broad. Night-lights. November 16

12811 A. McKune Margerison. Firelighters. October 25

13450 T. R. Dickson. Process and apparatus for manufacturing gas, and cyanogen or its compounds. November 9

13514. P. Jensen—From J. Leede and V. D. Stockbridge. Carburettors. November 9

13627 H. Kenyon. Production of illuminating gas, ammonia, etc., and apparatus therefor. November 9

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

COMPLETE SPECIFICATION ACCEPTED.

1886.

14840 J. Young. Carbonising or distilling coal or shale. October 26

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

14464 G. Pitt, London—From A. Weinberg, Prussia. A new class of diamido compounds and azo colours produced therefrom, and the process of producing the same. October 24

14646 C. A. Bennert, London. The manufacture or production of coloured compounds or colouring materials. October 27

14820 E. Ostermayer, London. Improvements relating to the production of iodised sulpho-acids of phenols, cresol, and thymol. October 31

15154 C. D. Abel—From G. C. Zimmer, Germany. Production of yellow, red, and violet colouring matters from tetrazodiphenyl and tetrazo-ditolyle. November 7

15265 G. Thomas, Manchester—From H. Schulz, Germany. The manufacture of a certain dye matter. November 9

15374 J. Y. Johnson—From the Badische Anilin and Soda Fabrik, Germany. Improvements in the manufacture or production of red colouring matters suitable for dyeing and printing. November 10

15459 S. Forel, London. The manufacture of yellow colouring matters by the reaction of tetrazodiphenyl or tetrazoditolyl on phenol or orthocresylol. Complete specification. November 11

15647 G. Tall and W. P. Thompson, Liverpool. Improvements in or relating to the separation or manufacture of colouring matter or mordant for dyeing purposes from cotton seed or cotton-seed oil. November 15

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

17083 J. Y. Johnson—From the Farbenfabriken vormals Bayer & Co. Manufacture of azo dyes. November 2

1887.

875 G. Thomas—From A. Zander. Manufacture of dye matters from red sanderswood and other woods. October 22

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

14196 H. M. Girdwood, Manchester. Improvements in retting, ungumming, washing, and otherwise treating rhea, ramie, or China grass, hemp, jute, flax and certain other fibres. October 19

14477 T. A. Boyd, Glasgow. Improvements in producing variegated or fancy yarns. October 25

15178 C. Robeson, Birmingham. Improvements in and in apparatus for cleansing and scouring wool. Complete specification. November 8

15364 D. Mason, Paris—From A. Schlamm and F. à Borassard, Germany. Improvements in treating wool. November 10

15693 T. G. Lee, Manchester. An improved means for rendering woven fabrics and other goods and materials non-inflammable. November 16

COMPLETE SPECIFICATION ACCEPTED.

1887.

12709 W. Nelson and E. Bowen. Apparatus for drying wool. October 22

VI.—DYEING, CALICO PRINTING, PAPER STAINING AND BLEACHING.

APPLICATIONS.

14092 F. R. Rothen, Manchester. Improvements in the method of and apparatus for dyeing, bleaching, impregnating and otherwise similarly treating yarn in bobbins and cops. October 18

14485 P. H. Booth, Leeds. Dyeing wool and woollen cloth and yarn, and all textile materials, either in the raw state, in process of manufacture, or manufactured, a fast and fadeless woaded green and other colours. October 25

14614 H. E. Newton—From the Actiengesellschaft für Papier und Druck Industrie Leykam Josefsthal, Austria. An improved process for bleaching jute. October 27

14813 D. Stewart and R. Walker, Glasgow. Improvements in machines for washing, soaping, or scouring piece goods. November 1

14850 J. Lodge, Huddersfield. A new treatment of worsted "tops" and other slivers of fibre for the production of an evenly mixed dyed yarn. November 1

15022 J. Lodge, Huddersfield. New or improved apparatus for dyeing worsted "tops" and slivers of fibre. November 4

15097 W. A. L. Hammersley, London. Improvements in machinery or apparatus for fulling, washing, scouring, cleaning, beating, softening, and beetling of yarns and textile fabrics. November 5

15350 M. Ashworth and R. Wild, Rochdale. Improvements in the means and method of and for the washing, scouring, boiling, and bleaching of fibres, fibrous materials, and textile fabrics, and the stripping of fibres from hides or skins, applicable for the like purposes for domestic or household use. November 10

15432 J. Grunhut, London. Improvements in dyeing. November 11

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

15340 W. H. Turner. Machines for printing designs on paper and other material, and for decorating earthenware, china, glass, etc. October 22

1887.

174 W. Birch. Apparatus for washing, soaping, dyeing, etc., woven fabrics. November 9

VII.—ALKALIS, ACIDS AND SALTS.

APPLICATIONS.

14127 L. Mond and G. Eschellmann, Liverpool. Improvements in the manufacture of chlorine. October 18

14345 The Tyne Alkali Company, Limited, and T. Gibb, London. Improvements in the manufacture of hydrate of baryta and of strontia, and the treatment of solutions containing barium or strontium for the obtainment of compounds thereof and other products, and the utilisation of the products so obtained. October 21.

14653 W. F. R. Weldon—From A. R. Pechiney, France. Improvements in apparatus suitable for preparing oxychlorides of magnesium. October 27

14654 W. F. R. Weldon—From A. R. Pechiney, France. Improvements in apparatus suitable for use in the process of desiccating oxychloride of magnesium. October 27

14906 C. Fahlberg, London. Improvements in apparatus for he production of phosphorus trichloride. November 2

14927 L. Gueret and C. Gueret, Liverpool. New or improved process and apparatus for obtaining a continuous and determined quantity of carbonic acid or other gas. November 2

14997 J. Hanson. The treatment of alkali waste for use in the purification and deodorisation of sewage and impure waters or matters. November 3

15168 H. Senier, London. A process for the separation of zinc hydrate as a crystalline body from solution in the fixed alkali hydrates. November 7

15189 F. J. Thompson, Hertford, Cheshire. Improvements in the manufacture of salt, and generation of steam or heat, by an improved furnace and system of firing employed therein. November 8

15237 L. R. Bazin, London. A process and apparatus for conversion of phosphates into thermophosphates. November 8.

15255 G. W. Hart, London. Improvements in obtaining carbonates of soda and other products, and in apparatus suitable for this purpose. November 8

15295 A. Feldman, London. Improvements in the production of the fluorides of magnesium, of strontium, and of barium. Complete specification. November 9

15540 G. E. Davis, Manchester. Improvements in apparatus for the distillation of ammoniacal fluids. November 14

15575 C. T. J. Vautin, London. Improvements in apparatus for the separation of solutions of metallic salts from pulverised material mixed therewith. Complete specification. November 14

15687 J. Dixon, Sheffield. Improvements in the method of and apparatus for concentrating and evaporating soda lye. November 16

15770 J. F. Madocks, Andover. See Class XV.

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

13654 L. Grabau. Manufacture of fluoride of aluminium, the double fluoride of aluminium, and an alkali. October 26

16199 W. B. Giles and A. Shearer. Manufacture of phosphoric acid. November 12

1887.

13746 B. J. B. Mills—From T. B. Fogarty. Process and apparatus for producing sulphate of ammonia. November 12

13747 B. J. B. Mills—From T. B. Fogarty. Process and apparatus for producing sulphate of ammonia. November 12

VIII.—GLASS, POTTERY AND EARTHENWARE.

APPLICATIONS.

14457 J. C. Ghest. See Class I.

14619 J. Armstrong, London. Forming necks or tops on glass bottles or other articles, and appliances therefor. Oct. 27

14951 T. Minton, H. Minton-Senhouse, H. Minton Robinson, J. Clegg and J. Lea, London. A new method of printing on pottery and tiles, and apparatus therefor. November 2

15096 S. Fenn and A. Fenn, Birmingham. Improvements in fireplaces of kilns or ovens for burning bricks, pipes, terra-cotta, tiles, and other articles. Complete specification. Nov. 5

15119 D. Grant, London. A novel process of producing artistic and commercial devices in and upon glass. Nov. 11

15690 G. Wood, Leeds. Improvements in apparatus employed in the manufacture of glass. November 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

15340 W. H. Turner. See Class VI.

15678 H. Sulley. Manufacture of glazed pavement lights. October 26

16833 W. D. Cliff. Manufacture of porcelain and metal baths. October 22

1887.

354 D. Rylands and B. Stoner. Manufacture of glass bottles, jars, etc. November 12

576 P. M. Justice. From the Société Anonyme des Manufactures de Glaces, Verres, Vitres, etc. Apparatus for handling crucibles used for melting glass. October 29

2076 J. C. Mitchell. Producing plain and ornamental designs on glass. October 29

6779 W. Lutwyche—From J. Valère. Ornamenting glass ceramic ware and metal by means of translucid and opaque enamels in relief. November 5

9292 M. F. L. Ehrlich. Producing dead gold (silver platine) decorations on china, crockeryware, glass, and enamelled metals. November 9

IX.—BUILDING MATERIALS, CLAYS, MORTARS AND CEMENTS.

APPLICATIONS.

14286 J. Tennyson, London. Improved method of and devices for laying asphalte roadways, yards, and other analogous surfaces. October 22

14392 G. J. Snelus, W. Whamond, and T. Gibb, London. Improvements in the manufacture of cement. October 22

14393 G. J. Snelus, W. Whamond, and T. Gibb. Improvements in the preparation or manufacture of cements. Oct. 22

14394 G. J. Snelus, W. Whamond, and T. Gibb. An improved manufacture of cements. October 22

14551 E. B. Lee, Manchester. Improvements in the manufacture of concrete and cement fireproof building materials and parts of buildings, bridges, and other structures, safes, strong rooms, slabs, blocks, baths, tanks, and other articles, parts, and receptacles. October 26

14875 P. S. Larsen, London. Improvements in the process of crushing and screening clay. November 1

14897 P. von Krystoffovitch. An improved process for the manufacture of artificial granite. Complete specification. November 1

15028 J. Lauder, Glasgow. Improvements in artificial stone for flooring, paving, decorating, and like purposes. Nov. 4

15065 F. Ransome, London. Improvements in the manufacture of cement. November 4

15395 R. A. McGregor, London. Bricks, blocks, tiles, and any article made of clay, porcelain china, stone, terra-cotta, or other material used for building of houses, sewers, arches, etc. November 10

15596 J. W. MacKnight, London. Improvements in artificial pavement. November 15

15634 J. Gay and F. W. Wood, Northfleet. The manufacture of firebricks and other fire goods. November 15

15666 G. M. F. Layton, London. Improvements in the manufacture of cement. November 15

15733 J. W. T. Stephens, Cardiff. The manufacture of Portland, Roman, and other cements. November 17

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

424 W. White. Roads and pavements, and paving blocks therefor. November 2

11283 W. Bull. Manufacture of tiles for roofing. Nov. 5

X.—METALLURGY, ETC.

APPLICATIONS.

14159 F. L. Tirmann and H. Tirmann. See Class XXI.

14174 J. S. MacArthur, R. W. Forrest, and W. Forrest, London. Improvements in obtaining gold and silver from ores and other compounds. October 19

14221 A. B. Cunningham, London. Improvements in the reduction of lead, silver, and other metals, and apparatus therefor. October 19

14271 S. J. Evans, London. Improvements in hydraulic apparatus for preventing upsetting of converters employed in the manufacture of steel, which improvements are applicable also to hydraulic centre cranes. October 20

14311 T. C. R. Horsfield and R. Porter, London. An improved hydraulic press for mining coal and other minerals, or for other purposes requiring pressure. October 21

14356 L. Grabau, London. Improvements relating to the production of fluoride of aluminium. October 21

14371 J. Toy and S. H. Stevens, Helston. Improvements in machinery for reducing tin stuff and other partially pulverised ores to extract the metal therefrom. October 22

14451 T. Elford, G. Ackland, and R. Morgan, London. Improvements in calcining and melting copper, lead, and other ores and regulus. October 24

14452 J. A. Crawford and R. M. Black, London. Improvements in the manufacture of steel and of malleable iron. October 24

14457 J. C. Ghest, London. See Class I.

14458 F. von Ehrenworth, London. Improvements relating to the blasting of coal and other substances in mines, and to apparatus therefor. October 24

14470 M. Settle, Manchester. Improvements in or applicable to cartridges employed for blasting in mines and other places where inflammable gases are present. October 25

14482 E. B. Smith—From J. Brown, New Zealand. Improved construction or arrangement of surfaces for separating gold or other fine metal particles from quartz or earthy matters. October 25

14492 C. E. Moncrieff, Belfast. Improvements in means of raising rock salt from the mine. October 25

14515 M. Gledhill, London. An improved method of and machine for forging metals, chiefly designed for the manufacture of tubes, cylinders, shafts, and similar work. October 25

14602 C. Netts, London. Improvements in the manufacture of sodium and potassium, and in apparatus therefor. Oct. 26

14617 H. H. Lake—From A. Breden, Austria. Improvements relating to the electro-deposition of silver and nickel upon iron, steel, and other metals. October 27

14661 J. H. Bell and W. Rockcliffe, Sunderland. Improved plates for ship-building and other purposes. October 28

14687 A. M. Crossley, Glasgow. Improvements in making spiegeleisen or ferro-manganese. October 28

14700 L. A. Groth—From V. and E. Rouff, Paris. Improvements in the manufacture of chrome and its alloys. Oct. 28

14723 W. Crawford and J. Crawford, Glasgow. Improvements in shaping sheet iron, steel, or copper into vessels of various forms, and in apparatus therefor. October 29

11750 W. Lloyd, London. Improvements in the lining or fettling of puddling and other furnaces employed in the manufacture and heating of iron and steel. October 29

11784 B. C. Tilghman, Manchester. An improvement in pig iron. October 31

11792 H. J. Allison—From J. B. D'Arcy Boulton, United States. Improvements in process for casting metallic ingots. Complete specification. October 31

11793 J. E. Bott and C. H. Cousins, London. Improvements in the manufacture of cast-steel shells and projectiles, also applicable to other forms of steel castings. October 31

11803 W. Hawdon, London. Improvements in apparatus for removing molten slag, scoria, and other similar materials from furnaces. October 31

14810 W. L. Purves, London. Improvements in tempering steel. October 31

14901 C. W. Kitts, London. An improved apparatus for distributing, mixing, separating, grinding, cleaning, and amalgamating gold or other ores or tailings. November 2

15029 J. G. Beckton, Middlesbrough-on-Tees. Improvements in ingot moulds for casting steel and other metals. Nov. 4

15042 J. Tibbs, London. A new or improved covering for the bottoms of puddling furnaces. November 4

15109 A. Gutensohn, London. Improvements in apparatus for and method of pickling or cleaning the surface of iron, steel, or other metals. November 5

10199A H. C. Bull & Co. Limited, and H. Clay Bull London. Improvements relating to the production of aluminium alloys. November 10: but dated July 21, when originally filed

15185 M. Swain, Manchester. Improvements in the manufacture of hollow-ware. November 8

15245 F. J. Legge, Liverpool. Improvements in or appertaining to the manufacture of tinned or terne plates. Nov. 8

15257 W. B. Middleton, London. Method of welding steel. Complete specification. November 8

15271 M. Darnbrough and E. Darnbrough, Drighlington. Appliances to prevent the oxidation of tin, lead, or zinc, when used in tempering coating, or galvanising steel or iron wire. November 9

9389 A. C. A. Burghardt and W. J. Twining, Manchester. Improvements in the production of aluminium. Received November 11; antedated July 2, when originally filed.

15417 T. Slater and J. Laidlaw, London. An improved method of coating cast-iron or wrought-iron with other metal or alloys thereof. November 11

15425 J. Westgarth, Manchester. Improvements in and connected with galvanising and similarly coating metals. Nov. 11

15422 J. Nicholas and H. H. Fanshawe, London. A mode of and apparatus for the recovery of aluminium and other earthy metals from ores. November 11

15448 G. Trier—From E. Fischer, Denmark. Improvements in the preparation of spongy lead for use in secondary batteries or accumulators. November 11

15474 H. Hobson, Manchester. Improvements in apparatus for pulverising minerals and other hard substances and materials. November 12

15504 A. N. Contarini, London. Improvements in the process of separating precious metals from their ores, and in apparatus to be employed therein. November 12

15515 A. B. Cunningham, London. Improvements relating to the production of aluminium and aluminium alloys. November 12

15574 C. T. J. Vautin, London. Improvements in apparatus for the extraction of gold from crushed or other finely-divided auriferous material. Complete specification. November 14

15593 L. Grabau, London. Improved processes and apparatus for the production of aluminium and compounds or alloys containing the same. November 14

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

13183 B. H. Thwaite. Pneumatic process of manufacturing steel ingots and castings. October 22

12654 L. Grabau. See Class VII.

12682 J. R. Turnock. Machinery for coating metal sheets. October 29

13928 J. E. Baugh and C. Hinksman. Humid reduction of gold and other ores. October 29

14297 J. Nicholas. Smelting and recovering metals from ores and dross. November 5

15040 P. Rogers and J. Player. Machine for coating metal sheets with tin, lead, or other metal or alloy. October 22

16017 G. Ashworth and E. Ashworth. Apparatus for hardening and tempering steel wire and tape. November 12

16196 J. Lauer. Firing blasting charges in mines, and means therefor. October 29

1887.

271 T. B. Sharp. Manufacture of copper and other tubes and apparatus therefor. November 5

285 E. Hunt—From G. Thomson. Obtaining silver from ores, mattes, etc. November 9

331 J. Vavasseur. Steel projectiles. November 12

1751 H. H. Lake—From Count de Montgelas. Extracting aluminium from its chlorides, and apparatus therefor. Nov. 12

4581 R. H. W. Biggs. Extracting tin from iron or tin scraps, and apparatus therefor. November 5

11613 F. A. Herbetz. Cupola furnaces for smelting metals and burning malachite, dolomite, etc. October 26

11900 A. J. Shannon. Extracting antimony from its ores. November 9

12353 H. Le Neve Foster. Fire-resisting compound for forming the stoppers and nozzles used in steel-melting operations. November 5

12486 O. M. Thowless. Production of sodium and potassium, and apparatus therefor. November 5

XI.—FATS, OILS AND SOAP MANUFACTURE.

APPLICATIONS.

14187 W. Lincolne and J. Templeman, Glasgow. Improvements in the manufacture of soap. October 19

14285 J. Thomson, London. An improved mercurial antiseptic soap. October 20

14627 C. Baines and W. Thompson, London. Improved compound suitable for washing, scouring, and cleaning purposes. October 27

14693 M. J. Whibley, H. G. Whibley, and A. Williams, London. Improvements in the decolourising and deodorising of tallow, grease, and similar substances. October 28

15054 M. J. Hartung and W. Gallagher, London. An improvement in the manufacture of lubricating oils and greases. Complete specification. November 4

15134 F. Workman, H. Workman, and A. Workman, London. Improvements in presses suitable for extracting oil from linseed, and for other purposes. November 7

15314 H. Wiesinger and L. Rissmuller, London. Method of manufacturing 100 per cent. soap free of water. November 9

15490 J. W. Lord, London. Improved apparatus for expressing oil from substances. November 12

15491 J. W. Lord. Improvements in the treatment of oils for their purification. November 12

15774 C. Williams, London. Improvements relating to purifying compounds for textile materials, and to washing powders. November 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

14729 H. Mackay. Preparation of oils for medicinal purposes. October 29

1887.

4 R. Tervet. Apparatus for treating or purifying paraffin wax. November 2

1893 W. Hicks. Manufacture of lubricating grease. Nov. 2

XII.—PAINTS, PIGMENTS, VARNISHES AND RESINS.

APPLICATIONS.

15231 P. M. Justice—From M. B. Church, United States. Improved process of coating or painting applicable to carriage bodies and other surfaces. November 8

15320. J. Hickisson, London. Improvements in the manufacture of coloured marking ink pencils, and in the mordants or fixers to be employed therewith. November 9

15381 K. McLea and R. Punshon, London. An improved paint or varnish for iron, steel, metal, and tarpaulins. Nov. 10

15406 A. Orr, Glasgow. Improvements in making white lead. November 11

15771 F. Crane—From W. D. Field, United States. Improvements in or connected with varnishes. November 17

15772 F. Crane—From W. D. Field. Process for purifying or clarifying resins and gum resins, or solutions of the same. November 17

15773 F. Crane—From W. D. Field. Improvements in the manufacture and composition of varnish. November 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

16832 H. Buczkowski. Polish (soluble in water) for leather. October 22

1887.

12632 J. C. Lyman—From J. H. Lyman. Waterproof compositions or paints. November 2

13109 S. C. Rowell and J. W. Newell. Manufacture of plumbic oxide or litharge, and apparatus therefor. November 12

XIII.—TANNING, LEATHER, GLUE AND SIZE.

APPLICATIONS.

11096 H. J. Allison—From J. J. Asch, United States. Improvements in fur-dyeing ovens. Complete specification. October 18

14129 J. E. Darby and E. Blakeslee, London. Improvements in process of impregnating chamois skin with rouge. Complete specification. October 24
14699 L. A. Groth—From C. Collin and L. Benoist, Paris. Antiseptic treatment of skins before or after training. Oct. 28
15766 C. Collin, L. Benoist, B. Nicholson, and T. Palmer, London. Improvements in means for preventing the formation or development of injurious germs of animal or vegetable life, applicable to the treatment of hides or skins. Nov. 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

16617 A. Bedu. Manufacture of substances suitable for tanning. October 22
16894 J. Straiton. Apparatus for burring, cleaning, and unhairing or softening skins. October 29

XIV.—AGRICULTURE, MANURES, Etc.

APPLICATIONS.

14151 H. H. Lake—From P. B. Rose, United States. An improved fertiliser. Complete specification. October 18
14701 F. H. Danchell, London. A new or improved manufacture of manure. October 28
15309 J. Davenport, London. Improvements in the manufacture of fertilisers or manuring compounds. Complete specification. November 9

XV.—SUGARS, GUMS, STARCHES, Etc.

APPLICATIONS.

14164 G. Fletcher, London. Improvements in the evaporation and concentration of sugar-cane juice and other liquids, and apparatus therefor. October 18
14801 B. E. R. Newlands, London. Improvements in means or apparatus for drying slabs of sugar, applicable for heating and cooling other articles, and for analogous operations. October 31
14883 A. Brin and L. Q. Brin, London. Improvements in the treatment of saccharine and sacchariferous matters for the purpose of decolorising, purifying, or refining them. Nov. 1
14884 A. Brin and L. Q. Brin, London. Improvements in the treatment of saccharine and sacchariferous matters for the purpose of decolorising, purifying, or refining them. Nov. 1
15770 J. F. Maddocks, Andover. The direct steam boiling of acid solutions generally, and the inversion of cane sugar in particular. November 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

15115 J. Baker, J. A. Baker, W. K. Baker, and G. S. Baker. Machines for manufacturing sugar wafers, etc. October 22
16827 H. Vivien. Apparatus for the manufacture of refined sugar, glucose starch, etc. October 26

1887.

165 C. D. Abel—From Pfeifer and Langen. Method for extracting foreign substances (raffinose, etc.) from sugar solutions by means of lead. November 5
12831 N. Tscherikowski. Producing refined sugar from raw sugar. November 12

XVI.—BREWING, WINES and SPIRITS.

APPLICATIONS.

14189 D. Mason—From V. d'Ostachiewicz and L. de Gerlicz, France. Improvements in the process and use of substances for the production of alcoholic fermentation. October 25
14518 J. F. Henderson, London. Improvements in or applicable to the manufacture of wine. October 25
14737 T. G. Bowick, Harpenden. An improved process and apparatus for purifying alcohols by means of hydrocarbons. Complete specification. October 29

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

54 P. Weinig. Malt germinating apparatus. October 22
521 E. Beanes. Treatment of wines of the port and claret class. October 26

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

APPLICATIONS.

A.—Chemistry of Foods.

14095 H. J. Allison—From The De la Vergne Refrigerating Machine Co. Limited, United States. An improved process for refrigerating by compression and expansion of gases, when such gases are compressed in contact with or in presence of lubricating liquids. Complete specification. October 18
14378 S. Puplett and J. L. Rigg, Knowle. Improvements in apparatus for mechanical refrigeration, and for the artificial production of ice. October 22
14410 L. Sterne—From J. C. de la Vergne, United States. Improvements in the manufacture of pure ice, and apparatus therefor. Complete specification. October 24
14527 J. F. Henderson, London. Improved compounds of coffee and cocoa. October 25
14711 S. M. Macrory, London. Improvements in the treatment of vats, and obtaining a new product therefrom. Oct. 28
14744 E. Scherff and C. Drenckham, London. An improved process for condensing milk and other fluids containing proteine, and preserving the same in glass or other hermetically closed vessels. Complete specification. October 29
14945 N. P. M. Tronson, London. Manufacture of a food for animals from wood. November 2
15502 A. Horn, London. Improved means of applying saccharine as a preserving and sweetening agent Nov. 12
15578 J. Hofmann, London. Improvements in the manufacture of brown bread. November 14

B.—Sanitary Chemistry.

14364 J. Greenwood, Keighley. Improvements in valves applicable for the outlets of sewage tanks, barrels, and the like. October 22
14656 T. Glennie, Glasgow. A new system of sewage disposal. October 28
14857 A. Engle, London. A furnace for and process of burning wet and offensive substances. Complete specification. November 1
14982 F. A. Hillé, London. Improvements in treating sewage, and in liquid disinfectants used for that purpose. November 3
15381 E. Hermite, E. J. Paterson, and C. F. Cooper, London. A process for disinfecting impure liquids. November 10
15385 E. Hermite, E. J. Paterson, and C. F. Cooper. Apparatus for disinfecting impure liquids by electrolytic action. November 10
15431 W. C. Roberts, Putney. An improved construction or arrangement for chemically charging water-closets to prevent the formation of noxious gases, and to destroy offensive smells arising from soil pipes, drains, etc. November 11
15519 S. Holman, London. Improvements in means or appliances for exhausting or consuming foul air or gases from sewers, or other places containing foul air or gases, and for effecting ventilation of the same; applicable also for heating purposes. November 12

C.—Disinfectants.

14861 W. B. Giles and A. Shearer, Stratford. The manufacture and application of new antiseptic and disinfectant substances. November 1
15564 A. Boake, F. G. A. Roberts, A. Shearer, and W. B. Giles, London. An improved manufacture or preparation of antiseptics. November 14
15668 W. J. Cooper, London. An improved antiseptic or disinfectant. November 15

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods,

1887.

4063 W. L. Wise—From C. A. Wahlin, A. Forssell, and F. L. Enquist. Treatment of milk. October 29

B.—Sanitary Chemistry.

1887.

13781 W. Mann. Refuse burners. November 12

C.—Disinfectants.

1886.

16834 F. H. Weber. Candles for fumigating or deodorising. October 22

1887.

276 C. T. Kingzett. Solutions for use as antiseptics, disinfectants, deodorants, oxidants, and general sanitary reagents. October 26
381 J. S. Stevenson, M.P., and J. G. Tatters. An improved disinfectant and oxidising agent. November 9
402 H. Schlichter. Platinum lamps for deodorising and disinfecting. November 9
451 R. V. Tuson. Production of powders for disinfecting and deodorising. November 9

XVIII.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

14107 N. G. Thompson, London. Continuous current commutatorless dynamos. October 18

14222 A. S. Elmore, London. Improvements in the electrolysis of aqueous solutions. October 19

14259 C. Hall and H. Binks, London. Improvements in the application of primary batteries for electric signals, telephones, lights, or other purposes. October 20

14270 B. J. B. Mills—From E. Emerson, United States. Improvements in means or apparatus to be employed in the production of sheet copper by electro deposition. October 20

14273 A. J. Littleton, Sydenham. Separating the plates of secondary batteries. October 20

14426 Sir C. S. Forbes, Bart., London. Producing voltaic electricity by means of a cell of which the positive element consists of an amalgam of either sodium or potassium or of both. October 21

14461 A. Stetson, London. Improvements in electric accumulators or secondary batteries. October 24

14622 E. W. Vaughton, Birmingham. An improved electric accumulator. October 27

14729 W. H. Douglas, Birmingham. An improved meter for measuring electrical currents. October 29

14901 C. R. Goodwin, Paris. Improvement in electric batteries. Complete specification. November 2

14954 W. Terrill, London. Improvements in apparatus to be used in the deposition or treatment of metals by the electrolytic process. November 2

15063 D. Skrivanow, London. Improvements in galvanic batteries. November 4

15141 A. F. St. George and C. R. Boune, London. Improvements in galvanic batteries. November 7

15259 T. J. Jones, London. An improvement in voltaic batteries. November 8

15321 J. Pitkio, London. Improvements in electrical storage batteries. November 9

15323 A. Schanschieff, Gipsy Hill. Improvements in galvanic batteries. November 9

15385 E. Hermite, E. J. Paterson, and C. F. Cooper. See Class XVII. (B.)

15392 H. J. Haddan—From B. Scheithauer, Germany. Improvements in primary batteries. November 10

15532 S. Joyce, London. Electric explosives. November 14

15555 W. M. Mordey, London. Improvements in and pertaining to electric motors and their application for charging secondary batteries or accumulators. November 14

15588 J. Y. Johnson—From W. C. Recknicwski, France. Improvements in dynamo-electric machines. Complete specification. November 14.

15730 J. V. Sherrin, Ramsgate. Improvements in galvanic batteries. Complete specification. November 16

15751 W. J. S. Barber-Starkey, Manchester. Improvements in the electrolytes of secondary voltaic batteries. Nov. 17

15760 W. Webster, jun., London. Improvements in the electrolytic treatment of sewage and sea-water for the production of certain products therefrom, and apparatus therefor. November 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

15831 F. E. Elmore. Apparatus for the deposition or obtainment of metals by electrolysis. November 5

1887.

114 W. A. Leipner. Dynamo-electric and electro-dynamic machines November 12

4303 W. Main. Secondary and other batteries. October 22

13722 C. E. Ponder, J. McGregor, and P. Harris. Secondary batteries. November 12.

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

14521 C. J. Richardson and R. Squire, London. Improvements in apparatus for the manufacture of paper. October 25

14733 J. Jameson, Newcastle-on-Tyne. Improvements in the preparation of safety paper, affording protection against erasure or other alteration. October 29

15386 C. Morfit, London. Improvements in the manufacture of paper. November 10

15419 C. Morfit, London. Improvements in the manufacture of paper. November 11

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

14614 D. Allport. Incorporating wire with paper, paper-pulp, wood-pulp, etc. November 9

1887.

8391 J. Craig—From C. H. Hanbold. Manufacture of paper suitable for use for calender bowls. October 22

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

APPLICATIONS.

14459 A. Brunn, London. Improvements relating to the production of peptone and maltose or maltose substances. October 24

14689 W. Stevenson and R. Howell, London. Improvements in the manufacture of aerated beverages and syrups and essences for carbonating or flavouring purposes. October 28

15587 C. D. Abel—From W. Roser, Germany. Improvements in the production of alkaloids. November 11

XXI.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

14159 F. L. Tirmann and H. Tirmann, London. Improved percussion fuses for shooting and blasting purposes, especially applicable for working in mines infected with fire-damp. October 18

14390 R. Morris, London. An electric firing fuse or primer. October 22

14470 M. Settle. See Class X.

15532 S. Joyce, jun., London. Electric explosives. Nov. 14

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

391 W. Bickford-Smith and G. J. Smith. Means of igniting fuses without exposing flame or sparks. November 9

393 W. Bickford-Smith and G. J. Smith. Means of igniting fuses without exposing flame or sparks. November 9

11658 E. Edwards—From R. Sjöberg. Explosives. Nov. 2

XXII.—ANALYTICAL CHEMISTRY.

APPLICATION.

15667 B. Nieholson and T. Palmer—From C. Collin and L. Benoist, France. A process for testing or estimating the strength of solutions of tannin. November 15

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Notice is hereby given that the numbers for January 1882, 1883, and 1886, and February, 1886, are exhausted, and no orders for those copies can be executed.

The Secretary is instructed to negotiate for the purchase of copies of the Society's Journal for January, 1882, at the price of 5s. each. Members possessing odd copies of this number are particularly requested to communicate at once with Mr. Cresswell.

Authors of communications read before the Society or any of its Local Sections are requested to take notice that, under Bye-Law 43, they cannot receive the prescribed 50 copies of their communications unless they comply with the condition laid down in that Bye-Law—viz., that they give notice of their desire to receive such copies upon their manuscript before sending it to the Editor. Mention should also be made as to whether the Discussion is to be included in the reprint.

Members are requested to note that the subscription of 25s. for 1888 falls due on the 1st January. Cheques and orders should be made payable to the Honorary Treasurer, Mr. E. Rider Cook, and forwarded either to him, at Bow, or to the General Secretary. Until payment is made members are not entitled to the Society's Proceedings, under Rule 29 of the Bye-Laws.

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Thos. Snape, Phœnix Alkali Works, Widnes, alkali manufacturer.

Oscar J. Steinhart, 47, Earl's Court Square, South Kensington, S.W., Ph.D., chemist.

Death.

R. R. Kelly, l o 3, Pall Mall East, London, S.W.

Communication.

REPORT ON SECTION III. OF THE MANCHESTER ROYAL JUBILEE EXHIBITION:

THE CHEMICAL AND ALLIED INDUSTRIES.

BY WATSON SMITH,

Lecturer in Chemical Technology in the Victoria University, etc.

(Continued from p. 701.)

GROUP X.—FATS, OILS, AND SOAPS.

Joseph Crosfield & Sons, Warrington (No. 838).—Toilet and household soaps, and more especially a Turkish temple, entirely built of cakes and blocks of soap. The structure was so arranged that whilst in it elegance and artistic effect were combined, yet every variety and colour of soap was brought in and exhibited. A silent hand stamping machine was shown in operation, producing small tablets of the speciality of the firm, the "Perfection" soap, in which it is claimed that no free alkali and only very little free fat are present.

Joshua Margerison & Co., White Windsor Soap Works, Preston (No. 842).—Besides samples of various soaps are elegant designs in the speciality of the firm—viz., a scented white curd soap.

William Brown, Victoria Soap Co., Limited, 47, Oldham Road, Manchester (No. 844).—Specimens of soaps for silk throwing, spinning and dyeing, cotton sizing and feeding; also prepared soap for cops. Fulling and scouring soaps.

T. B. Rowe & Co., Thames Soap Works, Brentford, London (No. 845).—The exhibits of this firm consist of a variety of soaps for manufacturing purposes, as follows:—

(*a*) *White Oil Soap*, a neutral emollient soap used by China silk throwsters, and manufacturers of machine-made writing papers.

(*b*) *Refined Curd Soap*, used by white silk throwsters and cotton bleachers.

(*c*) *Mottled Soap.*—This is used by calico printers, by clothiers for milling and scouring, and for domestic and laundry purposes.

(*d*) *Bengal Yellow Soap*, used for "boiling off" Bengal silks, and for softening and glossing them.

(*e*) *Brown Oil Soap*, used by general silk dyers as an addition to certain dye baths.

Since the duty on soap was abolished in 1852 there have been no means of estimating accurately the amount of soap annually produced, but it was calculated that in 1881 the quantity had risen to 225,000 tons.

James Alexander & Co., 18, Paradise Street, Lambeth, London (No. 846).—Savon Hamamelis Virginica, or Hazel soap. (See this Journal, 1885, p. 563.)

Gray, Smith & Bennett, Rockingham Soap and Starch Works, Wath-upon-Dearne, Yorkshire (No. 847).—Household soaps, toilet soaps, soft soap, dry soap, milling and scouring soaps, starch, and various chemicals, tallow, etc., used in the manufacture of these articles, their annual production amounting to about 1500 tons.

David Shaw & Co., 35, Market Street, Manchester (No. 858).—Machinery oils suitable for cotton and woollen industries, some of which are known as *stainless oils*. *Cylinder oils* are shown in the various stages of manufacture, from a dark green to a pure white. *Prepared tallow* for engines, and oils suitable for railway and colliery lubrication, *oleine*, *cloth*, *wool*, and *soap oils*, and the tallows and fats from which they are made. Samples of yarns spun, and scoured with these oils are also shown. A variety of greases, showing the various stages of distillation and refining. *Lanolin*, made from the grease recovered from wool scouring liquors, *olive*, *fish*, *animal*, and *seed oils*, *chemical manures*, *paraffin wax*, and a bust in stearin made from tallow and palm oil, are also exhibited.

A. B. Fleming & Co., Limited, Caroline Park, Edinburgh; and 67, Piccadilly, Manchester (No. 859).—Patent solidified oil and lubricators, spindle, loom and engine oils, cylinder and valve oils, Russian and American colliery greases. The new mineral fibre, known as *agalite*, both in its native rock-form and ground. The special features of this exhibit are the solidified oil and the agalite. The first of these is a lubricant intended to replace tallow and suet. Tallow often contains acid and suet always leaves a residue of membranous matter, and both these lubricants act injuriously on india-rubber valves. It is claimed that the solidified oil has none of these drawbacks. *Agalite* is a fibrous silicate of magnesia, similar to asbestos. It is obtained from America in the form of a powder, which under the microscope is seen to consist of small elastic fibres. It is used by paper-makers as a "loading" for paper instead of China clay, and for this purpose from 6000 to 7000 tons are consumed annually.

John Sandeman, Ruchill Oil Works, Maryhill, Glasgow (No. 860).—Specimens of greases prepared from mineral oils, for use in collieries, and for carts, cogwheels, etc. Rosin oils, used for printing ink, jute-batching, etc. Siccative, used as substitute for linseed oil in paints and varnishes. Rosin spirits and rosin pitch.

Edwin Washington Wollaston, 12, Dutton Street, Manchester (No. 867).—This firm exhibits lubricating and burning oils, as enumerated below. (1.) Oils and tallow; oils for all kinds of machinery. These oils are stated to be free from acidity and mucilage. (2.) Burning oils, for lamps of all kinds; colza oil, refined rape oil, cotton seed oil, colliery lamp oil, marine lamp oil, brown rape oil, seal oil, petroleum oil. (3.) Various oils for machinery, calico printers, dyers and finishers, woollen mills, bleachers, painters, etc., etc. The oil trade comprises a great variety of productions from animal, vegetable and mineral sources. In Manchester and the district within 30 miles, the chief sale of oil is for machinery, spindles, looms, and engines. For this purpose mineral or hydrocarbon oils have largely taken the place of sperm, animal, and other oils, and the average price has been reduced from about 8s. per gallon to 1s. 6d. per gallon.

The superiority of mineral oils as lubricants for machinery rests on the fact that being hydrocarbons, and having a somewhat inert character they do not decompose and give rise to corrosive and sticky products under the action of steam, heat, and the oxygen of the air, as do the ordinary vegetable and animal oils: the latter are of course composed of glycerol and fatty acids, and under the influences mentioned oxidise and produce sticky resinous substances, or they decompose more or less readily according to their origin and quality into the component parts referred to. The liberated fatty acids act very energetically upon iron, especially under the influence of steam, hence in ocean steamers mineral oil has practically displaced tallow as a lubricant for the cylinders of the steam engine. The chief point to be attended to is the selection of a mineral oil of such viscosity that it is entirely adapted to the light or heavy character of the machinery and its bearings. So many improvements have been effected in the distillation, etc., of mineral oils in recent years, that it has now become possible to obtain an oil suitable for every possible purpose of lubrication. The average prices given below, for the various oils and tallow in 1870, 1880 and at the present time, show a great reduction in value:—

	1870			1880			1887		
	s.	d.		s.	d.		s.	d.	
Olive oil	54	0	per cwt.	44	6	per cwt.	36	0	per cwt.
Rape oil	46	6	,,	32	0	,,	21	0	,,
Linseed oil	33	6	,,	28	6	,,	22	0	,,
Cotton seed oil	35	0	,,	28	0	,,	21	0	,,
Palm oil	38	6	,,	31	0	,,	20	0	,,
Cocoa-nut oil	47	6	,,	38	6	,,	38	0	,,
P. T. C. Tallow	47	0	,,	43	0	,,	32	0	,,
Mineral oil	15	0	,,	10	0	,,	6	0	,,
Lard oil	6	0	per gall.	3	3	per gall.	3	4	per gall.
Sperm oil	7	0	,,	4	9	,,	3	0	,,

Joseph Kershaw & Co., Hollinwood, near Manchester (No. 869).—Samples of non-conducting composition for coating steam boilers, steam pipes, and all steam heated surfaces, also a variety of greases, soaps, lubricants, and paints, etc. Thirty years ago steam heated surfaces were usually left bare, and nothing was adopted as a non-conducting coating to prevent loss of heat. Later, well-mixed mortar and hair was used, then laths and a second coating of the mortar and hair were applied, and finally cloth was put over all and painted. At the present day there is a large number of non-conducting compositions in the market, and this firm particularly claims for its composition, that it is very hard, does not shrink, and is not destroyed by the continual heat to which it is subjected.

Wm. Gossage & Sons, Widnes, Lancashire (No. 872).—A most elegantly constructed pavilion containing large specimens in illustration of the history, chemistry, and manufacture of ordinary English soaps. The chemical substances employed in soap-making in former times and as now used. Palm plant, with fruit from which palm oil, as imported from Africa, is made. Raw palm oil as imported. Cocoa-nuts, in fibre and divested of fibre. Coprah, the dried fleshy part of the cocoa-nut, from which cocoa-nut oil is expressed. Palm nuts and palm kernels from which palm-kernel oil is made. Cotton seeds from Egypt, from which cotton oil is produced. Kelp weed. Kelp salts, as used by soap makers before the invention of Le Blanc revolutionised the soda manufacture of the earlier period. Soda ash. Caustic soda and soda crystals. Spent lye, waste liquor from soap making, the largest source of glycerin. Crude glycerin. Pure glycerin, fit for dynamite making. Imitation sample of nitro-glycerin and cases (empty) in which dynamite is usually packed to form dynamite cartridges. Silicates of soda and potash, both solid and liquid. Besides the employment of silicate of soda (water glass) in soap making, it is also used largely in the manufacture of artificial stone, and in calico printing The calico with which this court was draped had been printed by a process in which silicate of soda served as "fixing agent" for the alumina of the alumina mordant employed.

Lever Brothers, Sunlight Soap Works, Warrington (No. 873).—The exhibit of this firm consists of samples of their soap, known as the "sunlight soap." They show the "stamping" process by which the soap tablets are produced, also a series of illustrations of the methods of using the soap, and a complete model to scale in fibrous plaster of the "Sunlight" Soap Works at Warrington. The whole was enclosed in a beautiful pavilion resembling a Turkish Mosque, and adjoining that of Messrs. Gossage & Sons, which it almost rivalled in elegance. It is claimed for the "sunlight" soap, that it is perfectly saponified and only contains a trace of free alkali.

In this Section the department of soaps, oils, greases and fats, was most largely represented, besides those mentioned the following firms also exhibited:—N. Kilvert & Sons, Henry Shaw & Co., David Thom & Co., William Brown, Chiswick Soap Company, Hazlehurst & Sons, J. C Paton & Son, Geldart & Co., Roy & Co., Bignall & Co., Smith & Forrest, Robert Brown & Co., The Health Soap Company, George & George W. Skelton, George Fairclough, Senior & Brooks, Limited, Colledge Roy & Co., Broadbent & Son, J. Veitch Wilson, Halliday & Co., W. H. Samuel & Co., James Light & Son, and Robert Oliver & Co.

GROUP XI.—TANNING, LEATHER, GLUE, GELATIN, ETC.

William Walker & Sons, Rose Hill and Bark Street Tanneries, Bolton (No. 874).—This firm exhibits English sole leather (bends), shoulders, bellies, and the curried goods known as English strap-butts, welt-shoulders, and clog-butts. The art of manufacturing sole leather, and some species of upper leather, has been known from ancient times, but it is only during the last half-century that tanning has become a science, and that the value of chemistry has been appreciated by the tanner. The manufacture of strap-butts is a growth of the present century, and it has naturally developed with the increased application of machinery throughout the world, until now it may be estimated that there are manufactured from English strap-butts alone upwards of from 35 to 40 million feet of belting per annum. The manufacture of "clog-butts" is mainly confined to this country, and is not an increasing industry. Probably less than a million pairs of clogs are made annually in England, and these are made entirely from English leather. The number of hides and skins imported into this country for English consumption may be roughly estimated at about 9,000,000 per annum, the bulk of which come from South America, the Cape, Australia, Brazil, Madagascar, and the West Indies. With regard to English hides, if we take as a basis the amount of beef consumed in Lancashire, the supply of hides will be about 195,000 to every half-million inhabitants. This would mean a total of about 10,000,000 English hides per annum, and about 1,000,000 calf skins. The value of these hides (in all about 20,000,000) is probably 15 to 18 millions sterling, and this value, after the cost of tanning, and perhaps currying has been added, will probably be increased to something between 30 and 40 millions sterling. (For statistics of exports and imports, see description of exhibit 878.) The chief tanning agents used in England are, oak bark, stripped in English and Belgian forests, valonia from Smyrna, myrabolams from the East Indies, divi divi, Mimosa bark, hemlock, and other extracts used in smaller quantities. The staple agents used in currying are cod oil from Newfoundland, and tallow melted in England or imported from Russia.

Henry Parkinson & Co., Latchford, near Warrington (No. 875).—Specimens of heavy and light sole and in-sole leathers, also army, hydraulic, and other machinery leathers. The chief characteristic of these materials is their fineness of texture and compactness of pattern, and these qualities are attained by special preparation. The ordinary sole leather is tanned for nine months in oak-bark liquors, and three months in strong valonia liquors, to give solidity. The leather for army and hydraulic purposes is continued six months longer in the valonia liquors. The "offal" or in-soling is tanned for a period of six months only.

James Taylor & Sons, 27, 29 and 31, Union Square, Bury, Lancashire (No. 878).—Specimens of closely-rounded English bends exhibited, weighing 10lb.—19lb., made from English hides and tanned with oak bark and valonia, also "ranges" cut from the above and specially adapted for slipper and shoe work. Shoulders for sewing, pegging, or riveting, in-soles, welt-shoulders, and oak bark tanned, hand-shaved, shoe-butts matured in grease before finishing. Black-grained butts for shooting boots, brown-grained for army purposes, and clog-butts for both whole-backed and seam-backed clogs. East India kip-butts of all weights and classes. Black and brown bellies and black shoulders for slippers and boots. Harness hides and backs, black and brown. The following materials employed in tanning are also shown:—*Tanning Extracts:* Clarified oak, myrabolam, sumac, valonia, larch, and divi divi extracts. *Ground Tanning Materials:* Extra best Palermo sumac, fine ground myrabolams. *Raw Tanning Materials:* Sumac, divi divi, myrabolams, and valonia.

IMPORTS INTO THE UNITED KINGDOM OF ARTICLES CONNECTED WITH THE LEATHER TRADES DURING THE YEAR ENDING DECEMBER 1, 1886, WERE:—

Hides (dry)	732,578 cwt.
,, (salted)	518,542 ,,
Leather	76,633,037 lb.
,, value	£5 462,966
Boots and shoes dozen pairs	104,489

EXPORTS FROM THE UNITED KINGDOM DURING THE YEAR ENDING DECEMBER 1, 1886:—

Hides (dry)	516,096 cwt.
,, (salted)	118,427 ,,

British Manufacture.

Leather unwrought	155,050 cwt.
Declared value	£1,380,231
Leather wrought, and boots and shoes, declared value	£1,829,549
Saddlery and harness, declared value	£382,819

Gridley & Co, Bishopsgate Avenue, London (No. 876).—This firm exhibits Russian isinglass. Brazil isinglass in similar stages. Isinglass of every description, in crude state, from Penang, Bombay, Hudson's Bay, West Indies, Saigon, Singapore, and China; also the same kind in their manufactured condition. The trade in isinglass, though considerable in itself, is small compared with many other fish industries. Isinglass consists of the dried swimming-bladder of different fishes. The bladders vary much in shape, according to their origin, and they are prepared for the market in various ways. Some are simply dried while slightly distended, forming pipe isinglass. When there are natural openings in these tubes they are called purses. When the swimming-bladders are split open, flattened, and dried, they are known as leaf isinglass. Other things being equal the value of a sample is determined by the amount of impurities present. These impurities are ordinary dirt, mucus naturally present inside the bladder, technically called grease, and blood-stains. If the bladders were hung up to dry with the orifice downwards, the mucus could be drained off; but usually the fishermen fear the reduction in weight, and take care to retain all they can. It is necessary to insist on having the bladders slit up and rinsed clean as soon as they are removed from the fish. This would so much increase the value of the product that the extra labour would be very profitable. Blood-stains cannot be removed without injuring the quality. If any process could be devised effectual for this purpose, a valuable discovery would be made. The chief places of production are Russia, Siberia and Hudson's Bay, Brazil, West Indies, Penang, Bombay, Manilla, this being approximately the order of their importance. All Russian and Siberian is known as Russian, the more frequent varieties being "Beluga leaf," the finest in the market, obtained from a species of sturgeon; Astrakhan leaf; Saliansky leaf and book; and Samovy leaf and book. The fish yielding them inhabit the great rivers and fresh-water lakes. They are caught during the winter, and the bladders removed and dried in various forms. The winter catch is collected at the great fair at Nijni-Novgorod, and is there bought by brokers and merchants from St. Petersburg. Some trade is done in Hamburg, but the varieties there sold are not what we know as Russian. When the ice breaks up the isinglass is shipped by steamer as quickly as possible, mostly to the London Docks, on account of the isinglass merchants there. The end of June and the beginning of July is the season when the winter's produce reaches this country. The Brazil, Penang, Bombay, and Manilla products are imported at all periods of the year, generally packed in cases, varying in weight. Original cases of Penang isinglass weigh about 3cwt.; Manilla, about 2cwt.; Brazilian, about 2cwt. 3qrs. The uses of isinglass are not very varied. The largest quantity is used by brewers and wine merchants for clarifying their goods. This property is extraordinary, for gelatin, which seems chemically the same thing as isinglass, does not possess it. One theory is that the tenacious mucilage shaken with the liquid gradually settles to the bottom, entangling all floating particles as it sinks. Another suggestion is that a very delicate fibrous network remains after the isinglass is dissolved, and entangles the particles in the way the mucilage is supposed to act. Many varieties of isinglass, generally the lower brands, are used for this purpose. Some brewers use it in the natural state, others prefer it manufactured into a fine or wide strip, which dissolves quicker, and suffers no waste. At present, Penang is the favourite kind. Russian long-staple isinglass is used only by the Worcestershire farmers for clarifying their cider. In spite of its costliness, Scotch brewers prefer Russian leaf. The use of Samovy isinglass was formerly universal among the Irish brewers, and much is still sent to Dublin; but other varieties have partly taken its place. It is a Russian kind, obtained from the bladders of the *som* fish. Its name is the adjective form of the noun *som*. It is used only by brewers. Russian isinglass is also shipped to Madeira for use in clarifying wines. A good deal of various kinds is used in this country by wine merchants. For clarifying purposes the isinglass is "cut" or dissolved in acid, sulphurous acid being used by brewers, as it tends to preserve the beer. When reduced to the right consistence, a little is placed in each cask before sending it out for consumption. Sole skins are the only substitute used for isinglass. They can only be had in winter, the supply is uncertain, and they have not the strength of the Penang varieties. Next to the brewer's demand comes that of the cook, who uses it for making jellies, thickening soup, and stiffening jams. For this purpose best Russian takes the highest position, owing to the superior strength and nourishing properties. Isinglass being the purest natural form of gelatin, a very pure article, artificially prepared without the use of acids or other chemicals, has long been known in the market as patent isinglass. It does not possess the clarifying power of the natural article, but is equally useful for cooking. There seem to be only six isinglass cutters in England, all being domiciled in London. The sorted isinglass is very hard and tough, very difficult to bend or manipulate. It is soaked till it becomes a little pliable, and is then trimmed. Sometimes it is just pressed by hand on a board with a rounded surface, at others, it is run once between strong rollers to flatten it a little, and make the dark and dirty spots accessible to the knife, the top of the roller being used to bend the pieces on. The cuttings are sold separately as an inferior grade. The next process is that of rolling. Very hard steel rollers, powerful and accurately adjusted, are used. They are capable of exerting a pressure of 100 tons. Two are employed, the first to bring the isinglass to a uniform thickness, and the smaller ones kept cool by a current of water running through them, to reduce it to little more than the thickness of writing paper. It is very curious to see the thick, tough pieces gradually spreading out under the rollers, and folded and rolled like puff-pastry till the separate pieces so unite that no joint can be seen, and the mass is reduced, under the coarse rollers, to what looks like semi-transparent millboard. From the finer rollers it comes in a beautifully-transparent ribbon, many yards to the pound, "shot" like watered silk, in parallel lines about an inch broad. It is now hung up to dry in a separate room, the drying being an operation of considerable nicety. When sufficiently dried, it is stored till wanted for cutting, or it is sold as ribbon-isinglass to all who prefer this form. The machines for cutting are well and accurately made, and are so adjusted that they slice pieces off a sheet of paper without stirring or bending it in the least. For the "fine-cut" isinglass in which chemists are interested, these machines are run a great speed, 2000 to 2500 revolutions, making 10,000 to 12,000 cuts in a minute. It takes an hour to cut 5lb. or 6lb., so that each pound would contain 100,000 to 125,000 separate fibres if none of them were broken. The actual number must be very much greater.

J. M. Collett & Co., High Orchard Works, Gloucester (No. 823).—Already noticed on page 701, under Group IX., alkalis, acids, and salts. Besides being an exhibition of sulphites and bisulphites, is also an exhibition of isinglass from Russia, Siberia, Brazil, Penang, Bombay, Kurrachee, and Manilla.

Thomas R. B. Bindley & Son, Smethwick, near Birmingham (No. 877).—Sample cakes of gelatins and glues. Samples of size and grease. Specimens of articles of different trades in which these goods are consumed. Raw materials from which manufactured, and the refuse products.

GROUP XII.—INDIARUBBER, GUTTA-PERCHA, ETC.

Chas. Macintosh & Co., Cambridge Street, Manchester (No. 885).—This exhibit has been divided into two parts, one of which is devoted to the origin of indiarubber and the various materials used in its manufacture, and the other to the processes of manufacture of finished articles. Probably no exhibit illustrating the indiarubber industry has ever before been shown of so complete a kind.

The articles exhibited are the entire trunk of an indiarubber tree (*Siphonia elastica*), specially obtained from South America, and from which fine Para rubber is obtained. It is a tree inhabiting dense forests on the banks of the Amazon and several of its tributaries, where it is called the "*Seringue*." The chief district from which its caoutchouc is obtained is, according to Wallace, the country between Para and the Xinqui river. The "*Siphonia*" species comprises trees varying from twenty-five to upwards of one hundred feet in height, and all contain a milky juice in more or less abundance, though they do not all yield caoutchouc of good quality, that from some of the species being brittle. The fruit is a rather large capsule, composed of three one-seeded pieces, which split in halves when ripe. The raw seeds are poisonous to man and to quadrupeds, but macaws eat them greedily, and they are an excellent bait for fish; long boiling deprives them of the poisonous principle, and renders them very palatable. The bulk of the caoutchouc exported from Para, whence our chief supply comes, is obtained from *S. brasiliensis*, which is the one common in the forests of the Province of Para: but that brought down the Amazon and Rio Negro is derived from *S. lutea* and *S. brevifolia*. The thin white milk is obtained by making incisions in the trunk, from which it exudes. The trunk exhibited is thus punctured, and a pocket-shaped receptacle of clay has been attached just below the puncture so as to represent the way in which the milk is caught. This clay receptacle is furnished with a lip, so that the milk overflowing may be caught in the earthen vessels used by the native workpeople. This clay receptacle to the tree holds about a tumblerful, and it requires about three hours to fill if the tree be fruitful; this will give an idea of the rate of flow. When the first cutting ceases to yield, the natives make a second one lower down, and so on until they have exhausted the milk in the tree, which is done by making in all four incisions, all at equal distances. They then pour the milk into larger vessels, gather heaps of Urucari or Inaja nuts, which yield a thick oily smoke, and set them on fire. Now they begin the manufacturing process by covering the wooden forms for sheets, long and flat bottles, etc., with clay (so as to be able to detach the rubber easily afterwards), dip the forms into the milk, and hold them over the smoke. As soon as the milk is dry, they dip them a second time, and so on till the rubber is of sufficient thickness: they then take it off the form, and it is ready for exportation. A tree cannot be again made use of for two years, as it requires that time to recover its exhausted strength. A section of a rubber tree is shown, measuring about 18in. in diameter; also a bottle of the white milk brought from Para, and now coagulated. The actual trunk of the tree is so arranged as to appear to form the foreground of a picture in which the scene is completed in a very ingenious manner, as a painting, the foliage of the trees being represented, the natives at work curing the rubber, carrying the milk, etc.; a small sapling (*Ficus elastica*), actually growing, and planted close to the picture referred to, assists still further the imagination of the visitor. Specimens of the Urucari nuts are shown, and also of crude rubber as imported—fine Para, Negro head or Sernamby, Mangabeira, and Ceara. In the other parts of the exhibit are three other pictures pourtraying all the details of the native work—the collecting of the rubber from the trees, smoke-curing, a rubber-collector's settlement, and a river boat. An actual specimen of such a boat, made of rubber, is also to be seen. Specimens of washed Para rubber, pure solid rubber block, and fine cut sheet used for making tobacco pouches, elastic bands, surgical bandages, etc., are shown, along with drugs, chemicals, and pigments used in the manufacture of rubber goods. Very interesting are also the six specimens illustrating the products of the destructive distillation of caoutchouc.

Elastic Rubber Thread.—The manufacture of this is one of the most important branches. This thread is used for weaving with silk or cotton into elastic webs for boots, braids, and other articles of dress. Amongst these threads are some exceedingly fine vulcanised varieties shown by this firm. A considerable variety of articles used for mechanical purposes is shown, and also a convenient form of matting recently introduced, which is finely ribbed. It is used as floorcloth, and presents several advantages in such use; it is styled "Rabdotos." There are also waterproof and air-proof fabrics, and all varieties of garments; mattresses which can be used on board ship, and, by being inflated, will, in case of necessity, serve as rafts. A camp equipment is shown, consisting of bed, air-mattress, folding-bath, and bucket; playing balls, Macintosh tennis balls, and elastic bands.

The works of this firm were first established in 1824 by Mr. Charles Macintosh, who first applied indiarubber to the waterproofing of articles of clothing; whence the term "Macintosh." The processes used to render rubber non-adhesive and insensible to cold, usually termed vulcanisation, are the invention of Mr. Thomas Hancock, one of the members of the firm. The effect of vulcanising is also to make the rubber permanently elastic, as well as insensible to cold or heat, besides resisting largely the dissolving action of oils or fatty matters. Vulcanisation has enabled rubber manufacturers to produce articles applied by engineers in machines driven by steam or otherwise.

With regard to statistics of the rubber trade:—

	Tons.	Value.	Per lb.
Raw rubber imported in 1886	9625	£2,202,716	or 2s. 0½d.
Raw rubber exported in 1886, chiefly to America, Germany, and Russia	5470	£1,281,199	or 2s. 1d.
Raw rubber manufactured in the United Kingdom	1155	£921,217	
A large amount of other materials used, as cotton, woollen, linen and silk fabrics, iron wire, metal mounts and fittings; also drugs and chemicals, probably		£500,000	
		£1,421,217	
Exports from the United Kingdom of British manufactured goods in 1886		£971,052	
Imports into United Kingdom of foreign manufactured goods:—			
1885	1100	£397,730	or 2s. 6d.
1886	1200	£353,729	

EXPORTS OF MANUFACTURED GOODS FROM THE UNITED KINGDOM.

Country.	Caoutchouc.		Gutta Percha.	
	lb.	£	Cwt.	£
Foreign Countries	83,022	9,197	1	113
Australasia	32,362	2,816		
Other British Possessions	8,010	875	2	38
1886	123,421	13,188	6	151
1885	169,75	11,707	1	20

IMPORTS.

Country.	Caoutchouc.		Gutta Percha.	
	lb.	£	Cwt.	£
Germany	1,611,751	191,112	15	381
Holland	313,715	52,155	32	577
Belgium	258,965	13,580		
France	267,695	38,620		
United States	185,488	27,181	1	3
Other Foreign Countries	11,150	801		
British North America	2,235	226		
Other British Possessions	211	21		
1886	2,681,210	353,729	78	961
1885	3,139,632	397,730	105	903

David Moseley & Sons, Chapel Field Works, Ardwick, Manchester (No. 879).—An extensive exhibit of indiarubber for mechanical purposes; washers, sheet, valves, railway buffers, steam packing, ball valves, bearing springs, deckle straps for paper machines, door mats, stair treads, etc. Tubing for chemical purposes, as also delivery and suction hose, and the figure of a diver completely clad in the necessary waterproof garments and helmet, and furnished with hose-gear for supply of air; Anchor linen hose for fire brigades, Simplex cotton belt, vulcanite and ebonite for electrical and chemical purposes; patent Cornscus waterproof garments and waterproof garments of all kinds, especially ladies' cloaks, printed by the new process in most elegant patterns; the new Rex tennis balls, and many varieties of rubber tobacco pouches.

J. **Mandleberg** & Co., Albion Rubber Works, Pendleton, Manchester (No. 880).—Also an extensive exhibit, illustrating the various applications of indiarubber, though paying special attention to waterproof clothing in various styles and materials; ventilated waterproof clothing, Albion and embossed proofing, waterproof pouches.

Besides the foregoing are similar exhibits by Messrs. Broadhurst & Co., Bradford, Manchester; The Salford and Irwell Rubber Company, Limited; William Currie & Co., Caledonia Rubber Works, Edinburgh; Cooper, Box, & Co., 7, Love Lane, Wood Street, London; Bilsland & Co., 99 Princes Street, Edinburgh; and the Ancoats Vale Rubber Company, Limited, Palmerston Street, Ancoats, Manchester.

Isidor Frankenburg, Greengate Rubber and Leather Works, Salford, Manchester (No. 888).—Both indiarubber and leather goods, as well as specimens of crude rubber as received from abroad. It is due to this exhibitor to mention the fact that he has recently patented a new appliance and means whereby the workpeople of the rubber factories may be protected from the very deleterious and poisonous fumes of carbon bisulphide. The arrangement is such that after leaving the tap of the bisulphide cistern the liquid runs along a gutter covered by glass, until it reaches the apparatus where the solution of the rubber is effected, which is surrounded by glass and furnished with slide doors, the whole being covered by a dome connected with the chimney, so as to carry off by the draught all fumes which escape. The work-table and proofing machine are similarly covered over, so that the fumes escaping into the atmosphere of the rooms is reduced to a minimum. Those who know what a terrible malady the carbon bisulphide poisoning induces, and have witnessed the cases, which resemble in some respects those of *delirium tremens*, but differ from this by the peculiar blueness and numbness induced in the hands when dipped in water, will appreciate the boon to the workpeople of any effectual method of avoiding the vapours of the volatile bisulphide. Those interested in the phenomena of bisulphide of carbon poisoning will find the subject exhaustively treated in the excelient article by Dr. Ross in the *Medical Chronicle*, vol. v. No. 2, pp. 257—269.

The Laverine Chemical Co., Abbey Hey, Gorton, Manchester (No. 891).—A very interesting indiarubber substitute, designated "Sea foam," or light white artificial indiarubber, is exhibited by this firm. It is an extremely porous light article, almost resembling sponge in appearance. The writer understands that it is obtained by the action of sulphur chloride upon linseed oil, and also that it possesses physical properties which almost exactly resemble those of indiarubber; and, finally, that it may be mixed with rubber perfectly, and will produce a mass adaptable to all the purposes to which ordinary rubber is applied. Articles of clothing waterproofed with the rubber substance are shown, etc. Amber, or hard, yellow, artificial indiarubber; Nigrum elasticum, or hard black; and Castor, or hard grey artificial rubber; powdered white, yellow and black artificial indiarubber, are also represented by various samples.

GROUP XIII.—BUILDING MATERIAL.

Kneeshaw, Lupton & Co., 41, Oldhall Street, Liverpool (No 892).—Specimens of paving sets from their quarries at Port Nant, N. Wales. A special feature of these sets is the cleavage, and it is claimed for them that they do not become slippery. Specimens of macadam, chippings and breaking stones from the same quarry, are shown; also specimens of limestone, limestone chippings, dust and lumps, as used by limeburners, chemical manufacturers and contractors; also specimens of lime burnt in Hoffman kilns. Analyses of this limestone show it to contain 98 per cent. of calcium carbonate; it is obtained from the Lysfaen quarries of the firm.

Thurstonland Brick & Stone Co., Limited, Brockholes, near Huddersfield (No. 893).—Specimens of bricks and hard York blue stone. The various kinds of brick shown are displayed in a sunk panel of dark red bricks, and a wall of dark red bricks with moulded stone coping. There are shown also special moulded bricks and hard-burnt imperishable engineering bricks. The display of stone consists of specimen steps, palisading stone and platform coping stones, also moulded steps, and coping and cornice stones. This stone, which is known as "hard York blue stone," is said to be very hard and tough, and specially suitable for positions exposed to great wear. The bricks are made from a quality of shale containing 65 per cent. of silica, two cubic yards of the shale producing 1000 bricks. This shale contains a large percentage of iron, which becoming oxidised in the kiln, gives the cherry red colour they possess. Each brick is subjected to a pressure of 14 tons, to make it solid, and the heat of the kiln is such that the bricks are almost vitrified. It is claimed for these bricks that they resist the action of acids, weather and fire, and are not broken by a crushing strain of 390 tons to the cubic foot.

Geo. King Harrison, The Lye Fire-clay and Brick Works, Stourbridge (No. 894).—The exhibits of this firm include gas retorts in one piece and in segments, firebricks, samples of best Stourbridge fireclay, as raised from the mines of the firm, and the same after being subjected to intense heat, after which no contraction is shown. Stourbridge clay used in the manufacture of glass-melting pots, linings of potash furnaces, etc. This clay has been well known for more than three centuries. It is estimated that the trade in firebricks finds employment for about 3000 hands, and that the quantity of clay raised for this manufacture amounts to about 200,000 tons per annum.

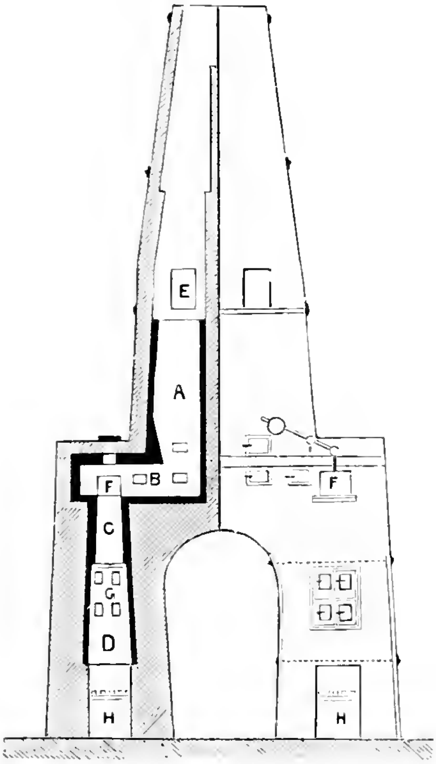
The Croft Granite, Brick & Concrete Co., Croft, near Leicester (No. 895).—Articles for building, paving and decorating in Croft adamant. String courses, panels, medallions, and other ornamental mouldings. Paving slabs, plain and grooved.

Thomas Lawrence & Son, Brackwell, Berkshire (No. 896).—A piece of gauged and carved brickwork in the form of a niche, the bricks used being those made by the firm, and known as No. 8, "Orange Red Rubbers." The erection stands on a base built with red-pressed facing bricks. The special feature claimed for these bricks is that they are solid throughout, and free from air or sand holes; and that though soft enough to be readily worked and carved by hand, they will yet stand exposure to the most severe weather. They are made from clay found on the edge of the Bagshot Sands, on the verge of the London clays.

William Mellor, Gorton Brook Pottery, Ardwick, Manchester (No. 897).—Chemical stoneware pottery, used in condensing, evaporating, collecting, crystallising, or mixing of chemicals, and consists of receivers, taps, pipes, mugs, jugs, funnels, test trials, jars and dishes.

Edward Brooke & Sons, Fieldhouse Fireclay Works, Huddersfield (No. 898).—This firm exhibits white and coloured glazed bricks, sanitary tubes, silica firebricks, white and coloured glazed sinks, salt glazed earthenware cisterns, glass tank boats, glass tank syphons, gas retorts and tuyeres. The silica firebricks are made from ganister, a silicious, fine-grained sandstone in the lower coal measures known geologically as the "Ganister Beds." The analysis of this ganister is 98 per cent. of silica, 1·50 per cent. of alumina, 0·50 per cent. of iron, lime, etc. Special features of this exhibit are the fireclay blocks, used for plate, window-flint and bottle-glass furnaces. Most of the English furnaces are supplied with these blocks. This firm consumes annually about 35,000 tons of raw material, and the value of the articles manufactured amounts to about £60,000.

Otto Trechmann, West Hartlepool (No. 899).—Handsome model of Dietzsch's patent kiln, for the continuous burning of cement, limestone and other materials. Explanatory drawing of the same. Apparatus for testing the tensile strength, soundness, fineness, setting time, etc., of cement. Calcimeter for estimating the amount of carbonate of lime in the slurry. Sundry sample specimens of chalk, clay, slurry, clinker, Portland and other cements. Briquettes and standard sand for testing. Set cement and concretes, illustrating the manufacture, testing and application of cement. In the Dietzsch's kiln it has been sought to combine the principle of the cone kiln with the advantages of the circular kiln, and instead of allowing the heat to circulate through the mass, to pass the material by the aid of gravitation through a canal kept at a constant high temperature. This is achieved by dividing the vertical shaft of the former horizontally into two parts and connecting the upper with the lower by a horizontal channel, thus reproducing in a manner several chambers of the circular kiln; not in a horizontal plane but vertically superimposed. The upper part of the lower shaft is retained at a clinkering temperature by the addition of fuel, and all superincumbent weight on the clinkering cement is obviated, thus permitting it to descend by its own weight so soon as the decrease in volume, due to the completion of the calcining process, takes place. With this movement a disturbance of the mass ensues, and the incipient cooling, together with a slightly conical form of the shaft, tend to prevent adhesion. The annexed figure represents a double kiln, produced by simply building two kilns back to back. The individual kiln consists of three essential parts, of which the two lower ones, C and D, lie in a different vertical plane from the upper one A. A may be called the warming or pre-heating chamber, C the calcining chamber and D, a continuation of it, the cooling chamber. At E are doors or openings for charging A with dried slurry. The covered calcining chamber C is connected with A by means of the arched horizontal channel B, and the cooling chamber D terminates with ordinary firebars H, through which the air to supply the whole system enters. The finished clinker is drawn at H, and the calcining chamber C, as the central point of the system, is the one where the main operation of burning is carried out, where the cement becomes soft and plastic, alters its form and eventually welds into larger or smaller blocks and inclines to adhere to the walls of the furnace. This part is therefore arranged in such a manner that it is accessible from all directions, by means of small openings G, for the removal when necessary of adhering lumps. In order to put the kiln into operation A is filled with dried slurry, D with clinker, and C with alternate layers of dried stuff and coal or coke. After the fuel is fired, the heat escaping from C strikes through the direct slurry lying on B and in A and is almost totally absorbed, only sufficient passing to keep up the requisite draught in the chimney-like continuation of A. As soon as the cement is sufficiently calcined in C a quantity of clinker is drawn at the bars, causing the whole mass in C and D to sink; thereupon fuel is introduced through the furnace doors F, and preheated slurry is, with the aid of flat shovels, turned over from B into C, the fuel and dried mass being placed in layers until C is filled again. This operation is repeated at intervals of half or three-quarters of an hour, and the burning proceeds continuously without further interruption than may be caused by the adhesion of clinker to the sides of the furnace. It is apparent from this description that the fuel is utilised to its utmost extent, for the cold air entering at the firebars, coming into contact with the hot descending clinker, becomes gradually heated to a white heat before reaching the fuel, thus producing a combustion akin in intensity to that of the regenerative furnace. It is, however, not completed at this point, but the mixed products of combustion, which entail such an enormous loss of available heat in the ordinary kilns, here strike the dried mass lying at B, and which at this point is in a state of bright cherry redness and incipient fusion, and are completely burnt. This system of burning cement, lime, etc., therefore offers a double advantage to most previous systems—firstly, in the complete utilisation of the fuel, combined with a minimum loss of heat, since the unavoidable radiation is restricted to one part of the kiln; secondly, because the mass to be burnt remains for the shortest possible time at the point of greatest heat, the critical period where over or under calcination so easily takes place. The amount of fuel required for each of the three principal systems in use for cement burning is approximately, per ton of clinker:



For the open or chamber kiln....	22 to 23% of coke, or $4\frac{1}{2}$ to $6\frac{1}{2}$cwt.
.. .. Hoffman type............	17 to 18·5% .. or $3\frac{1}{4}$cwt.
.. .. Dietzsch	10 to 16% of small coal, or 2 to 3cwt.

Or roughly, $\frac{1}{3}$ to $\frac{1}{2}$ of the weight of a cheaper and cleaner fuel.

The Great Rocks Lime & Stone Co., Dove Holes, near Stockport; works, Peak Forest, Buxton (No. 900).—Sample of best lime. Ordinary raw lump limestone. Crushed limestone for chemical and other purposes.

T. C. Brown-Westhead, Moore & Co., Cauldon Place, Staffordshire Potteries (No. 901).—Specimens of all the materials used in the manufacture of china and various kinds of earthenware. All the stages of manufacture are illustrated in a most instructive manner.

Doulton & Co., 17, Deansgate, Manchester; and Lambeth Pottery, London (No. 902).—Stoneware drain pipes, self-adjusting joint and composite joint drain pipes of Lambeth, Rowley Regis and St. Helens manufacture, Gullie's interceptors, patent channels, Doulton peto fireproof flooring, patent silicon tread, blue facing, paving and coping bricks, red and buff terra cotta, water waste preventers, double-valve syphon waste preventers, drop-by-drop flushing siphons for main and branch drains, flushing tanks, grease interceptors, stop cocks, etc., glazed ware, slow combustion grates and mantels; also radiating open tile stoves for halls, etc.

The Troutbeck Park (Westmoreland) Green Slate Co., Limited, Windermere (No. 905).—Specimens of light and dark sea-green roofing slates. The special advantages claimed for these slates are durability, colour and thin cleavage. It is stated that they are from strata composed of volcanic ash, and are therefore more durable than the Welsh slates quarried from ordinary sedimentary deposits; the colour, a soft sea green, either light or dark, said to withstand all climatic influences, whilst the thin cleavage renders it possible to have a strong roof without corresponding increase in weight. One ton of the best slate is said to cover about 27 superficial square yards. These quarries have been worked about 100 years, and it is estimated that at the present time they turn out from 8000 to 10,000 tons of slates per annum, the value of the total production being about £28,000 to £35,000.

Willesden Paper Works (The Patent Waterproof Paper and Canvas Co., Limited), Willesden Junction, London, N.W. (No. 908).—This firm shows a ventilating shaft of Willesden 4-ply paper, for mining and other purposes; awning, illustrating uses of Willesden canvas; tank made of Willesden 4 ply paper, holding water; Willesden roofing, Willesden paper, Willesden rotproof canvas and rotproof scrim, in rolls ready for use. The peculiarity claimed for this paper is that it is rendered waterproof and weather resisting by the so-called "Willesden" process, and that canvas treated in the same way is made rotproof. The process consists of a treatment with a metallic solution, originally discovered by Dr. Scoffern; it has since been improved by Dr. C. R. Alder Wright and others. It is based on the fact that cellulose is soluble in an ammoniacal copper solution. The pores of the paper become thus stopped up by a dried magma of cellulose and cellulose solution formed by treating the sheets of paper with the said solution.

Casebourne & Co., Limited, West Hartlepool (No. 909).—Portland cement, showing the raw material (chalk and clay) from which it is manufactured; the cement as it is when mixed and ready for burning. The same in the form of clinker when burnt, and also in the powder when ground and sifted ready for use; also Faija's cement-testing machine, and Scheibler's apparatus and Arnold's Patent Cement Test Moulding Machine. Apparatus has now been devised by which cement may be almost immediately tested in such a way that perfect confidence may be felt in regard to its behaviour under any circumstances. The object of testing cement is to determine in a short time its quality and the results which may be expected by ascertaining the fineness to which the cement is ground; by its tensile strength (when gauged and treated in a certain manner) at the expiration of three and seven days from gauging, and by observing the increase in strength between those dates; and lastly, by the soundness of the cement—*i.e.*, the absence of either expansion, contraction or cracking, commonly called blowing. Faija's testing machine is intended to facilitate this operation. The ordinary-sized machine, adapted to test briquettes of one square inch section, will test from 1lb. up to 1000lb.; it stands 14in. high, is 14in. long, 3in. wide and weighs under 30lb. It is of the best workmanship and materials, the knife, edges, and all wearing parts being of phosphor-bronze, and special gearing has been arranged so that the strain may not be put on the briquette at too great a speed. The clips of the machine are made to suit the form of briquette adopted by the Metropolitan Board of Works, but can be made to suit other forms at a small extra cost. The firm also shows Scheibler's apparatus for estimating the proportion of lime used in the process of cement-making, samples for testing, test bars, and samples of different kinds of concrete. This Company's works at West Hartlepool produce about 250 tons of cement per week. Hydraulic cements are those which have the property of solidifying under water. They are produced by burning or calcining calcareous rocks containing 10 or more per cent. of insoluble matter. The hydraulic quality depends chiefly upon the amount of the insoluble matter, and the percentage of silica, alumina, magnesia, or iron which it contains. By the calcining the silicates insoluble before the action of heat are modified. The caustic lime and the modified silicates react upon each other in the presence of water and produce a solid stone-like silicate The water contributes to harden the cement by uniting with the silicate formed and producing therewith hydrate. Portland cement is a mortar which is now largely manufactured from chalk and certain kinds of clay. It possesses the property of solidifying and hardening under water, and is therefore said to be a "hydraulic" cement. The chalk and clay are thoroughly ground together with water and the finely-divided mixture termed "slip," is dried and then carefully burnt in kilns. The clinker thus produced is ground to a powder and sifted and is then ready for use. This cement forms the basis of concrete and the artificial stones so largely used in engineering operations.

GROUP XIV.—SUGAR, GUMS, STARCHES, ETC.

Thomas Critchley, 10, King William Street, Blackburn (No. 910).—A prepared form of starch known as "starch gloss."

Thew & Stiebel, 65, Sackville Street, Manchester (No. 911).—Shellacs of all descriptions, viz.: Button, orange and garnett shellacs, as imported by the exhibitors; also the seedlac and sticklac, from which the shellacs mentioned are obtained. White shellac manufactured from the crude shellac. Various gums used in varnish making.

Tootell & Co., Alexandra Buildings, Ormond Street, Liverpool (No. 912).—Exhibited by their agent, **E. J. Scott**, Blackburn.

I. Materials used for the sizing and finishing of cotton, linen, jute, and other textile fabrics, paper, etc.; also for brewing, confectionery, etc.:—*(a)* In Sizing, substances used for laying the fibre, and for causing the size to adhere; also for stiffening the finished fabrics: Farina: Granulated, ground, and sifted, "prime" or ordinary quality, second and commoner qualities; sago flour: finest quality, fine "Sarawack" (Liverpool classification), fine "Borneo" (Liverpool classification); tapioca flour; Indian corn starch; rice starch; wheat starch; rice flour (various qualities); wheat flour (various qualities); dextrin or British gum (various shades); "Virine" (a new preparation from farina). *(b)* Substances used for giving weight and body to the size: China clay (various qualities); French chalk; sulphate of baryta; Epsom salts; Glauber's salts. *(c)* Substances used for strengthening the yarn, giving weight, and preventing the growth of mildew:—Chloride of magnesium ("prime white," German manufacture); chloride of magnesium (English manufacture); chloride of calcium; chloride of zinc (solid and liquid). *(d)* Substances used for softening the size, and giving "feel" to the cloth: Tallow, various kinds; sizing soap; soft soap; prepared sizing wax; paraffin wax, various kinds; Storey's warp softeners, various; "Emolline." *(e)* Prepared sizes: "Lancashire size"; "muciline"; paper stainers' size.

II. Various products of the potato and sago palm, etc. (other than those mentioned before), used in the arts and for food:—*(a)* Of the potato: Glucose, both solid and liquid; crystallised sugar; potato spirit, raw, fine, and wine spirit; caramel, various kinds, for beer, spirits, etc.; potato barley; pearl farina; potatoes; pulped potatoes showing the precipitated starch; photos of machines used in the manufacture of farina. *(b)* Of the sago palm: Photo of a sago palm; section of trunk of sago palm; piths of sago palm; raw sago from the troughs; sago flour; pearl sago (small, medium, large). *(c)* Tapicca: Tapioca plants; bulbs or roots of plant; tapioca flour; flake tapioca.

A variety of articles manufactured from potatoes, and chief amongst these is farina, in its granulated, ground, and sifted forms. Whatever excellence of quality has been arrived at, is by (1) years of careful cultivation of selected seed, certain varieties of the potato yielding not only larger quantities but better quality of starch than others: (2) gathering and storing the potatoes properly. If the tubers are taken up too soon or stored too long afterwards, the quality of the starch they contain is very greatly deteriorated. (3) The avoidance of all chemicals in the manufacture, the process being entirely mechanical. By these precautions it is possible to produce the strongest possible starch of one regular and uniform quality, points of considerable importance, since it is found that in the farina used for sizing the slightest variation in quality is of great concern to the users as likely to cause injury.

For Light Sizing.—11lb. shirtings, 40 yards long, are being sized with ¾oz. of farina alone.

For Heavy Sizing.—Warps of medium counts are being weighted to the extent of from 150 to 180 per cent. (with China clay and the usual chlorides), and this weight is being successfully carried through the weaving process by the aid of farina already mentioned.

The sago palm and its products are also of interest. As in the manufacture of the farina, the same system of careful selection of the best variety of palm, combined with a select method of manufacture, is being carried out, and although the progress is but slow, owing to the length of time which the sago palm requires to arrive at maturity, yet the improvement in the quality of the sago flour produced is very marked.

The "Lancashire Size" and "Muciline" are for use chiefly in hot and dry climates for the sizing and weighting of cotton fabrics; the paper stainers' size for use with delicate shades of colours.

H. L. Lilley & Co., Albert Works, Queen's Road, Manchester (No. 913).

(*a*) *Starches* for various industries. "Crystal" rice starch and rice starch in powder: Indian corn starch, same varieties: "Crystal" wheat starch: farina and potato starch, granulated and in powder, with various kinds of finishing starch for bleachers, calico printers, finishers, and paper makers.

(*b*) *British Gums* of all kinds for calico printers, paper stainers, etc.

(*c*) *Rice Starch* for domestic purposes. Certain specialities are (*a*) some very fine "crystals" obtained by moulding and stoving the starch in blocks of about 20lb. each. (*b*) Some blocks of starch specially prepared, and showing the process of "crystallisation" of starch.

(*d*) *Corn Flour* for domestic uses.

Henry Tate & Sons, 15, Exchange Buildings, Liverpool (No. 913A).—Specimens of refined sugars.

The Crystals are manufactured at the Liverpool refinery, and are of the best quality, it is said, containing 99·9 per cent. of real sugar.

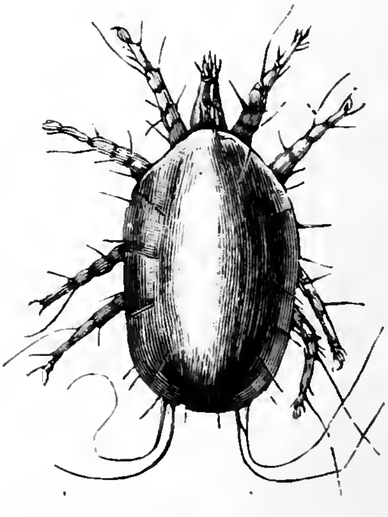
The Cut Loaf Sugar, known as "Tate's Cubes," is made at Silvertown, in London, and is cut ready for use instead of being sold in loaves. It is stated that the mechanical device for producing at once the cube sugar, at the same time maintaining its purity, has enabled this firm to keep an industry in London, which must have otherwise been taken away by its Continental competitors.

The Sankey Sugar Co., Earlestown, Lancashire (No. 914).—In the lower part of this show case are the refined sugars in the bags as sold—the largest 2cwt. each, medium 1cwt., and the smallest size 56lb. each. In the upper part of the case are all the refined sugars made by the firm, and also samples of (*a*) Java raw sugar; (*b*) Peruvian raw sugar: (*c*) Demerara grocery sugar: (*d*) Peruvian concrete sugar (all four made from pure sugar cane, and all containing *acari*); liquor in the various stages of refinery, etc.; (*e*) raw sugar dissolved in water; (*f*) the same liquor after passing through fine cotton filter bags; (*g*) sample of dirt (dried) removed by these filter bags; (*h*) liquor ready for boiling into grain after passing through animal charcoal, the only refining agent; (*i*) sample of the animal charcoal used; (*j*) specimen of black treacle: (*k*) specimen of refined treacle.

The specialities are two very pure varieties, termed "Castor" and "Pulver." Analyses made by the writer and Dr. Burghardt show that these sugars are extremely pure, an average specimen of "castor" containing 99·889 per cent. of real cane sugar, and one of "pulver," 99·922 per cent. Some interesting photographs are shown of sugar cane plantations, raw cane sugar factories: interior and exterior views in the Fiji and Sandwich Islands and West Indies; cane mills, small size for the East Indies and larger size in general use in West Indies: Fryer's concretor, for making concrete sugar: Wetzel's pan used for concentrating raw cane juice: four views of the Sankey Sugar Refinery, and several of places in the West Indies.

Photographic views are shown of the sugar mite (*acarus sacchari*) considerably magnified, and also of a sugar cane in bloom, and a cabbage palm.

The *acarus sacchari* is almost always contained in unrefined sugars, and the average number per pound has been estimated as upwards of 100,000. Filtration through the bag filters removes the creature along with other sedimentary matters. Its food consists chiefly of nitrogenous matter contained in the coarse sugar. The illustration below shows the magnified form of the sugar mite. It is only seen as a very minute moving speck on the surface of a solution of raw sugar. These insects are the cause of the "grocers" itch, from which those workmen who handle the raw sugar suffer.



Stiff & Co., Redcliff Street, Bristol (No. 915).—Specimens of starch and other products obtained from rice.

GROUP XV.—MISCELLANEOUS.

The Wrexham Lager Beer Co., Limited, 14, Brown Street, Manchester; Brewery, Wrexham (No. 916).—This firm exhibits samples of the well-known lager beer so largely consumed on the Continent and in the United States, and which is now enjoying considerable popularity as a beverage, especially in the larger towns of this country. It is produced by the system of bottom-fermentation (Untergährung) followed by the Bavarian brewers, in contradistinction to that of top-fermentation generally adopted in this country. The "mashing process" differs only in detail from that usually followed. It consists essentially in the mixing of malt and water of such a temperature that the ferment of the malt (the diastase) changes the starch of the same into glucose. The clear saccharine liquid or "wort" obtained by the mashing process is then submitted to the sedimentary- or bottom-fermentation alluded to above. This fermentation, which forms the characteristic feature in the brewing of lager beer, is excited by that particular form of yeast which is deposited at the bottom of the fermentation-vats of a previous brewing. This yeast consists essentially of the round-celled variety of the alcoholic ferment known as *saccharomyces cerivisiæ*. The fermentation requires three or four weeks, and takes place in comparatively shallow tuns placed in cool cellars, the temperature not being allowed to exceed 40° F. (4½° C.), which necessitates in summer time a large consumption of ice. During the fermentation the carbonic acid is disengaged in very minute bubbles, and carries up a mere film of froth and yeast, it being chiefly deposited at the bottom. One main object of the lager beer process is to completely remove the gluten and all other oxidisable matters from the "wort." The gluten or yeast is deposited as a viscid sediment during the fermentation, while other matters are oxidised by the oxygen of the air, their destruction in this manner being accelerated by the freedom of the surface of the beer from any protecting layer of yeast and the large area of the fermenting vessels. Lager beer being deficient in alcohol is not suitable for home consumption, since it is impossible to keep it for any length of time in barrels, but it is eminently adapted for export in bottled form. To sum up the chief characteristics of "store" or lager beer, it is less alcoholic, of higher specific gravity, richer in dextrose, albuminoids and carbonic acid than English beers. Further, since ice is used instead of hops to preserve the lager beer the narcotic action of the hop is avoided. Lager beer is eminently adapted as a safe beverage for quenching the thirst in hot weather without inducing that soporific action so characteristic of English beers.

John Johnson & Co., St. Anne's Works, Liverpool (No. 918).—Specimens of various qualities and forms of plumbago or graphite (a native form of carbon, also termed "blacklead") from different parts of the world and in the different stages of manufacture. The price of this article of commerce varies from £9 to over £5000 per ton. An exceedingly fine quality of plumbago but limited in amount is regularly imported from the celebrated mines of Prince Schwarzenberg. None of the native products are entirely suitable for making a really good polishing blacklead. Some descriptions are too hard and gritty, others too soft and dusty, some too pale and with so little body that they will not adhere to the surface of a smooth piece of ironwork. The so-called "prepared blacklead" used for machinery is obtained by separating the lighter portion of the blacklead by grinding, the product of which is dried, ground to an impalpable powder and sieved. The residue—*i.e.*, the heavier portion—is used for making the block blackleads. The grinding of the "natural" and also of the levigated leads is accomplished by means of vertical grinding stones of about one ton weight each, revolving at a certain rate upon horizontal stones of similar proportions. The ground lead passes into machine sieves, which separate the finely ground from the rougher portions; the latter falling again into the millstones, is re-ground, whilst the finished powder is conveyed by means of elevators into the mixing-room, where the different qualities are mixed together—various proportions for the preparation of block black-leads and powder leads. The blocks of blacklead are formed and polished by special machinery.

This firm also exhibits various forms of laundry blues manufactured from the ultramarine of commerce, and indigo blues for laundry purposes are also exhibited. The ultramarine blue is exhibited in the various stages from the raw materials to the finished article. [See also Nos. 753 and 754.]

Bryant & May, Limited, Fairfield Works, Bow, London, E. (No. 919).—A complete selection of household matches, also wax vestas and wax tapers for gas lighting. Specially to be noticed are the specimens of patent safety matches. The principle observed in making the latter is best exemplified by a brief description of the modes of preparation of ordinary and safety matches. In the former the wood splints are tipped with a composition containing amorphous phosphorus mixed with oxidising agents, which cause the phosphorus readily to inflame on friction. Such oxidising agents are, *e.g.*, saltpetre, chlorate of potash and red lead. Other accessories are glue and finely powdered glass. Now, in the latter (the safety matches), the splints are simply tipped with a composition containing the oxidising agent only, the rubber on the box being painted with a solution of glue containing amorphous phosphorus and powdered glass. The matches are thus rendered at once non-poisonous and incapable of ignition under ordinary circumstances.

Jewsbury & Brown, 113, Market Street, and 44, Downing Street, Manchester (No. 919a).—Aërated waters and beverages generally known in the trade as mineral waters—Soda water, seltzer water, potash water, lithia water, carrara water, magnesia water, Vichy water, simple aërated water, lemonade, ginger ale, quinine tonic water, ginger beer, horehound beer, champagne cider, Brin's oxygen water, in bottles, half-bottles, and siphons, for which accuracy of preparation and perfect purity are claimed. One speciality in siphons is the metal part, which is of pure English block tin, thus absolutely avoiding any injurious metallic impregnation. Specimens of the pure English tin pipe are shown. The materials used by this firm in the manufacture of artificial mineral waters and aërated beverages are represented. According to analysis the soda water contained 5 grains of bicarbonate of soda; the potash water, 20 grains of bicarbonate of potash, and the lithia water, with potash, 5 grains of carbonate of lithia, and 15 grains of bicarbonate of potash per bottle, or half imperial pint; the seltzer water was found to contain the more important mineral constituents of the natural spring.

Frederick King & Co., Limited, 26, Waring Street, Belfast, and 6, Bishopsgate Avenue, London (No. 920).—The following is a list of the exhibits of this firm:—Edwards's preserved potato—a granulated preparation of the fresh potato. Edwards's desiccated soup—a dry preparation of vegetables and extract of beef, and his white (vegetable) soup. The potato was first preserved by a former member of the firm, the late Mr. Downes Edwards, in 1840 (see Dr. Ure's "Dictionary of Arts," etc.). It was quickly adopted by H.M. Navy, and for sea dietary generally. The effect of being able to carry this anti-scorbutic vegetable at sea materially assisted in expelling the scurvy, which formerly was very destructive to life on board ship. Edwards's patent desiccated soup is a mixture of beef with the potato and other vegetables, the principle of preservation being the same as in the preserved potato—viz., the entire removal of the water, which enables both the animal and vegetable substances to keep for any time and in any climate. The white desiccated soup is a preparation of vegetables only, adapted for use with milk. The annual production varies considerably, the requirements of H.M. Government increasing largely when any war arises abroad, as recently in Burmah and Afghanistan. In quiet times 3000 to 4000 tons of potatoes and other vegetables are manufactured by this firm, and from 300 to 400 tons of beef represent the animal raw material required for the desiccated soup manufacture. The force value of 1lb. (dry) of Edwards's desiccated soup is said to be about 500 foot tons, and the animal and vegetable elements are so proportioned as to produce a diet in which the nitrogen, carbo-hydrates and mineral substances exist in suitable proportion. The concentration is effected in localities where beef and vegetables are very low in price, and its transport in the concentrated form being trifling, a very cheap and nutritive food is thus obtained.

Bratby & Hinchcliffe, Sandford Street, Ancoats, Manchester, and 146, Minories, London, E.C. (No. 921).—Various essential oils, fruit essences, syrups and cordials, citro-chloric acid, salts for natural mineral waters, lime juice, harmless colours, and sundries connected with the aërated water and confectionery trades. The pure soluble de-resinised fruit essences, essential oils, etc., are used in the manufacture of aërated beverages, and for confectionery purposes. The special feature of these articles is their solubility (mixing perfectly bright and clear with water or syrup) while they impart rich, fruity, aromatic flavours to the drinks. This firm also shows specimens of the various chemicals used in the trade. Salts for mineral waters, prepared by a compounding which is based on analysis of the natural mineral springs, such as Seltzer, Vichy, etc. Citrochloric acid is used as a substitute for citric and tartaric acids. It is a mixture containing 75 per cent. of the acid of lemon juice, and 25 per cent. of hydrochloric acid. One fluid ounce is equal in strength to one ounce of citric or tartaric acid crystals, while the cost is about one half. The approximate annual production of these articles represents a value of about £100,000.

Morgan, Lomas & Co., Crumpsall Vale Match Works, Blackley, near Manchester (No. 926).—Ordinary household matches of various brands, household dry soap, and Hoffman's rice starch. A detailed account of the manufacture of these matches appeared in the *British Journal of Commerce* for February, 1887. The illuminating power of each match is 0·75 candle light. The total value of the English match manufacture is estimated to be about 1½ to 2 millions sterling, one half of which amount is spent in raw materials.

Burroughs, Wellcome & Co., Snow Hill Buildings, 67, Holborn Viaduct, London, E.C. (No. 928).—The following specimens are exhibited by this firm :—Kepler extract of malt, Kepler solution of cod liver oil in extract of malt, hazeline (a distillate of witch-hazel), beef and iron wine, tablets and tabloids of compressed drugs, strophanthus (African arrow poison, a heart tonic), digestive ferments (zymine, pepsin, etc.), pure terebene, medicine chests and cases fitted with compressed drugs, etc.

Jacob Barstow, Filter Works, Pontefract, Yorkshire (No. 931).—Filters of various patterns, such as domestic filters, tank filters, table filters, emigrants' filters, tourists' and pocket filters. The oldest style of water-filter is the old drip stone, used very many years ago. They were huge stones hollowed out into the shape of a basin and fixed in a frame, and a vessel placed underneath to catch the water as it filtered or dripped through the stone. About thirty years ago they were made of a more compact form, a slab of stone being cemented across the middle of an earthenware jar, a space underneath being left for the filtered water. Two taps were provided, one to draw off the filtered water, the other to draw off the dirty water. This style of filter was used until it was recognised that "stone" was a mechanical filter, and had no effect on the matters in solution, when it was superseded by such modern filters as are shown by this firm. In these filters the water has first to pass through "natural stone," which removes all suspended and mechanical impurities, and then through a layer of "specially prepared carbon." The carbon being thus kept clean and free from suspended impurities can exercise its full purifying power on matters held in solution in the water, so that the water is first filtered and afterwards purified. The filters are so constructed as to be readily taken to pieces for the purpose of cleansing and examination. The water is said to be cooled and aërated in passing through the apparatus.

Slack & Brownlow, Canning Works, Upper Medlock Street, Manchester (No. 932).—The exhibits of this firm comprise filters for household, military, and manufacturing purposes, the largest of which is capable of purifying 500,000 gallons of water per day. The filtering medium in these filters is compressed carbon.

James & Joseph Clayton, 139, Higher Cambridge Street, Manchester (No. 937).—Natural stone filters with or without charcoal, for domestic purposes, immersion in cisterns, etc., also pocket filters on the same principle, for tourists, etc. The filtering arrangement consists of a hollow cylinder of natural stone cut out with machinery ; this cylinder is filled with charcoal, and there is also a layer underneath, so that the stone filters the water, and the charcoal purifies it after it has passed through the stone. In this arrangement it is sought to imitate the filtration which takes place in nature through beds of rock. The stone cylinders employed are cut out of solid blocks of porous sandstone, in such a manner that the core taken from a large cylinder can be used for making a smaller cylinder. By this method a block of stone 2 feet square can be made to yield no less than ten cylinders, varying in size from the core 1½ inches in diameter to the outer cylinder 2 feet in diameter. Before the application of machinery the entire core of these cylinders was chipped out with a chisel.

Liebig's Extract of Meat Co., Limited, 9, Fenchurch Avenue, London, E.C. (No. 938).—The well-known extract of beef, ox tongues, corned beef, meat meal, etc. These products are manufactured principally in South America or other grazing countries where large herds of cattle are at hand. The extract of meat is prepared from the flesh of cattle not less than four years old so as to ensure it being healthy and mature. In the season this firm slaughters over 1000 oxen per day, and since 1865, when the company was established, the number of cattle slaughtered amounts to 2,600,000 head, representing a value of £8,000,000.

Evans, Sons & Co., 56, Hanover Street, Liverpool (No. 939).—This firm exhibits raw Montserrat lime fruit juice, as received in its filtered state, also the cordials, sauce, bitters, tablets and jujubes made therefrom. Specimens of the fresh fruit itself are also shown.

The lime tree (*Citrus limetta*) is a member of the orange family, and grows well in all the West India Islands. It requires a light, loamy and somewhat stony soil, and an elevation, depending upon latitude, from sea level up to 500ft. The trees are planted 15ft. apart, and come into bearing in about six or seven years, but light crops are often gathered from trees at five years. To ensure large and permanent crops, the trees require to be regularly pruned and kept free from all parasitic growths, such as Loranthus, etc. They are also greatly benefited by tillage, loosening of the soil around the roots, and being kept free from grass and weeds.

The annual mean temperature of Montserrat at sea level is given at 78° F., and the annual rainfall at 59in. These conditions are evidently those most suitable for the successful cultivation of lime trees.

The lime fruit harvest is heaviest from September to January, but a good supply of fruit is yielded throughout the whole year. The fruit, after collection, is taken to central factories, where it is sliced by machinery, and then squeezed in huge wooden presses, the juice being run into puncheons and quickly bunged up. This is a most important point in preparing the juice in a tropical climate, for if exposed it would rapidly decompose. The choicest fruit alone is used, and only about two-thirds of the juice is pressed out, thus ensuring greater freedom from mucilaginous and pulpy matter. The further pressings, together with the juice of unsound fruit, is evaporated to the consistence of treacle, and sent over to this country for the manufacture of citric acid. The export of lime juice, both crude and concentrated, is now nearly 100,000 gallons per annum.

The Distillers Co., Limited, 12, Torphichen Street, Edinburgh (No. 940).—A collection of grain and malt whiskies, London gin, and other spirits. Spirits and whiskies for export in bottle. The Distillers Company was formed by the union of the seven largest distillers in Scotland, and they subsequently acquired the Phœnix Park Distillery in Dublin, and the Tooley Street Distillery in London. The actual output of spirit is 10,000,000 gallons a year, the plant being capable of producing 13,000,000 gallons if at full work. The capital is £887,600, and there is in addition a debenture capital of £450,000. The exhibit (in the two front compartments) consists of different kinds of spirits and whiskies, chiefly grain whisky, some of which is very old. Also gin, spirits of wine, and British brandy from the Tooley Street Distillery. The Company also exhibits Squire's patent yeast, of which they are the sole manufacturers. About 300 tons of foreign yeast are imported every week into England, of an annual value of £840,000. It was believed that pressed yeast could not be made in Great Britain owing to the excise regulations. Dr. Squire, however, succeeded in devising a process which was approved by excise, and the manufacture commenced on a large scale only 18 months ago. The production already amounts to 2000 tons a year, and when the process is at work at all the distilleries of the Company the production will be about 120 tons weekly, or say 6000 tons a year. At present the yeast is made only at Cameron Bridge and Port Dundas Distilleries.

Archibald Lauder, 76, Sauchiehall Street, Glasgow (No. 941).—The exhibitor shows samples of materials used in the manufacture of pure malt whisky, illustrating the various stages in the process of distillation; also a working model of a "Multiple Pot Still," and samples of whisky. The following is a synopsis of the method pursued in the distillation of pure malt whisky. Samples of the different stages herein enumerated are exhibited along with whisky, old and matured:—

No. 1. The barley received from the farmer is stored in large barns or lofts. From the loft the barley is shot down into a cistern, where it is immersed in water, and allowed to remain for some 40 to 60 hours, till it is thoroughly swelled and germination has just commenced.

No. 2. Out of this cistern it is run through a shoot into the "couch" where it lies a day or two; it is then removed to a cool barn with a composite floor, where it remains some 10 to 16 days, being turned over till it has been thoroughly malted.

No. 3. This stage attained, it is transferred to the kiln, where the vegetation is destroyed by great fires placed under the perforated tile or wire-cloth flooring. After two or three days on the kiln it is dry, and is then called malt.

No. 4. It is then removed to the mill and ground, and when ground is placed in the mash tun, where hot water is run in upon it to extract saccharine matter.

No. 5. After remaining some time, the liquid called "worts" is removed from the mash tun to the refrigerator, the object being to cool the liquor as fast as possible to a certain temperature so as to prevent it being soured, or, as it is technically termed, "blinked."

No. 6. From the refrigerator the "wort" is run into the "wash backs" and yeast is added to cause fermentation. Fermentation is allowed to proceed until the whole of the saccharine matter in the liquid is changed into alcohol. The liquid now is technically called "wash."

No. 7. The "wash" is then removed to the "wash charger" and thence to the "wash still," a large copper boiler with a closed head, to which is attached a copper pipe leading to the "condenser," which consists of a "worm" of copper tubing immersed in cold water. On heating the still the vapours pass and are condensed in the condenser, whence they issue in the form of a liquid technically known as "low wines."

No. 8. After the "low wines" are collected they are removed to the "low wines" and "feints charger," and thence to the "low wines still," a vessel similar to the "wash still," for redistillation.

No. 9. When the vapour arising from the boiling of the "low wines" is condensed, the first product—a strong spirit containing a large quantity of the essential oil of the grain called "foreshot"—is run into the "feints receiver." On testing and finding the liquid free from oil, it is run into the "spirit receiver" until it is found on trial that the liquid is becoming weaker, when the remainder is run into the "feints receiver" and mixed with the "foreshot."

No. 10. That liquid which has been run into the "spirit receiver" is the pure whisky, which is pumped thence to the spirit store and vatted. The produce of each week's distillation, or "period," as it is called, is kept separately.

The origin of distillation seems to be lost in antiquity. Although the Greeks knew the art of evaporating water and extracting the aromatic principles of plants, they had but crude ideas as to the art of distillation. The Romans knew nothing about brandy. Pliny, who wrote during the first century and to whom we are indebted for a treatise on wine, nowhere alludes to it.

It is said that the first navigators of the islands of the Archipelago obtained fresh water by boiling sea water and receiving the steam in the sponges placed over the vessels for that purpose.

It is probable that the art of distillation originated with the Arabs, who, from the earliest times were acquainted with the extraction of scents, and who introduced their processes successively into Italy, Spain, and the south of France. The word "alembic" is composed of two Arabic words and is found in writings previous to the 10th century. Raimond Sulle, an alchemist of the 13th century, mentions eau-de-vie and alcohol, and describes the method of obtaining eau-de-vie by means of fixed alkali, a process for which Basil Valentine substituted lime in the following century.

J. Rubée describes a process which he found in the writings of the ancients, consisting of the reception of vapour in very long winding tubes immersed in cold water. Towards the end of the 17th century, B. Porta, a Neapolitan chemist, published a treatise on distillation, and it is evident that the apparatus described by him served as a model for succeeding inventors.

N. Lefebore published in 1651 the description of an apparatus by which he obtained pure alcohol by one distillation, and he was followed by numerous inventors, but distilling apparatus up to the close of the 18th century was only very slightly modified, the variation consisting chiefly in increased size.

The inventions of Mr. Edward Adam in 1800 and of Mr. Isaac Bérard in 1805 marked an epoch in the history of distillation, and these have been succeeded by a host of others culminating in the "Multiple Pot Still," a model of which is exhibited. The special feature of this still is that it is capable of making whisky of a fine "aged" character direct from the "wash" and "low wines," purifying it from the fusel oil which is such an offensive and dangerous ingredient in much of the whisky regularly consumed. There are two kinds of stills in use in this country—*i.e.*, the old pot still and the Coffey patent still. The first is that used by the whisky distillers, and with it three separate distillations have to be made before what is called "finished spirit" is obtained. Even then only about one-fourth part of the third distillation is really finished, the remainder requiring to be distilled over and over again. The Coffey still is that used for making "silent spirit" for the gin rectifiers, and is employed by all the large London distillers. It finishes the spirit in one operation, but it may be pointed out that its "silencing" the whisky flavour is only apparent, and this enables "silent spirit" to be made from every kind of fermentable material, including that produced by the chemical action of sulphuric acid on potato, beetroot, inferior or damaged cereals, or even on sound grain, which saves the cost of the necessary malt in brewing, and allows to creep into consumption a most deleterious form of alcohol infinitely more poisonous than the coarsest make of genuine whisky or brandy.

The general principle embodied in this invention may be thus briefly stated: The hot alcoholic vapour is made to impinge upon numerous inverted copper dishes arranged throughout the column of the still. Upon these the vapour partially condenses, depositing the heavier poisonous impurities in conjunction with the excess of water, which drip into separate side receptacles from which they are conducted by dropping pipes to the lowest compartment of the still, whence they are discharged in one continuous independent stream while the purified alcohol, with its œnanthic or flavouring ether, passes over as a finished spirit. "Feints" and "low wines" are unknown in this process, and only a very small modicum of weak spirit is required to be held over at the end of each distilling period. Even this, however, can be dispensed with, and the most remarkable feature of the operation to a practical distiller is the fact that the "foreshot" is equal to matured pot-still whisky.

The quantity of spirits consumed as beverage in the United Kingdom is as follows:—

Year 1884—85..	England	16,322,991	gallons.
	Scotland	6,629,361	,,
	Ireland	5,069,028	,,
	Total......	28,021,380	,,
Year 1885—86..	England	15,290,816	gallons.
	Scotland	6,297,265	,,
	Ireland	4,751,670	,,
	Total......	26,312,851	,,

The quantity of spirit distilled in the United Kingdom was:—1884—85, 41,006,486 gallons; 1885—86, 38,961,842 gallons.

The number of distilleries at work, was, in each country:—England, 10; Scotland, 127; Ireland, 27; total, 164.

It is estimated that the following amounts of raw material were used:—Malt, 928,919qrs.; unmalted grain, 986,366qrs.; molasses, 341,087cwt.; rice, 167,513cwt.

The quantity of British spirits remaining in bonded stores at the close of the year was—1884, 59,245,624 gallons; 1885, 64,405,817 gallons.

The amount exported being—1884—85, 2,588,078 gallons; 1885—86, 2,808,198 gallons.

The following table shows the consumption of British and foreign spirits in the United Kingdom during the twenty years ending 1885:—

Year.	Gallons.	Per Head of Population.
1866	29,769,000	0·99
1867	29,090,000	0·96
1868	28,610,000	0·94
1869	29,624,000	0·96
1870	31,707,000	1·02
1871	34,454,000	1·09
1872	33,618,000	1·06
1873	37,779,000	1·19
1874	40,510,000	1·26
1875	42,427,000	1·31
1876	41,796,000	1·28
1877	40,420,000	1·22
1878	40,722,000	1·23
1879	38,475,000	1·15
1880	35,761,000	1·05
1881	37,094,000	1·05
1882	36,916,000	1·03
1883	36,765,000	1·02
1884	36,634,000	1·01
1885	35,956,000	0·99

LIEBIG'S WINE CO., 12, St. Helen's Place, London, and 68, Highfield Street, Liverpool (No. 942).—Liebig's Beef Wine with quinine, pepsine or iron; Liebig's invalid and tonic port wines; extracts of malt and meat; also malt and meat wine, and health sweets. All these preparations are intended for invalids, the object being to condense the largest amount of nourishment in the smallest and most palatable form. This firm produces over 38,000 dozen of the beef wines annually, and consumes, in preparing these and extract of beef, 12,000 head of cattle, 287 tons of barley, and 256 pipes of wine.

THE LONDON AND COUNTIES TEA CO., Moulton Street, Strangeways, Manchester (No. 943).—Model of a Chinese junk, laden with original packages of various growths of tea from the tea districts of China, India, and Ceylon, including fine Darjeeling pekoe; Assam pekoe souchong; Ceylon pekoe; Moning, Kaisow, Kintuck, and Ningchow congous; Formosa Oolong; Moyune, young hyson, and gunpowder; Lapseng souchong; Foochow and Canton scented orange pekoe; and scented caper tea. Tea was first imported into Europe by the Dutch East India Company, in the early part of the seventeenth century; but it was not until the year 1666 that a small quantity was brought over from Holland to this country by the Lords Arlington and Ossory, and yet, for three generations past, tea has been reckoned among the principal necessaries of life by all classes of the community. To provide a sufficient supply of the beverage produced from this plant, many thousand tons of the finest mercantile navy in the world are annually employed. The plant is indigenous both to China and Japan, and has been used in the former country from the earliest times: but it is only a particular part of the central provinces which is distinguished as the tea country of China. The plant is a shrub, having the botanical name of *Thea*, and its leaves constitute the tea of commerce. The first crop of leaves is not collected until the plant is three years old, after which they are gathered three or more times a year, generally in April, June, and August, the earliest gathered leaves having the most delicate and aromatic flavour. In 1834, a committee was appointed to consider the question of introducing tea cultivation into British India, and a scientific party was sent to explore the newly-acquired province of Assam, a district in the north-eastern extremity of India, and to make special inquiries respecting the tea-growing there practised. The result was that a Mr. Bruce was selected to superintend the formation of Government nurseries: and, with the aid of Chinese seeds, Chinese plants, and Chinese cultivators, he proved beyond doubt the possibility of producing good tea in India. This profitable industry is now well established in several of the provinces of our Indian Empire. Mr. Goschen, the Chancellor of the Exchequer, in his annual financial statement this year, stated that "the consumption of tea had doubled between 1857 and 1887. In 1857 the consumption was 2·45lb. per head of the population, whilst in 1887 it was 4·87lb. per head. Ten years ago, 156,000,000lb. of tea were imported into this country from China, and only 28,000,000lb. from India; in 1886, England imported 145,000,000lb. from China, and 81,000,000lb. from India, thus showing that the importation of tea from India had increased threefold." The customs duty on tea is now 6d. per lb., and the total weight of tea on which duty was paid in 1886 was 178,893,880lb., producing a revenue of £4,472,347 to the National Exchequer.

JOHN L. JOHNSTON, 10, Trinity Square, Tower Hill, London (No. 947).—Johnston's fluid beef, or bovril, bovril lozenges, bovril lozenges peptonised, bovril cream lozenges, bovril and iron lozenges, peptonised fluid beef, beef and iron wine, beef flour, beef flour peptonised, and beef flour soup. The special feature claimed for these preparations is the addition of albumen and fibrin, the nutritive constituents of meat, to the extractive or stimulating portion. The manufacture is carried on in Canada and America. The juices of the meat are evaporated to a thick syrup in steam pans, and this syrup is mixed with the powdered meat and other substances. From 30 to 48 tons of beef are required daily by this firm for their manufactures.

HENRI NESTLÉ, 9, Snow Hill, London, E.C. (No. 948).—Samples of the well-known condensed milk, Swiss milk, and milk food. The latter is composed of milk, wheaten bread, and sugar.

PEARSON & Co., LIMITED, Cambridge Street, Lower Broughton, Manchester, and Dunster House, Mincing Lane, London (No. 951).—Raw chicory and specimens of chicory in the different stages of manufacture; also the various forms of packages in use for the home and export trades. French coffee and dandelion coffee are also shown, and the various packages in which they are sold. Chicory has been in use in England for nearly 40 years, but has only been scientifically manufactured within the last 15 years. The trade in this article has been considerably retarded by the excise regulations. The approximate annual production of manufactured chicory in the United Kingdom is 100,000cwt., valued at about £175,000. This includes both the English grown, which is only a small item, and the foreign imported. At least 90 per cent. of this is consumed in the United Kingdom.

BENJAMIN ROBINSON, Church Street, Pendleton, Manchester (No. 953).—Natural sparkling wines made from English fruit: universal champagne, sparkling cowslip wine, sparkling raspberry wine, British or home-made wines, fruit cordials, and soluble essences of lemon, orange, and ginger. These wines are produced by the fermentation of the juices of English fruits and foreign white grapes, or from refined cane sugar, flavoured with fresh flowers or fruit. The process is exactly similar to that used on the Continent for the production of sparkling wines from grapes. Some of these wines are stored four years before they are fully matured. The "British wines" are free from added alcohol, and are made solely from fruit and sugar. Not being liable to excise duty, there are no available returns as to the annual production and consumption. "Fruit cordials" are made from the juices of various fruits. The fruits are subjected to hydraulic pressure, and the juice, after being clarified, is mixed with sufficient refined cane sugar to preserve it. They are free from alcohol, and are frequently called "non-alcoholic wines."

London Section.

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The meetings of the London Section will be held on the first Monday in each month.

Communications to be addressed to the Local Secretary.

THE WELDON-PECHINEY PROCESS FOR THE MANUFACTURE OF CHLORINE FROM CHLORIDE OF MAGNESIUM.

BY PROFESSOR JAMES DEWAR, M.A., F.R.S.

It will be in the memory of my hearers that the late Mr. Walter Weldon, just before the sad event which deprived industrial chemistry of his services, had been actively engaged in attempting to develop a second chlorine process. It is a fact—and a fact of which I have no doubt Mr. Weldon was fully conscious—that it is a most rare thing for one man to make two great sucesses as a patentee dealing with the same subject. Yet he was always hopeful of the success of this new process, which was patented on the 23rd June, 1884, under the title of "Improvements in obtaining, partly in the free state and partly as vapour of hydrochloric acid, the chlorine of the chloride of magnesium, of aqueous solutions of chloride of magnesium, or of mixed solutions of chloride of magnesium and chloride of sodium." It would take too much time and space to go into the history of previous attempts to economise chloride of magnesium. Suffice it to say that though numbers of patents have been taken (including several by Mr. Weldon himself at about the time of the industrial application of his great process for the regeneration of manganese) for the direct utilisation of magnesium chloride in the production of chlorine, none have been successful. Before proceeding to a description of the process I should say that, besides the patent already mentioned, there are others, taken at the same time and subsequently, partly based on suggestions of Mr. Weldon's, but chiefly the inventions of M. Pechiney—namely, patents for the various pieces of apparatus, diagrams of which are shown. I think my hearers will agree with me that the chemical side of this question has not been so difficult to deal with as the mechanical side, and that the development of the process has required the application of engineering talent of the very highest order. In fact the credit for the realisation of this process must be divided between three names—those of Mr. Weldon, M. Pechiney, and the able chief of Pechiney's staff, M. Boulouvard. Mr. Weldon himself pointed this out in the letter which accompanied his account of the process for this Society's report on the Chemical Exhibits at the Inventions Exhibition (see note, p. 526, September, 1885). The process has been worked at Salindres for about five months, on an experimental plant designed for the production of one ton of chlorine per day, and may be briefly described as follows, the description being in great measure in M. Pechiney's own words:—The raw material employed is hydrochloric acid. The process consists of the following operations:—

(1) Dissolving magnesia in HCl.
(2) Preparation of oxychloride of magnesium.
(3) Crushing, breaking, and sifting the oxychloride.
(4) Drying the oxychloride.
(5) Decomposing the oxychloride.

First Operation.—Dissolving the Magnesia in HCl.

The magnesia to be dissolved in HCl is a portion of that which results from the fifth operation. The HCl itself also results in part from the fifth operation, and the remainder from the decomposition of salt. The operation in question is somewhat difficult, owing to the considerable rise in the temperature which it produces. It has to be performed slowly to prevent the solution from boiling, which is apt to occur with violence. To this end the operation is performed in an ordinary well, similar to those used in the Weldon manganese process. The agitator is put in motion; the hydrochloric acid is run in slowly, and magnesia is then added little by little as fast as it will dissolve. When the temperature of the solution reaches the point of ebullition the operation is stopped for a short time, to allow the solution to cool. [One means of moderating the elevation of the temperature consists in employing, for the saturation of the acid, not magnesia only, but a certain quantity of oxychloride *in powder*, resulting from the sifting which forms part of the third operation. This portion of the oxychloride cannot be treated in the decomposing furnace, because it would render the charge too compact, and therefore difficult to be traversed by gases. On the other hand, it will be well understood that the solution in HCl of magnesia, combined with $MgCl_2$, will disengage less heat than the solution of magnesia alone, the destruction of the oxychloride itself absorbing a considerable amount of heat.]

When the well contains a sufficient quantity of the solution, the operation is terminated by adding to the liquid (which always retains a little acid) some further small quantities of magnesia, in order to precipitate part at least of the foreign oxides (oxides of iron, alumina, etc.), and thus prevent the accumulation of these impurities. There is also added a certain quantity of solution of $CaCl_2$ for the purpose of transforming into $MgCl_2$ and SO_4Ca a part at least of the magnesium sulphate resulting from the presence of sulphuric acid in the hydrochloric acid employed. The solution is then pumped into standing vessels, wherein the insoluble matters (oxides and calcium sulphate) are deposited, and the clarified liquor is then ready for the following operation.

Second Operation.—Preparation of the Oxychloride of Magnesium.

The solution resulting from the first operation is evaporated in boilers down to the point at which it will contain not more than about 6 equivalents of water, and is now ready for conversion into oxychloride.

The apparatus in which this conversion of the chloride into oxychloride is performed is illustrated by Figs. 1 and 2 of the accompanying diagrams, Fig. 1 being a vertical section, and Fig. 2 a horizonal section. It consists of an annular sheet iron vessel A resting on rollers *a*, *a*. The bevelled wheel *b* acting on the pinion *c* gives a continuous but slow rotary motion to the vessel A. M is a fixed frame upon which are mounted three agitators G, D, E, as well as the shafts *d* and *f*. These agitators are rotated from the shaft *f* by means of a bevelled wheel gearing with a bevelled wheel on the shaft of the central agitator D, which also carries a spur wheel gearing with two equal spur wheels on the shafts G and E. The fast and loose pulleys B and B^1, driven by a band, give motion to the whole machine.

The quantity of MgO used at Salindres in this operation is about $1\frac{1}{3}$ equivalents per equivalent of $MgCl_2$.

This magnesia is brought to the above described annular vessel by means of a chain of buckets which elevates the magnesia and then lets it descend through a strainer under which the horizontal rotary motion of the annular vessel brings successively every portion of the $MgCl_2$ which the latter contains. The operation lasts only about twenty minutes. The whole mass becomes very hard and during solidification disengages much heat. It is then in the form of solid pieces, of different sizes. This operation finished, the material is discharged from the annular vessel into little waggons, which, by means of a lift, bring it to an upper floor, where the reaction, which was not quite finished, continues for some time.

The composition of the oxychloride in this state is approximately as follows:—

Impurities..	4·00	
Water	41·16	
$MgCl_2$	35·00	Cl=26·16 per cent.
MgO	19·84	=1·316 equivalents per equivalent of $MgCl_2$.
	100·00	

Third Operation.—Breaking, Crushing and Sifting of the Oxychloride of Magnesium.

The oxychloride produced by the preceding operation is in the form of pieces of various sizes along with a small quantity of powder. It is necessary to reduce this material to morsels, of which the largest shall not be larger than a walnut, and further to clear these pieces of all dust, which might, when in the decomposing furnace, prevent the free passage of air through the mass.

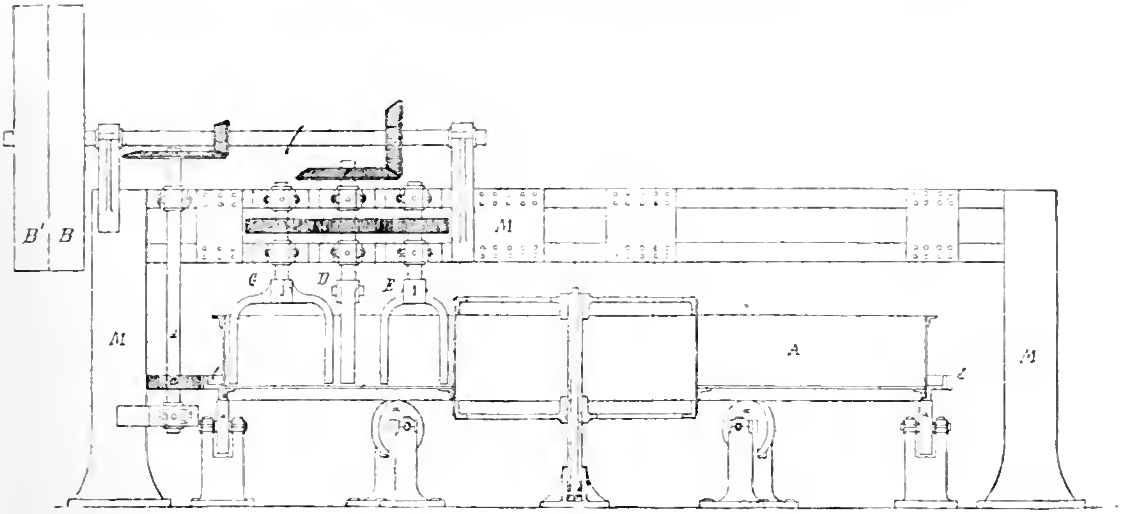

FIG. 1.

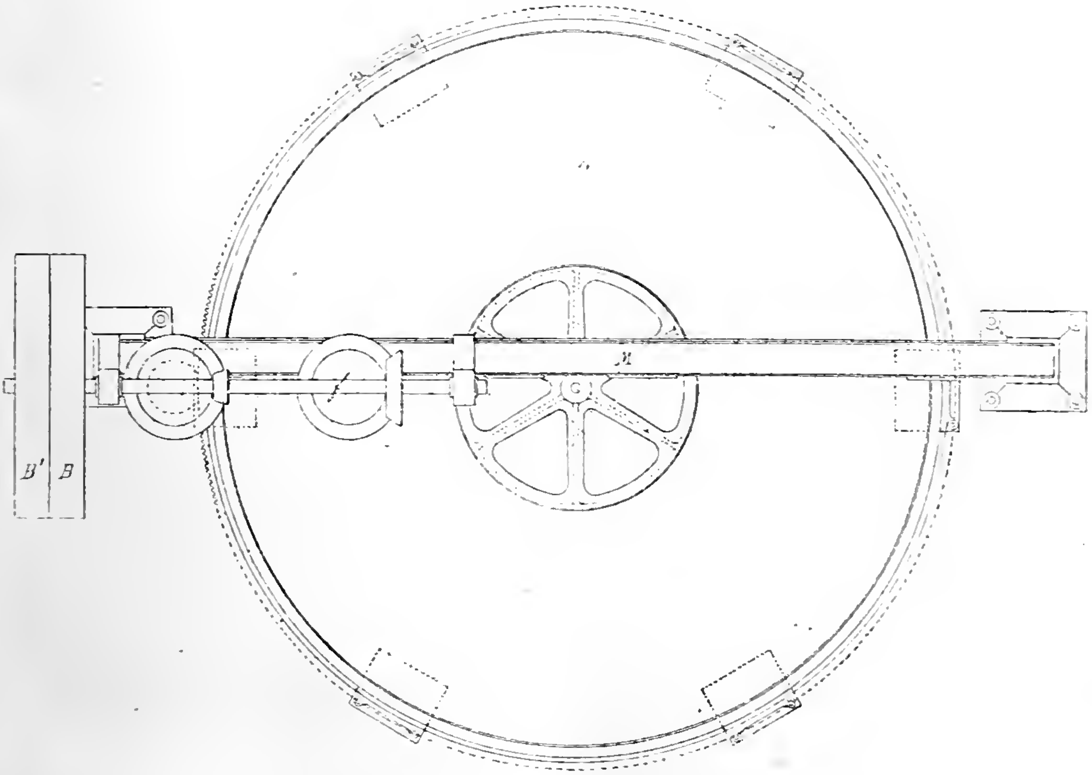

FIG. 2.

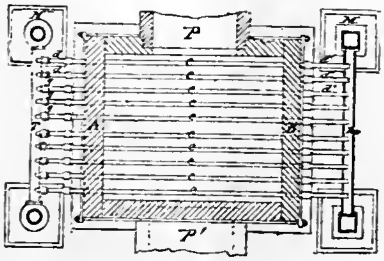

FIG. 10.

To this end the oxychloride, after remaining for some time in the boxes mentioned in the preceding operation, is crushed in a special apparatus consisting of cylinders bristling with diamond points. In passing between these cylinders the material is broken to pieces of the required size. It then falls into a rotary sieve, which separates from it all that can pass through a metallic cloth of which the threads are 5 millimetres apart. That which passes through this sieve constitutes the powder of oxychloride spoken of above. This dust can be either dissolved in HCl with magnesia in the first operation, or be reintroduced into the operation of preparing the oxychloride. We have succeeded in reducing the proportion of dust to 20 per cent. of the total weight of oxychloride.

FOURTH OPERATION.—DRYING THE OXYCHLORIDE OF MAGNESIUM.

The operation of drying previous to decomposition is necessary, because in the decomposition of the oxychloride by heat and air a larger quantity of free chlorine and a smaller quantity of hydrochloric acid result: 1st. If the material to be decomposed contains less water; and 2nd. If the decomposition is performed at a higher temperature. The previous drying is necessary for the realisation of the first condition. It is indirectly necessary for the realisation of the second condition, because the less water the material contains the less will it lower the temperature of the decomposing furnace.

Whereas chloride of magnesium containing six equivalents of water cannot be dried even partially without a large quantity of HCl being disengaged, the oxychloride can be made to lose a considerable quantity of water without the escape of more than a small portion of HCl. However, the desiccation must not be carried on at a temperature above 250° to 300° C. The only practicable means of drying the oxychloride therefore is to submit it to the action of a current of hot gases. The necessity of avoiding the formation of dust during the operation made it impossible to use the mechanical agitator for exposing the surfaces of the pieces of oxychloride to the current of hot gases. We have therefore adopted a system of working which consists in making a train of wagonettes with shelves one above the other, on which the oxychloride is spread in layers of 5 to 6 centimetres thickness, circulate in a flue in a direction opposite to that traversed by the hot gases.

The apparatus in and by which the drying of the oxychloride is effected is shown in Figs. 3 and 4 of the accompanying diagrams. Fig. 3 is a cross section of the flue or tunnel of brickwork through which the trucks filled with oxychloride pass. Fig. 4 is a longitudinal section of the said flue and trucks. The flue is furnished at its ends with the locks A, B, which permit trucks to enter and leave without opening direct communication between the interior of the flue and the atmosphere. To introduce a truck, the door *a* is opened, and is shut again after the truck has been put in the lock. The dampers *c* and *d* are then lifted, and by means of the pusher rack G the truck is made to advance into the flue. Having crossed the space separating it from truck No. 10, it pushes this truck and the whole train forward, itself occupying the place of No. 10, and No. 1 being pushed partly into the exit lock B. No. 1 is now drawn into the lock B by the hook D worked from outside The damper *d* is then shut, the door *b* opened and the truck withdrawn by hand. The hot gases enter the tunnel by the pipe M, and leave it by the pipe N. It may be produced in any manner, but it is important that its temperature should not exceed 300° C. Filling the trucks is a somewhat difficult operation, for it is necessary that the oxychloride should be spread in regular layers on each of the seven shelves of the trucks. We have succeeded in filling rapidly by means of the apparatus shown in Fig. 5. This apparatus consists of three parts:—1. A measurer A formed of seven equal spaces corresponding to the seven shelves of the truck. The bottom of each of these spaces is shut by an inclined door *a*, furnished with a lever. The seven levers are jointed to a connecting rod B, which is worked by a screw, two bevelled wheels and a hand wheel C, so that all the seven doors are shut or opened simultaneously. 2. Below the measurer is a sort of hopper D, also divided into seven compartments and mounted on wheels. 3. Under these two parts, and on a level with the drying apparatus, is a reversible frame E, on which the truck to be loaded is placed. In the drawing, this frame and a truck is represented as overturned—*i.e.*, in the position in which it should be to be loaded. Before being put in this position, the truck is furnished with a series of sheet-iron diaphragms, *d*, to limit on each side the thickness of the oxychloride. Two of the diaphragms are placed on each shelf, being introduced endwise by making them slide in like drawers. At the bottom end of the reversible frame are two rails R, on which the truck rests. These rails are supported by levers *f* and *g*, by which the truck can be raised so as to bring it against the top end of the reversible frame. The levers *f* and *g* are worked by the larger lever G, which is itself worked by the screw H and the crank M. The diaphragms are fixed by screws *n*, whose heads press against the cross-bars *o*, which form part of the diaphragms. The reversing movement is effected by the toothed wheel, pinion and crank shown by the dotted lines. When the diaphragms have been placed as described, the frame is reversed and the hopper D brought over the truck. The measurer having been filled with oxychloride, the wheel C is turned, opening the doors *a* and letting the material drop, which, being guided by the hopper D, descends into the spaces between the shelves and the diaphragms. The reversible frame is then brought to its normal position, the diaphragms are removed, and the truck is ready to enter the drying apparatus. The following table will indicate the results of this process of desiccation:—

TABLE A.

RESULTS OF DRYING OXYCHLORIDE OF MAGNESIUM.

Equivalents of MgO per Equivalent of Cl in the Oxychloride.		Percentage of Cl in the Oxychloride.		Percentage of H_2O in the Oxychloride.		Cl Lost per Cent. of the Cl in the Wet Oxychloride.	H_2O Lost per Cent. of Water in the Wet Oxychloride.
Wet.	Dry.	Wet.	Dry.	Wet.	Dry.		
1·333	1·359	26·73	32·89	44·27	30·89	1·12	44
1·391	1·511	25·91	32·05	44·97	29·81	4·67	49
1·343	1·531	25·80	32·73	45·93	27·97	7·43	55
1·346	1·511	26·16	33·30	45·16	27·09	6·60	57

During this operation the oxychloride loses 60 to 65 per cent. of its water; at the same time it disengages in the state of HCl from 5 to 8 per cent. of its chlorine. The dried product is therefore richer in magnesia than the original material. Thus 100 of original oxychloride, of which the analysis is given above under "Preparation of Oxychloride of Magnesium," is reduced by drying to 73·36, formed of:—

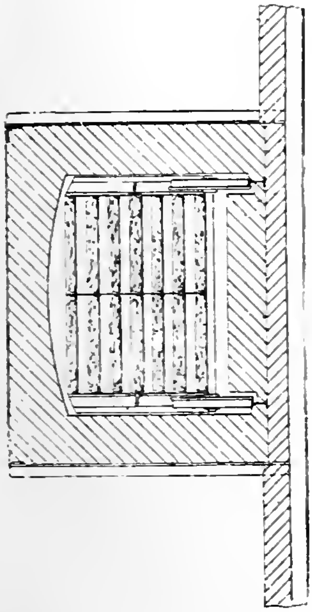

Fig. 3.

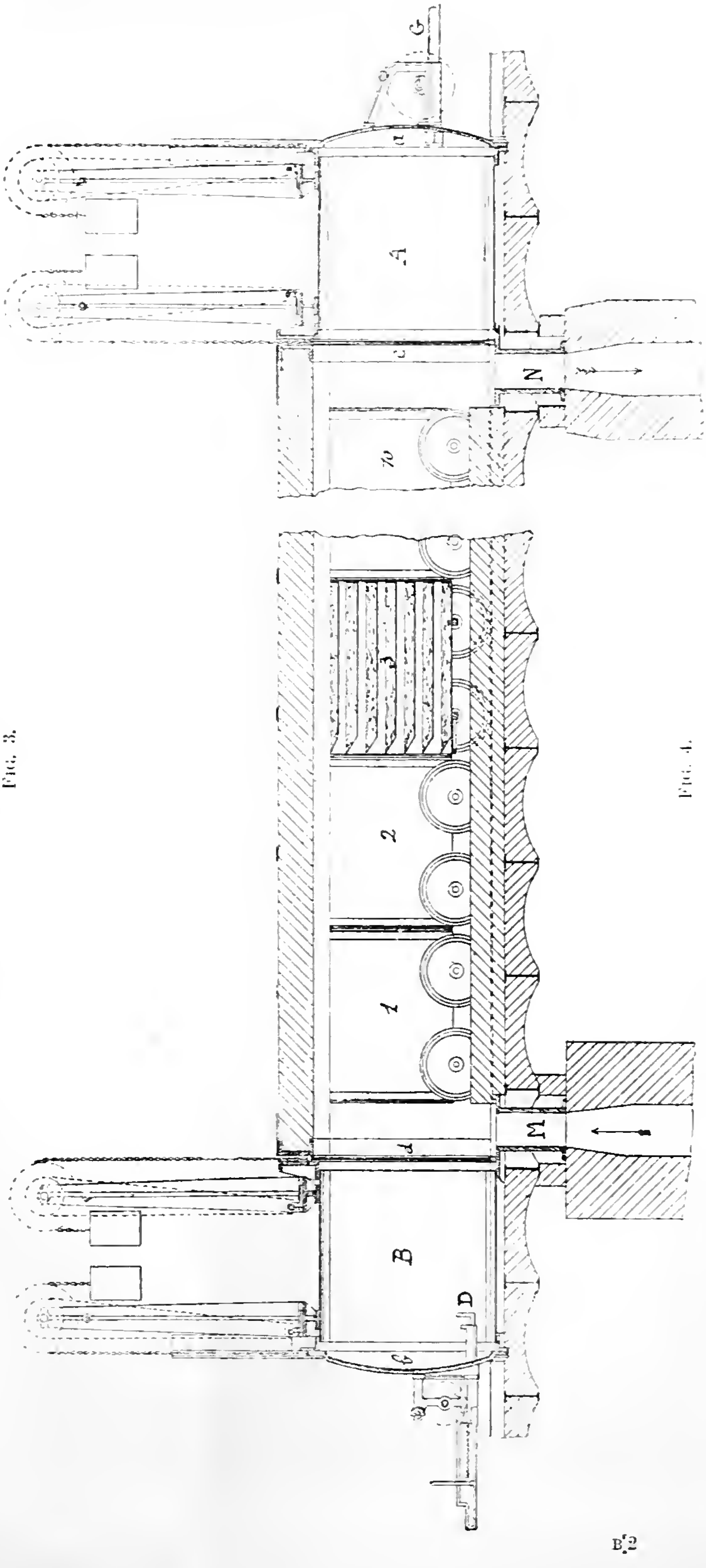

Fig. 4.

Impurities	4·00	
Water	15·86	
$MgCl_2$	32·69	($Cl = 24·43$)
MgO	20·81	
	73·36	

and of which the centesimal composition is:—

Impurities ..	5·47	
Water	21·62	
$MgCl_2$	41·45	($Cl = 33·30$ per cent.)
MgO	28·36	= 1·511 equivalents per $MgCl_2$.
	100·00	

As 100 parts of oxychloride before drying contained of Cl 26·16, and have been reduced to 73·36 parts containing Cl 24·43, the drying has caused a loss of Cl 1·73. Say that 6·6 per cent. of the Cl put in work have been lost in this operation. This loss will hardly exceed 8 per cent. We shall have occasion to speak of this further on.

FIFTH OPERATION.—DECOMPOSITION OF OXYCHLORIDE OF MAGNESIUM

The first idea which occurs to one's mind for carrying out this operation is to employ an apparatus analagous to a retort, heated externally, into which the dried oxychloride should be charged and air passed through. But this method of working was impracticable for several reasons, the chief one being that both magnesia and oxychloride of magnesium are very bad conductors of heat. Supposing a retort of practical size and dimension filled with oxychloride of magnesium, it would require a considerable time and an enormous quantity of fuel to bring the centre of the mass to a red heat. And not only would there be a great expenditure of fuel, but the operation would be executed under extremely bad conditions from the point of view of getting free Cl. Experience has proved that the proportion of free Cl driven off is always greater and the proportion of HCl always smaller the more rapidly the oxychloride is brought to the maximum temperature. For these reasons, and for others (for instance, the porosity of refractory retorts), the apparatus shown in Figs. 6, 7 and 8 was adopted instead of the retort. This apparatus and the method of working it may be briefly described as follows:—

Fig. 6 shows a vertical section, alike of the furnace proper and of the movable regenerative burner. Fig. 7 shows a horizontal section, alike of the furnace proper and of the said movable regenerative burner. The upper part of this section is taken along the line C, D, Fig. 1, and the lower part of it along the line E, F, Fig. 6. Alike in Fig. 6 and in Fig. 7, the movable regenerative burner is shown in the position, in relation to the furnace proper, which it occupies during the operation of heating up the working chambers of the latter. Fig. 8 shows a vertical section of the furnace proper, taken at right angles to the section shown in Fig. 6. A, A, A, A, Fig. 8, are four narrow decomposing chambers, having very thick walls. The upper extremity of each chamber A opens into the combustion chamber, B. The lower extremity of each chamber A communicates with one of the four horizontal channels, *a, a, a, a*. D, Fig. 6, is the movable regenerative burner. It consists of a system of cast-iron pipes, contained in an envelope of masonry, which envelope of masonry is encased with iron plates, and securely armatured. The cast-iron pipes are of rectangular section, and each of them is divided, by two vertical partitions, into three compartments, *i, o, u*. The central compartments, *o, o, o*, etc., convey gaseous fuel into the combustion chamber B, and the side compartments *i* and *u*, convey air into the combustion chamber. The gaseous fuel is supplied by the main pipe upon which is the valve N, Fig. 7, from which main pipe it passes by the pipes V and C, Fig. 7, into the flue C, Fig. 6, from which flue C it enters the compartments *o, o, o*, by apertures at the bottom of those compartments. Having reached the upper extremity of the compartments *o, o, o*, the gaseous fuel issues into the combustion chamber B, by the small pipes *d, d, d*, Figs. 6 and 7. The air which is to burn the gaseous fuel enters at the bottom of the compartments *i* and *u*, and, having risen to the upper extremity of those compartments, issues into the combustion chamber by the wide flat pipe T, Fig. 6. It will be seen from Fig. 6 that the small pipes *d, d, d*, pass through this wide flat pipe T, and that the small pipes *d, d, d*, are a little longer than the flat pipe T. The pipe V, Fig. 7, is fixed to the main pipe on which is the valve N. The pipe C, Fig. 7, is fixed to the movable regenerative burner. When the movable regenerative burner is in the position, in relation to the furnace proper, in which it is shown in Figs. 6 and 7, the pipe C communicates with the pipe V, at the point U, Fig. 6. The joint at U is one which can be readily made and readily unmade. From the combustion chamber B, products of combustion enter the narrow working chambers, A, A, A, A, by the upper extremity of each of them. After traversing these chambers downwards, they pass off, by the four horizontal channels *a, a, a, a*, into the movable regenerative burner. Following the direction of the arrows in Fig. 1, they pass upwards through the flues Z, Z, Z, Figs. 6 and 7, and then travel downwards, circulating round the rectangular cast-iron vertical pipes which have been described, and passing between those rectangular pipes, and then passing off from the burner by the pipe P, Figs. 6 and 7, which conveys them to the flues G, Fig. 6. In thus passing downwards through the movable burner, they heat the gaseous fuel which is passing upwards through the compartments *o* and the air which is passing upwards through the compartments *i* and *u*. They are then conveyed to the apparatus employed for the drying of the oxychloride. The pipe P, which is fixed, communicates with the flue by which products of combustion pass off from the movable burner by the piece Q, the lower part of which fits into the upper part of the pipe P, in such manner that the piece Q can be raised or lowered by the lever S. It will be seen from Fig. 6 that the whole regenerative burner is mounted on wheels. When the burner is in the position in relation to the furnace proper, in which it is shown in Figs. 6 and 7, the wheels of the movable regenerative burner stand on rails upon a truck K, K, Figs. 6 and 7. This truck also stands on rails. When the truck is drawn a short distance from the furnace proper the rails on the truck K become in such a position in relation to other rails, one of which is shown at *r*, Fig. 6, that the burner can be transferred to other rails, and drawn along them on to another truck installed opposite another furnace. Thus, while oxychloride of magnesium is being heated in a current of air in one furnace, the movable regenerator can be employed to heat up the decomposing chambers of another similar furnace. The working of the apparatus will now be easily understood. When the four working chambers A, A, A, A, have been heated to a sufficient temperature, the first step is to close the valve N, Fig. 7, and so to cut off the supply of combustible gas to the movable regenerative burner. The pipe C, Figs. 6 and 7, must then be disconnected from the pipe V, Fig. 7, the pipe P must be lowered, and then the truck on which the whole regenerative burner is supported must be drawn away from the furnace proper, until the wheels of the burner are opposite the rails, one of which is marked *r* in Fig. 6. The openings by which products of combustion have entered the working chambers must now be closed by the door E, Fig. 6, and the

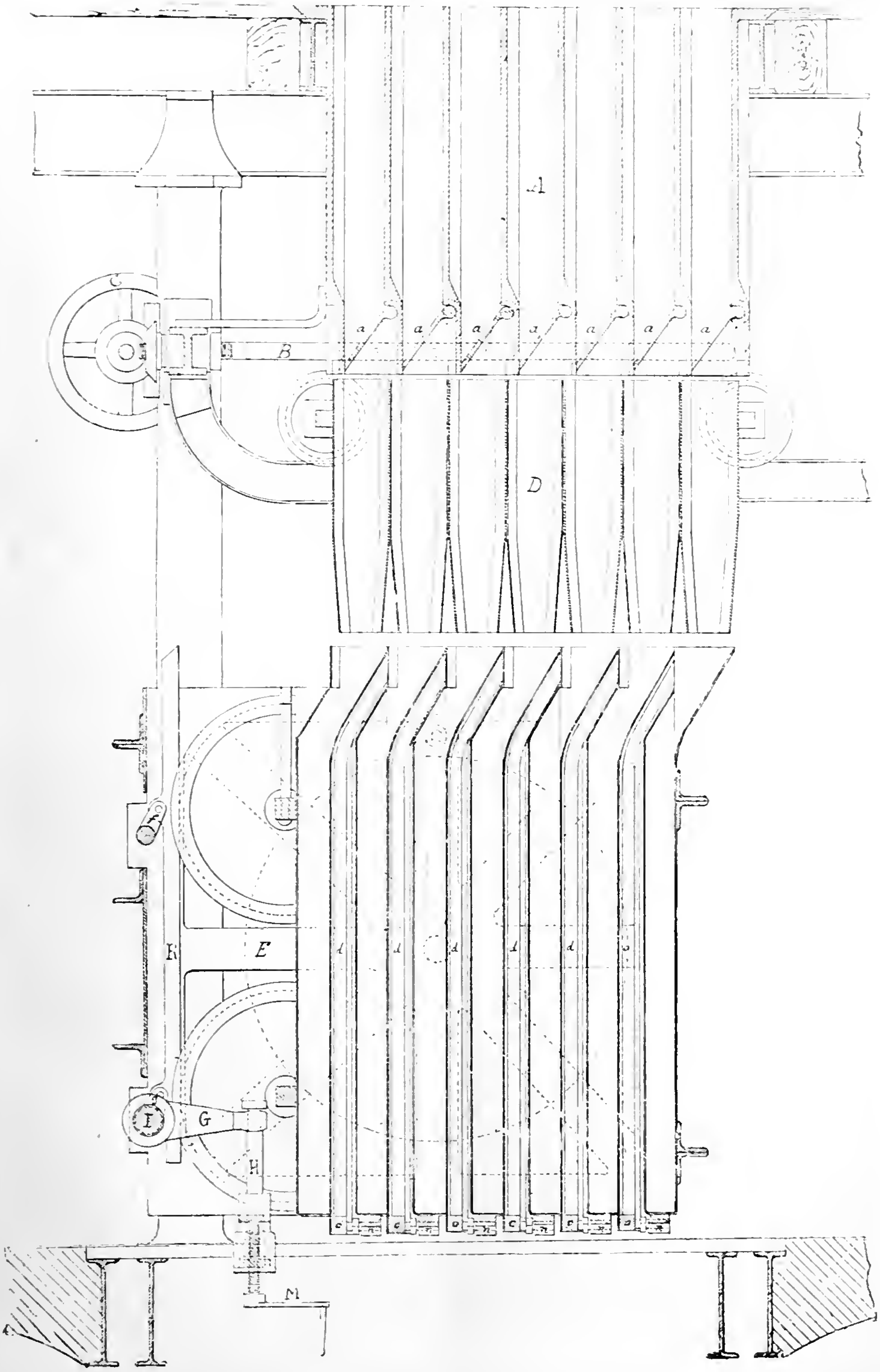

Fig. 5.

opening by which those products of combustion have passed off from the working chambers must be closed by the door F, Fig. 6. One door E and one door F suffice for the whole furnace. The doors E and F are hung on hinges; and when they are in position to close the openings to which they correspond, they are pressed tightly against their seats by screws. The decomposing chambers A, A, A, A, are charged with oxychloride of magnesium, in small pieces, from a tip-waggon charged therewith which has been previously brought into position on the top of the furnace. The oxychloride enters the decomposing chambers by the opening H, Figs. 6 and 8. The cover or door which closes this opening is seen in Figs. 6 and 8, but is not marked with any letter. This cover having been removed, a hopper is brought over the opening H, and oxychloride is then poured into the hopper, whence it falls into the chambers A, A, A, A. The door or cover of the opening H is then rapidly replaced and air is admitted into A, A, A, A, through apertures in the door E. The oxychloride rapidly becomes heated by absorption of some of the heat previously stored up in the walls of the chambers in which it is contained, and there passes off from those chambers a mixture of gases and vapours containing both free chlorine and vapour of hydrochloric acid. This mixture of gases and vapours passes off from A, A, A, A, by the horizontal channels *a*, *a*, *a*, *a*, into the vacant space between the masonry of the furnace and the door F, and then passes by the channel *l*, Fig. 7, into the pipe *m*, Figs. 7 and 8. From the pipe *m* the mixture of gases and vapours is conveyed to apparatus for condensing out of it vapour of hydrochloric acid, and what passes off from that apparatus then goes on to apparatus for the absorption of chlorine. The air which enters the chambers A, A, A, A, through apertures in the door E, is drawn in by means of an aspirator. When the decomposition of the oxychloride has proceeded sufficiently far, the admission of air into the working chambers is arrested, the door F is opened, and the residual oxide contained in the chambers A, A, A, A, is discharged. That residual oxide is drawn out of the horizontal channels *a*, *a*, *a*, *a*, by means of a suitable rake. When the residual oxide has been completely discharged the cover of the opening H is replaced, and then the door E having been opened, the movable regenerative burner is brought back into the position in which it is shown in Fig. 6, and the decomposing chambers of the furnace proper are then heated up again for another operation. Table B gives the results of several operations of decomposition. Fig. 11 shows the result of a special operation made at my request with a view to determining the rate of evolution of the chlorine.

Of course in actual working care would be taken to make the operations in the various decomposing furnaces overlap one another, so as to maintain the percentage of chlorine at a fairly constant average. The form of the curve obtained in this experimental operation suggested to my mind that the reaction was a reversible one: that is to say that when, as in this case, magnesium chloride is treated by oxygen it forms magnesium oxide and chlorine, and when the resulting magnesia is treated by chlorine it gives chloride of magnesium and oxygen. In order to arrive at an accurate understanding of the matter I determined to make a series of experiments myself. First, however, I looked up the literature of the subject in the best textbooks, but could find no mention of it. But when I went back to Davy I found that he did know that magnesia treated by chlorine gives chloride of magnesia + oxygen, and I found further that Graham knew that chloride of magnesia + oxygen yields magnesia + chlorine. However, all these facts appear to have been eliminated from our modern manuals. We will now make an experiment to prove this interesting reaction. My assistant has here a porcelain tube containing anhydrous oxychloride of magnesium. If he slowly passes through this tube a current of oxygen we shall collect at the other end an equivalent quantity of chlorine. If he now reverses the operation, substituting a current of chlorine, we shall obtain as the product a continuous current of oxygen. Therefore the reaction is a balanced or reversible one. Calling one end of my apparatus A and the other end B, I found that by passing oxygen from A to B, I obtained from 82 to 77 per cent. of chlorine, and by reversing the current and passing it from B to A I got 75 to 78 per cent. in the resulting gas. Whichever way I worked the result was practically the same, 75 per cent. of chlorine and 25 per cent. of oxygen. Then, by passing chlorine from A to B, I obtained 22 to 28 per cent. of oxygen, and from B to A 26 to 24 of oxygen in the gaseous mixture. The impression I had formed from the curve given in the above diagram was therefore amply confirmed. My theory of the decomposition which goes on in the furnace is that,

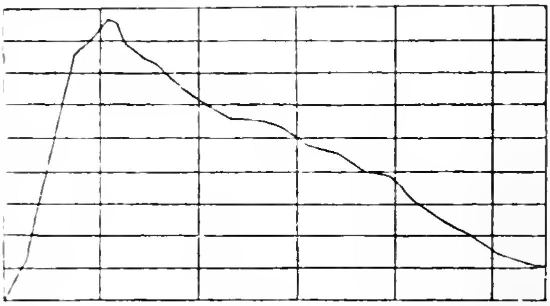

Fig. 11.

TABLE B.

DECOMPOSITION OF DRY OXYCHLORIDE OF MAGNESIUM.

Weight of Cl Charged.	Cl in the Residues per 100 of Cl Charged.	Per 100 of Cl Charged.			Per 100 of Total Cl Disengaged.		Weight of Free Cl per Operation.	Maximum Percentage of Cl in the Gases.
		Total Cl Disengaged HCl + Cl.	Free Cl.	HCl.	Free Cl.	HCl.		
Kilos.							Kilos.	
415	17·60	82·10	42·40	40·00	51·40	48·60	176	6·25
408	19·00	81·00	42·90	38·10	52·96	47·04	175	6·45
411	16·00	84·00	44·68	39·32	53·20	46·80	185	7·15
420	15·00	85·00	45·23	39·77	53·20	46·80	190	7·78

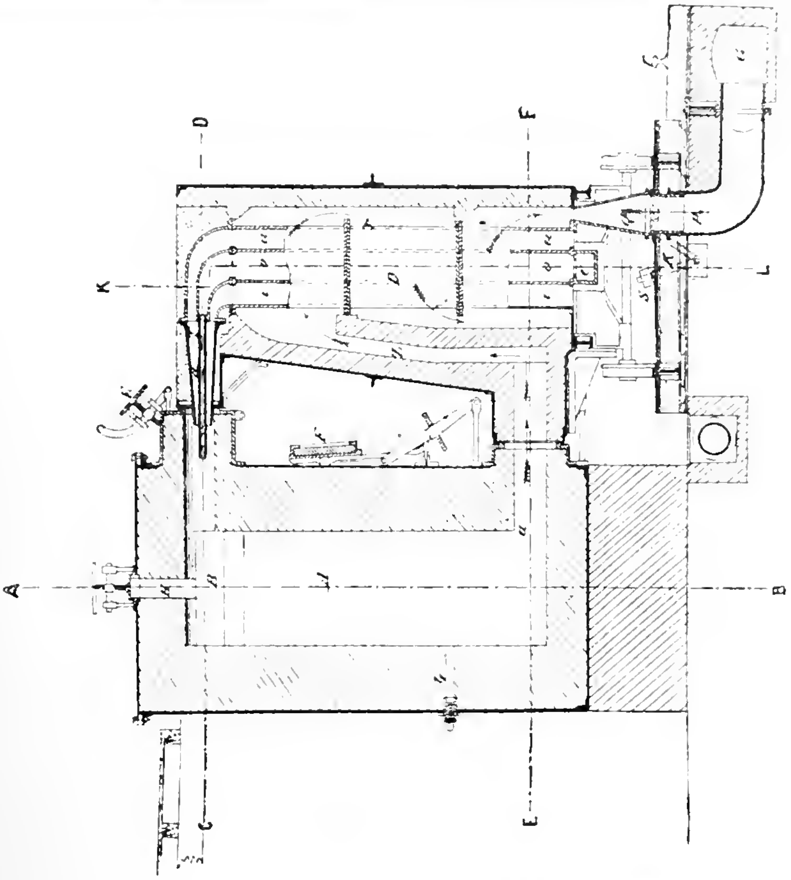

Fig. 6.

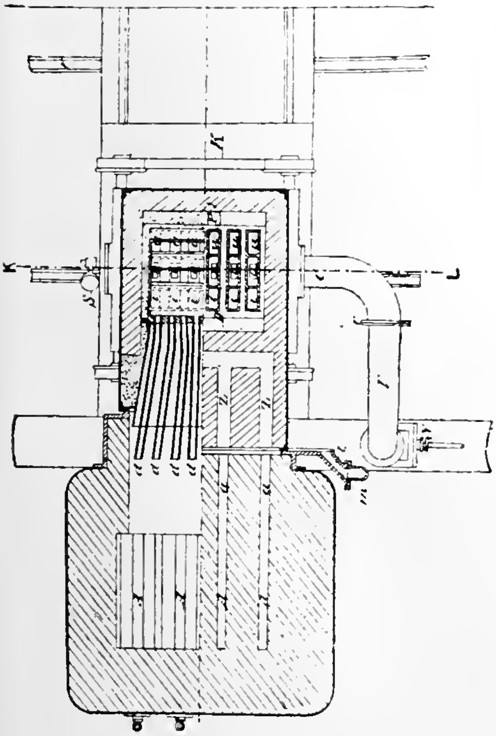

Fig. 7.

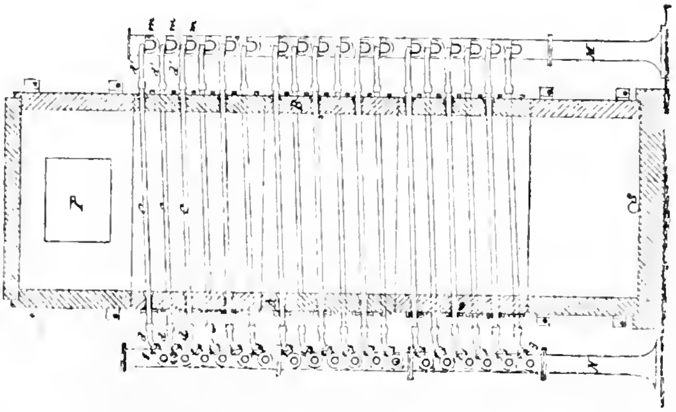

Fig. 9.

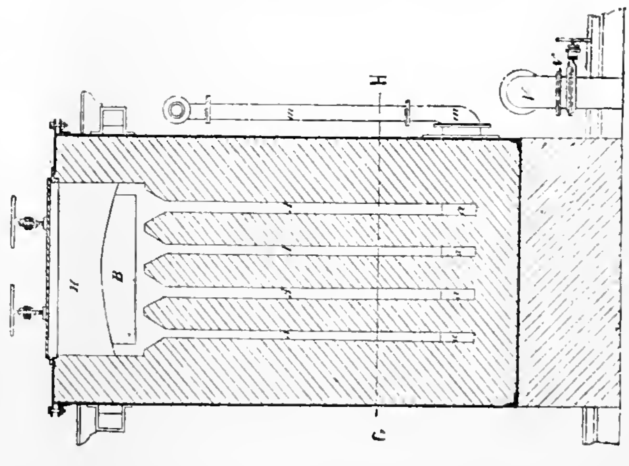

Fig. 8.

in the first stage, there is a rapid evolution of steam; the steam decomposes a portion of the magnesium chloride, producing hydrochloric acid, which passes off with the vapour of water. What remains is anhydrous magnesium chloride and magnesia, and this mixture then undergoes the reaction which we have just seen by the action upon it of atmospheric oxygen. I shall pursue these experiments further, because it will be interesting to know whether the decomposition will vary with a varying pressure of oxygen. Finding in my first experiment that three-fourths by volume of the original oxygen was replaced by chlorine I inferred that three-fourths of the oxygen contained in the air would be the proportion which would replace the chlorine at the temperature attained—viz., a full red heat, or nearly 1000° C. I therefore looked for 15 to 18 per cent. of chlorine when I used air; instead of which I got 30 per cent., showing a nearly complete absorption of the oxygen.

The products of the decomposition have to be drawn off from the furnace by means of a diminished pressure steadily maintained. For this purpose M. Pechiney employs an aspirator consisting of two small gasometers of cylindrical form, plunging in a concentrated solution of chloride of calcium. This solution is used rather than pure water, because Cl is nearly insoluble in it. These cylinders have a regular vertical movement, alternately up and down. A tube traverses the bottom of the vat which contains the solution of $CaCl_2$, and rises in the interior of the cylinder to a height superior to that which the liquid attains. When the cylinder rises it causes aspiration by means of this tube, and when it descends it drives back, through a tube, the gases with which it was previously filled. The said tube is connected outside the cylinder with two other tubes, one of which is fixed to the apparatus through which pass the aspirated gases, the other being fixed to the apparatus through which pass the rejected gases. Each of these new tubes is closed alternately by valves worked by the movement of the apparatus itself; that is to say, when the cylinder ascends the valve of the suction tube is opened and that of the ejecting tube is closed, and when the cylinder descends the valve of the ejecting tube is opened and that of the suction tube is closed. The two cylinders of the pump in question are suspended at the extremities of a balance, so that while one is rising the other is falling. The action of aspiration and rejection is therefore nearly continuous and regular. The aspirator is not in immediate connexion with the decomposing furnace, but acts through:

1. An ordinary HCl condensing tower.
2. A number of sandstone bonbonnes.
3. A glass tube refrigerator.

This refrigerator consists of a stone tower, of square or rectangular horizontal section, in the interior of which tower are arranged, in an inclined position, glass tubes, through which cold water is kept flowing. The said stone tower, in the interior of which the said glass tubes are placed, may be constructed after the same manner as the towers in which the vapour of hydrochloric acid which is generated in the first stage of the manufacture of soda by the Leblanc process is usually condensed. This tower is shown in vertical section in Fig. 9 and in horizontal section in Fig. 10. Two opposite sides of the said tower are each pierced with holes. These holes should preferably be arranged in horizontal rows, those of any one row except the lowest being, not immediately above the holes in the row beneath it, but above the spaces between the holes in the row immediately beneath. In Figs. 9 and 10 the two sides of the tower which are so pierced with holes are marked A and B. In Figs. 9 and 10 the glass tubes are marked *c*, *c*, *c*, *c*. One extremity of each of these glass tubes protrudes through one of the holes in the A side of the tower, and its other extremity protrudes through the corresponding hole in the opposite or B side of the tower. On the A side of the tower (which may of course be whichever of its four sides is most convenient in each case) the protruding extremity of each glass tube is connected by a piece of caoutchouc tubing, or other equivalent appliance, marked *d*, *d*, *d*, in Figs. 9 and 10, with one of the tubes or pipes some of which are marked T. These tubes T may be of iron or other convenient material. Water passes into these tubes T from the hollow column N, and then from the tubes T into the glass tubes *c*, *c*, *c*, *c*. On the B side of the tower the protruding extremity of each glass tube is connected with a piece of caoutchouc tubing, or other equivalent appliance marked d^1, by which, in each case, water which has entered one of the glass tubes from the hollow column N by one of the pipes T, and has traversed the glass tube, passes from that glass tube and is discharged into one of the gutters or conduits *m*, *m*, *m*. From the gutters *m*, *m*, *m*, the water discharged from the glass tubes passes away by the hollow column M. In order that the glass tubes *c*, *c*, *c*, *c* may not be liable to break, it is necessary that they should be kept always full of water. This result may be secured by slightly inclining the glass tubes, as in Fig. 9, placing that extremity of each of them by which water enters it a little lower than that extremity of it by which water is discharged from it. When the mixture of vapours and gases which the apparatus is employed to cool is one from which an acid liquor condenses during the operation of cooling it, this acid liquor will condense upon the glass tubes, and will run along each tube towards its lower extremity, being the extremity of it which is at the A side of the tower, or at the side of the tower at which the cooling water enters the glass tubes. It is, therefore, necessary that, at that side of the tower, the joint between the glass tube and the stone through which it passes should be perfectly tight. It will be seen that upon that extremity of the glass tube *c* which protrudes through the A side of the tower there is placed a short piece of caoutchouc tubing upon which is a caoutchouc flange, which flange comes in contact with the face of the stone through which the tube passes, and is pressed tightly against the face of that stone by the tubular flange of the gland *n*, *n*, that tubular flange of the gland *n*, *n*, being pressed tightly against the annular flange of the piece of flanged caoutchouc tubing *i*, *i*, by means of screws passing through the annular flange of the gland *n*, *n*, and working into the iron bar or band R, R. The joint between the other extremity of each glass tube *c* and the stone through which it passes on the B side of the tower may be made simply by means of any cement unattackable by acids. The gas or vapour to be cooled by this apparatus should preferably enter near the top of the tower, for example at P, Figs. 9 and 10, and the cooled gas or vapour should preferably pass off from near the bottom of the tower, on the opposite side of it, as at P^1, Fig. 10. Any liquid condensing in the tower will pass out of it by the aperture S, Fig. 9. It will be evident that if one of the glass tubes, *c*, *c*, *c*, happens to break, the broken tube can be removed and a new one put in its place very readily, and without stopping the working of the apparatus. The fact that a tube has broken will be perceived by an increase in the quantity of liquid discharged from S, and which tube it is which has broken will be indicated by water ceasing to issue from that extremity of the broken tube which protrudes through the B side of the tower. The cock *g* of that tube may then at once be closed, and the broken tube be removed, and a new one substituted for it, without interrupting the working of the apparatus.

It is this last apparatus which is in immediate connection with the decomposing furnace by means of a pipe. The gases leaving the decomposing furnace by the pipe M pass, by another pipe, into the glass tube refrigerator. There they are condensed. From the refrigerator they pass on through a series of sandstone bonbonnes and, lastly, through a condensing tower. In their passage above described the gases have been deprived of the whole of their HCl, and they now enter the cylinders of the aspirator as a mixture of air and chlorine gas. It is this gaseous mixture which the cylinders drive into special apparatus wherein they are brought into contact with milk of lime, which is gradually transformed into a mixture of chlorate of lime and chloride of calcium. It is by the volumetric measurement and the analysis of this liquid that the production of chlorine is calculated.

The hydrochloric acid condensed in the refrigerator, in the bonbonnes, and in the tower, is all mixed in a single reservoir, and yields an acid averaging about 12° B. It would be possible to obtain a much stronger acid, thus :—The vapour which at the beginning of the operation is condensed in the glass tube refrigerator, contains an enormous proportion of water, and only a small proportion of HCl. But later on the proportion of water diminishes greatly, while the proportion of HCl does not diminish. It would be possible to condense the relatively strong gaseous HCl in the weak aqueous acid of the refrigerator and the condensing tower. This has not yet been done, but it is a course which would suffice to bring the whole of the aqueous HCl of the process to a strong degree. For proof of this it will be sufficient to compare, in the figures which will be given later on, the relative quantities of HCl gas and vapour of water which are disengaged during the decomposition.

The decomposition of oxychloride of magnesium produces, as we have just seen, free chlorine and aqueous hydrochloric acid. The proportion of the Cl given off in the free state to that disengaged as HCl is as 53 to 47. There remains in the residues a quantity of Cl equal to about 15 per cent. of the total Cl charged into the furnace.

Consequently there is obtained per 100 of chlorine charged :—

Cl remaining in the residues	15·00
Free Cl	45·23
Cl as HCl	39·77
	100·00

Or, as these 100 of chlorine charged arise from 107 of Cl commenced with [there being a loss of 6·60 per cent. during the operation of drying], 100 of original chlorine would be accounted for thus :—

Cl lost in drying	6·60
Cl remaining in the residues	14·00
Free Cl	42·25
Cl as HCl	37·15
	100·00

If, besides this, we admit a loss of 5 per cent. of Cl during the various manipulations, especially in emptying the tanks in which the magnesium chloride is clarified, a loss which, if taken at 5 per cent., is certainly exaggerated, the account of each 100 of Cl put in work would be

Cl lost absolutely	In the various manipulations	5·00	11·27
	In drying	6·27	
Cl entering again into the process	Remaining in the residues	13·30	48·59
	Condensed in the state of HCl	35·29	
Cl produced in the free state			40·14
			100·00

Consequently, to produce 40·14 of free Cl one must consume 100—48·59 or 51·41 of Cl. The result in free Cl of the Cl entering the process is therefore 78 per cent.

One can see at a glance that this result can be improved only by succeeding in one or more of three things. :—

1. In diminishing the loss of Cl.
2. In increasing the proportion of free Cl yielded.
3. In diminishing the quantity of Cl remaining in the residual magnesia.

It is probable that the process will improve in all these various ways. And to produce this effect one means will suffice—viz., the improvement of the heating of the decomposing furnace. At present we obtain therein a mean temperature of about 1000 degrees C. It is necessary to greatly increase that temperature.

The magnesia when it is taken out of the furnace is, firstly, cooled by putting it in a vessel provided with a mechanical agitator, this vessel itself being placed in another vessel, and cold water being circulated through the space between the two. The MgO having a very weak capacity for heat is quickly cooled. The mechanical cooling is necessary, however, because MgO is an extremely bad conductor of heat. When the magnesia is cooled sufficiently it passes into a rotary sieve, which separates it into two parts :—

1. The more important part (about ⅘), which passes through the sieve as a fine powder, being almost entirely decomposed, containing hardly 4 per cent. by weight of Cl.
2. The less important part (about ⅕) which cannot pass through the sieve. This latter is oxychloride hardly at all decomposed, retaining no water, it is true, but containing much Cl, sometimes as much as 40 per cent. by weight. *This portion of the residue is at once mixed and re-charged* with oxychloride from the fourth operation.

It will be seen, therefore, that when native chloride of magnesium is treated, the magnesia which will be drawn out will be the *fine* magnesia, containing not more than 4 per cent. by weight of Cl—a small proportion considering the low equivalent of magnesia.

At Stassfurt, the working of 100 parts of $MgCl_2 6H_2O$ (containing, say, 35 parts of Cl) will yield a residue of about 20 parts of MgO. At the rate of 4 per cent. these 20 parts of MgO will contain 0·8 part of Cl, or only 2·3 per cent. of the total chlorine entering the process. Such a loss of Cl will be insignificant.

The present installation at Salindres comprises two furnaces of nine chambers each. These chambers are each 3 metres high, 1 metre long, and 0·08 metre wide. These two furnaces, heated alternately by a single regenerative burner, constitute a unit. It has been seen that such a unit should produce per 24 hours 1000kilos. of free Cl with three operations to each furnace, say six operations in all, or about 170kilos. per operation. Instead of which, at present, owing to the insufficiency of the heating apparatus, we can make only two operations in each furnace, or four operations in all per 24 hours, which give, according to the heat of the furnaces, from 180kilos. to 190kilos. of free Cl each. There is obtained, therefore, per 24 hours from 720 to 760kilos. of free Cl. The improvement of the heating of the furnaces would considerably change all the results. Indeed, if the furnaces could be made considerably hotter, one might dry the oxychloride a little less than at present without fear that the increased humidity of the material charged would inconveniently lower the temperature of the furnace. And as it is the expulsion of the last portions of the water driven off which causes the principal loss of HCl in the fourth operation, it will thus be seen that that loss might be considerably reduced. Moreover, with hotter furnaces, the quantity of total chlorine disengaged (Cl + HCl) would be greater, or in other words the decomposition would be more complete. And, lastly, with hotter furnaces, the decomposition would be more rapid, so that at least five operations might be made per 24 hours instead of four, as at present, and that without proportionately increasing labour or the consumption of coal. In a word, if a higher temperature is obtained in the furnaces, the quantity of chlorine will be greater, and the cost per ton for producing it will be less.

It has been said above that the respective quantities of steam and gaseous HCl which come from the decomposing furnace are such as not to prevent the obtainment of a concentrated aqueous HCl. In fact, for every 100 of chlorine charged there is obtained a quantity of Cl in the state of HCl=to 39·77. And it is shown above that in the dried oxychloride 33·3 of Cl are accompanied by 21·62 of water. That is to say, 100 of Cl charged are accompanied by

64·8 of water	64·8
But the above 39·77 of Cl have been disengaged in the state of HCl holding a quantity of water=	10·0
The quantity of water disengaged is thus only	54·8

and this quantity is not sufficient to condense the 39·77 of Cl in the state of HCl—which in reality represents about 41 of HCl.

Having now described the process itself, let us consider the question of cost of production, and in that respect compare it with the old Weldon process. The latter was essentially a cheap method. The plant required for it was not an expensive one, nor did it involve any great cost for repairs. The plant for the new process is more complicated, and consequently more expensive. On the other hand, the results obtained have increased the confidence which M. Pechiney has always had in the process, and have decided him to commence at once the erection of an industrial installation to work on a scale of 6000kilos. of free chlorine per day. Speaking of the small experimental plant which he has been working since last July, M. Pechiney says :—

1. We produce at the present time from 720 to 760kilos. of chlorine per 24 hours, at the following cost :—

		Francs.
Coal for the drying and decomposing furnaces	3300kilos.	
Coal for mechanical work	500 „	
Coal for concentrating $MgCl_2$	500 „	
	4300kilos. @ 12fr.	51·60
Labour		74·00
Repairs		20·00
Loss of magnesia (?)		5·00
		150·60

Say for 1000kilos. at the most 209·20fr.

2. If in working the one unit we succeed in producing 1000kilos. of Cl per day instead of 740kilos. as at present, by getting a higher temperature and a more rapid decomposition in the furnaces, the only expenses which would be increased (but which would certainly not be increased proportionately) would be those for fuel and magnesia. The other expenses would remain unaltered. The expenses for a production of 1000kilos. of Cl would then at the utmost amount to :—

	Francs.
Coal, 6000kilos. @ 12fr.	72·00
Labour	74·00
Repairs	20·00
Loss of magnesia (?)	7·00
Say for 1000kilos. of chlorine	173·00

3. The experience which we now have of the process, and certain improvements which we see our way to make in the heating of the decomposing furnace and in various points of detail, warrant us in expecting, with an installation producing 6000kilos. per 24 hours, the following cost of production per 1000kilos. of Cl :—

	Francs.
Coal, 1500kilos. @ 12·00fr.	18·00
Labour	75·00
Repairs	20·00
Loss of magnesia	5·00
Say for 1000kilos. of chlorine	118·00

It will be seen at once from these figures and from some which will follow, that the main expense of the process is for fuel, and that if fuel were as cheap in France as in England, M. Pechiney would be able to produce a ton of chlorine at the same working cost as he calculates it is now produced in England by the old Weldon process—viz., 94 francs. There is no doubt that the main feature of the new process is economy of hydrochloric acid ; for whereas the old Weldon process yields only 33 per cent. of the Cl entering into it, the process now under consideration yields 78 to 80 per cent. at least. Roughly speaking, therefore, the economy effected by it as compared with the old process, may be said to be the equivalent value of two tons of absolute HCl per ton of Cl produced. Now, Mr. Weldon has himself estimated the value of HCl. He says (this Society's Journal, 1883, p. 434) :—"HCl costs the Leblanc soda maker 36 per cent. of the total cost of the process by which he obtains it. The cost of that quantity of HCl, which is required by the present Weldon process for the manufacture of one ton of B.P., amounts to more than all the other items of the cost of that ton of B.P. put together. I believe M. Pechiney will eventually succeed in realising a cheap process which will diminish the present cost of B.P. for HCl by not less than two-thirds." He estimated the value of 27 per cent. acid to the Leblanc soda maker to be about £1 per ton, and he arrived at that value by taking the difference in the cost of producing a ton of soda by the Leblanc process and the ammonia process. That difference, he maintained, was the value to the Leblanc manufacturer of the quantity of acid which he produced in the making one ton of soda. It is incorrect to say that the value of HCl has diminished, though it is possible that the selling price of HCl has materially diminished. This decrease can be explained by the fact that the manufacture of B.P. having diminished by reason of an arrangement between the makers, there is a little more HCl for disposal. But this decrease in the selling price applies only to a certain limited quantity of HCl. The real value of HCl ought not to be expressed by the selling price of certain quantities of acid, but rather, as Mr. Weldon always maintained, by the difference between the cost price of ammonia soda and the cost price of Leblanc soda. Now, one ton of soda ash of 58 per cent. corresponds to about 2 tons 6cwt. of aqueous HCl of 28 per cent. If this latter is worth only 10s. per ton, there ought to be a difference of only 26s. per ton of 58 per cent. ash between Leblanc and ammonia soda. The difference is much greater than 26s., and must be nearly double that, say 50s. It cannot be much less than 20s. per ton. By finding the difference in the cost price of the two soda processes, I fix the value of HCl, and that difference is such as to bring the value of aqueous HCl of 28 per cent. to very nearly £1 per ton. Admitting, however, its value to be only 16s. per ton, that would bring the value of a ton of gaseous HCl to £2 16s.

It is possible, of course, that circumstances may be changed in the future—for example, by the recovery of sulphur; but that will be of no great importance. At present, the pyrites sulphur entering the Leblanc process at 3d. per unit, costs nearly 10s. per ton of 58 per cent. soda ash. If Mr. Chance succeeds in recovering sulphur at an average cost of 1d. per unit, the expense for pyrites will be lessened by two-thirds, or 6s. 8d. per ton of 58 per cent. soda ash. This would reduce the value of the 2 ton, 6cwt. of 28 per cent. HCl by 6s. 8d. in all, or say 2s. 6d. per ton.

It is therefore incorrect to say that the value of HCl has diminished in England during several years past. The value of HCl should increase in proportion as the selling price of alkali decreases. And for several years past the selling price of alkali has not ceased to decrease. The selling price of English soda ash and caustic soda is now 20 to 25 per cent. lower than it was in 1884. I admit, however, that this reduction is to some extent due to improvements in Leblanc plant, large furnaces, etc.

We have said above that for the English Leblanc manufacturer HCl gas ought to have a value of £2 16s. per ton. On the other hand the *probable* cost price of Cl per 1000kilos. at *Salindres* will be—

	Francs.
Coal, 4000kilos. @ 12fr.	48·00
Labour	45·00
Repairs, etc.	20·00
Loss of magnesia (?)	5·00
	118·00

The cost price will not be the same in England, for the simple reason that coal costs there only 6fr. per ton instead of 12fr. as at Salindres. The cost price in England would therefore be—

	Francs.
Coal, 4000kilos, @ 6fr.	24·00
Labour	45·00
Repairs, etc.	20·00
Loss of magnesia (?)	5·00
	94·00

That is to say, in England one ton of Cl will cost the same amount as by the old Weldon process.

To this conclusion two objections may be made:—

1. The cost price of 118fr. at Salindres mentioned above, is a *calculated* cost *not yet realised*. The experience gained of the new process warrants M. Pechiney in expecting that he will realise this result when an experimental plant producing only ¾ ton per day is replaced by an installation working on a scale of 6 tons per day, and to the working of which an experience which increases every day will be applied. It is with the expectation that the above estimate will be the maximum rather than the minimum that this probable cost price of 118fr. is given.

2. Wages, it may be said, are much lower in France than in England. Consequently, if 45fr. is the cost for labour in France a much higher sum will be required for England. An English workman, however, does more in a day than a French workman. So that, notwithstanding the lower wages in France, the expense for labour *per ton of material produced* is nearly the same in both countries.

The cost in England of 1 ton of chlorine obtained from the old Weldon process as compared with the Weldon-Pechiney will be as follows:—

1.—THE OLD WELDON PROCESS.

	£	s.	d.
Cost price of 1 ton of chlorine 94fr. =	3	15	0
Value of 3⅓ tons of HCl gas at 56s. =	9	6	0
	13	1	0

2.—WELDON-PECHINEY PROCESS.

	£	s.	d.
Cost price of 1 ton Cl 94fr. =	3	15	0
Value of 1⅓ tons HCl gas at 56s. =	3	14	0
	7	9	0

Therefore the saving by the latter process = £13 1s. less £7 9s., or £5 12s. per ton of Cl produced.

But, alas! where will the English manufacturer sell his bleaching powder if he produces 3⅓ tons instead of 1⅓ tons, as now?

But there are other matters to be regarded in considering the applicability of this process. In 1884 Mr. Weldon expected that its first effect would be to replace the Leblanc process by the ammonia process: because he then thought it probable that his new chlorine process might be used in conjunction with a method for decomposing the residual NH_4Cl of the ammonia soda process by MgO. And, although it is not my intention to go into that part of the question now, there is no doubt that that end could be attained if ammonia soda makers were willing to add to their already costly plant the additional expensive plant which would be necessary. M. Pechiney has patented a process and apparatus for thus treating NH_4Cl; and, moreover, Mr. Chance has proved that it is easy to transform calcium chloride into magnesium chloride by treating it with carbonic acid in presence of magnesia.

And this leads us to the more serious question, as to whether English manufacturers will care to use this new chlorine process in conjunction with the Leblanc soda process. In considering this question, we have to face the difficulty that magnesium chloride exists as a raw product at a place not far removed from a port easily available for the distribution of material, and from which centre enormous quantities of chemical products are already sent out—namely, Stassfurt. In the very able paper on the "Stassfurt Salts Industry," which Mr. Hake read before this Section in 1883 (p. 150), he said, speaking of the residual solution of magnesium chloride: "Many proposals have been made and numerous patents taken out for the further utilisation of this mother-liquor, but it still figures largely as a waste product. Of the 6,000,000 cubic feet yearly produced, corresponding to 150,000 tons of dry $MgCl_2$, one-half only is recovered, the remainder being run into the river, carrying with it 300,000lb. of bromine." Chloride of magnesium therefore costs at Stassfurt practically nothing. It is run into the rivers in the form of a solution almost as concentrated as that which is made at Salindres by dissolving the MgO of the process in HCl. The solution, therefore, has to undergo no more evaporation than is now made at Salindres, the cost of which is included in the estimated cost price of 118fr. per ton of Cl. However, as the Stassfurt solution contains some foreign salts (especially SO_3MgO and NaCl), which are deposited during the concentration, one may admit that the operation costs a little more than the evaporation made at Salindres, say 2·50fr. more per ton of $MgCl_26H_2O$—or for 3¾ tons, corresponding to 1⅓ tons Cl, 9·37fr., say 10fr. more.

	Francs.
The cost of 1 ton Cl at Salindres being	118·00
Will be increased, as we have shown, by	10·00
And will thus become	128·00
But it is still necessary to deduct for the loss of magnesia (which will be nil at Stassfurt, where $MgCl_26H_2O$ has no value), say	5·00
The cost of Cl per ton at Stassfurt will thus be	123·00

Or say £5.

To arrive at this result, it is assumed that fuel and labour cost the same at Stassfurt as at Salindres. In which case, chlorine and chlorine products will be produced at a much cheaper rate at Stassfurt than in England. On the other hand, Stassfurt is not so well situated as the English works for the exportation of B. P. However, the difference in this respect will not be great. The carriage from Stassfurt to Hamburg is about 6s. per ton by water and 9s. by rail. And the situation of Hamburg is as good on the whole for exportation as that of the English alkali works.

It would seem clear, therefore, that the natural place for the adoption of this process is Stassfurt. And if it can be worked there as economically as I expect it will—producing chlorine at less than one-half its present cost, it will become a serious question whether, even with the advantages which Mr. Chance is securing for it, the Leblanc process will be able to stand against its competitor. If this process succeeds at Stassfurt, the natural result in England will be a decrease of the amount of soda made by the Leblanc process, and an increase of the happiness of the ammonia soda makers. Mr. Mond and Mr. Solvay may, and probably will in time, succeed in developing their respective processes for producing chlorine from NH_4Cl and $CaCl_2$; but it will take a great deal to beat this process if it is applicable to the refuse chloride of magnesium of Stassfurt.

I will only say, in conclusion, that I think Messieurs Pechiney and Boulouvard deserve the very highest commendation for the labour, zeal and ingenuity which they have expended on the development of this process. There can be no doubt that the enormous personal enthusiasm which Mr. Weldon had, and the marvellous power he possessed of communicating a share of that enthusiasm to others, has been the mainspring which has induced these gentlemen, as a matter of honour to his memory, to endeavour to finish this work, believing all the time that it would ultimately attain that success which he had anticipated. I cannot conclude without quoting a few words of the inventor of this process, uttered from the spot on which I now stand. In his note on the influence of the ammonia soda process on the value of hydrochloric acid (see this Journ. 1883, 435) Mr. Weldon said: "If this process succeeds, *and I am still among you*, I will ask permission to give an account of it before this Section: and I can imagine few things more delightful than to be able then to tell you that the old Weldon process, after having forced its way into every chlorine works in the world except two, and those unimportant works, peculiarly situated, has at last passed into the limbo of things which have served their time."

NOTE.—I have to acknowledge the very great assistance I have derived from Mr. Renaut, Secretary of the Weldon's Chlorine Processes Company, in the preparation of this paper.

DISCUSSION.

The CHAIRMAN said the paper was one of singular interest from every point of view. Though it raised painful memories of the loss they had sustained by Mr. Weldon's death, everyone must feel a deep satisfaction in the fact that his labours had not been lost, and that his French fellow-workers had been able to carry out his plans with such marvellous skill and perseverance. The President had given a most beautiful exemplification of the fact that the highest science may find its application in technical chemistry, by working out before the meeting the real character of the reaction which took place in the process described. This was a process which proved the importance of engineering skill in its relation to manufacturing chemistry. He was not one of those who shared the delusion that the future of English manufacturers would be greatly helped by technical education given to boys of fourteen. Something was wanted which no boy of fourteen ever had—viz., the highest skill in pure chemistry coupled with a sound knowledge of physics, and to both must be added engineering capacity of the highest order, if any real progress was to be made in manufacturing chemistry. Without such knowledge even skilled chemists were apt to fall into the error of supposing that because an experiment went well in the laboratory it would go equally well when tons were dealt with—forgetting the enormous cost of manipulating large masses of material.

Sir HENRY ROSCOE heartily endorsed the remarks of the Chairman as to the importance of engineering skill to applied chemistry. At first sight he had been almost frightened by the complicated character of the apparatus shown—many parts of which, especially the glass-tube cooler, were striking examples of engineering skill and attention to detail. He would like to know whether bleaching-powder could be made from gases containing at the maximum only about 8 per cent. of chlorine, or whether M. Pechiney had confined himself to the manufacture of chlorate only. No doubt the late Mr. Deacon had made bleach from a very dilute chlorine, but he could not remember whether its strength was ever so low as 8 per cent. The question of technical education was not to be settled by merely teaching boys. Masters needed teaching as well; and the highest scientific instruction was needed in order to bring England up to the mark—or rather to keep her there. This process had been worked out by the skill of two eminent French engineers, but Mr. Weldon's own work was a brilliant example of what Englishmen could do. With such workers, and with higher education, England would not fail to keep her position.

Sir FREDERICK ABEL was glad to have an opportunity of expressing the pleasure he had felt, not only in listening to an interesting account of the last work of his friend Weldon carried on to completion by M. Pechiney, but seeing Professor Dewar throw himself, as they knew he could, with the greatest ease, from the highest branches of physical chemistry into the elucidation of practical processes, to the advantage of those who followed them, and thus illustrating the importance of a thorough education in all branches of science.

Mr. ALEXANDER M. CHANCE thought that the Chairman had called upon him for an opinion three months too soon. He might have something to say about it when he read his paper in March.

Mr. E. K. MUSPRATT was glad to find in the President's opening remarks a confirmation of the opinion he had expressed in addressing the Society from the same position — viz., that progress in industrial chemistry had now taken the form of the development of chemical engineering. The ammonia-soda process, as patented by Dyar and Hemming, in 1837, was perfect chemically, but his father and Mr. Young had failed to work it economically simply because their apparatus was imperfect; and M. Solvay's merit lay in the fact that he had overcome the engineering difficulties. However interesting the process under consideration might be from a chemical point of view, if it was to become a manufacturing process it could only be by reason of the perfection of the apparatus employed. And it would be seen by the diagrams exhibited that it was not a question of one piece of apparatus, but of a whole series. In going through the works of Messrs. Pechiney & Co. he had been deeply impressed by the admirable manner in which every engineering detail had been carried out. M. Pechiney's glass-tube cooler was most ingenious. Mr. Deacon had tried to cool the hot gases coming from his decomposer by a glass-tube apparatus in which the tubes were arranged vertically, instead of horizontally, as in M. Pechiney's apparatus; but his tubes broke so rapidly that he had to abandon the idea. M. Pechiney got his tubes from Belgium, and they were probably better than the English tubes. With respect to the question of the cost of the process and the probability of its going to Stassfurt, he did not think anyone could yet speak positively. It was true that at Stassfurt the raw material was in one sense much cheaper than either in England or France; but then the working loss of magnesia was put at only 5fr. out of 118fr., or, say, 5 per cent. England, on the other hand, had a great advantage in cheaper fuel; for it would be seen that simply on account of the higher price of fuel, the ton of Cl cost 25 per cent. more at Salindres than it would in England. He was not familiar with Stassfurt, but he understood that the fuel in use there was an inferior quality of lignite, and there would be difficulties in obtaining the high temperature required, which would make the fuel dearer. He did not fear, therefore, being absolutely bowled over by the Stassfurt manufacturers. He thought it probable that there would be some, though not insurmountable, difficulty in making bleach from a dilute chlorine such as this process yielded. The average strength of Deacon chlorine was 9 or 10 per cent., and he knew that with that percentage it was difficult to absorb the chlorine in hot weather. For the manufacture of bleaching liquor and chlorates, however, such a dilute chlorine would be quite applicable—it being merely a question of size of apparatus. M. Pechiney at present used the chlorine obtained by the new process for the manufacture of chlorate of potash. If he could produce his chlorine in that form cheaper than could the English manufacturer, the latter would be affected just as much as if bleaching-powder were produced, since the two manufactures were, so to speak, convertible. The effect would be that the English manufacturer would be able to make bleaching-powder only. He did not take a despondent view of the future of the English chemical trade. Though England might have fallen behind in some matters, she had advanced in others. English workmen were still, taking them all round, equal to, if not better than, Continental workmen. What was wanted was a more thorough education of the higher middle-class, and that would, he believed, be supplied by such institutions as the Owens College, and the new colleges at Liverpool and Leeds.

Dr. D. B. Hewitt was not prepared to criticise the process. Such an invention, however, was a matter of the greatest interest to everyone concerned in the manufacture of soda or chlorine products. Many active minds were at present engaged on similar problems, and he expected great advances to be made during the next five years. The result of increased knowledge might appear to be at one time to pinch the ammonia manufacturer, or at another time the Leblanc manufacturer; but, in the end, no one would find himself much the worse, and the human race would be benefited. An increased population and growing civilisation would create an increased demand for these articles in proportion to the development of the processes producing them. It was extremely remarkable that notwithstanding the vast development of the ammonia soda process, the decomposition of salt in England by the Leblanc process had been affected very slightly; and the Leblanc soda manufacture still showed a remarkable vitality. With respect to the utilisation of dilute chlorine, long experience enabled him to express a firm conviction that there was no difficulty whatever in making bleaching powder with chlorine that varied from 4 to 8 per cent. by volume. In a Deacon chamber there was no difficulty in absorbing the Cl to the very last traces. That he had proved to the satisfaction of Dr. Angus Smith. The whole difficulty consisted in obtaining the gases free from any bodies which would spoil the bleach. If the gases contained neither carbonic acid, hydrochloric acid, nor water, good bleach could be made even if only 3 per cent. by volume of chlorine were present in the mixture of gases. Of course as the percentage of chlorine decreased it became more difficult to exclude these deleterious bodies. With respect to the apparatus employed in this process, and especially the glass-tube cooler, words failed him wherewith to express his admiration. The glass-tube cooler seemed to him to have great advantages over the ordinary coke tower for very hot vapour of water mixed with chlorine and hydrochloric acid. As to whether more chlorine would be made at Stassfurt or in England no one could at present speak positively; but there could be no doubt that a great reward was in store for whoever should solve the problem upon which so many scientific men were now at work.

Colonel Gamble had not seen the process in operation. He had seen the plant in course of construction nine months ago, and, like everyone who had seen it since, was struck with the amount of engineering skill expended on it. M. Pechiney's belief then was that this process would be the chlorine process of the future—whether of two years hence or twenty years hence M. Pechiney thought might be questionable, but the speaker feared that most chlorine manufacturers now regarded that future as much nearer than they had hoped. The position was a most serious one for the Leblanc manufacturers of this country. They were already blessed with too much chlorine, in the shape of muriatic acid, and had to restrict its use as much as possible in order to make any profits. If the amount of available chlorine from each ton of salt was to be more than doubled, he did not know what would become of them. He feared Mr. Muspratt had hardly expressed the effect of the possible Stassfurt manufacture as fully as he might have done. He had said that the 5 per cent. loss of magnesia would be balanced in England by cheaper fuel, etc. But the fact was, as Mr. Muspratt was aware, that at Stassfurt they would have not only magnesia but chlorine also for the cost of evaporation. That being so, he feared that bleaching powder would soon be very cheap at Stassfurt, if the process could be satisfactorily carried out with their waste magnesium chloride.

Mr. John Pattinson quite concurred in the views expressed by previous speakers, that there appeared to be considerable danger of the transference of the chlorine industry from England to Stassfurt; and that real progress in industrial chemistry was now more dependent on the application of engineering ability than on the invention of new chemical processes.

Mr. A. E. Fletcher thought that, beautiful and ingenious as the apparatus appeared to be from the diagrams shown, manufacturers would look with dismay at the number of parts, knowing as they did that each part would add to the cost of production and maintenance. If, however, this elaborate apparatus produced results not to be obtained otherwise, then all thanks were due to the engineers who had designed it. The condenser had a special interest for him, and appeared to be extremely ingenious and effective. It should not, however, be compared with a coke tower. The latter was well suited to the conditions of the chlorine manufacture as now carried on, the supply of acid being intermittent, and it being therefore necessary to hold a large store of water in reserve, and available for use at any moment. M. Pechiney's condenser, on the contrary, was intended to deal with a constant supply of acid. It had been said that good bleach could be made from very dilute chlorine if it were pure. But of course dilute chlorine was not pure; and although elaborate arrangements might be devised for excluding noxious elements, there would always be the danger of leakage, and thus of the presence of carbonic acid or vapour.

Mr. Thomas Royle inquired on what scale the drawings were supposed to be.

Dr. Alder Wright asked whether it would not be possible to recover economically some of the HCl lost in drying; secondly, whether the percentage of Cl would not be increased by decreasing the air supply during the process of decomposition, and thus diminishing the total volume of the gases; and, thirdly, whether, supposing the process to be worked at Stassfurt, the by-product of magnesia which would result would not be available for use for making fire-bricks, thus cheapening the production, and perhaps turning the scale in favour of Stassfurt in a way not anticipated.

Mr. C. T. Kingzett remarked that some 16 years ago he had been associated with the late Mr. Weldon in experimenting a process for the production of chlorine by means of magnesia. In that case no attempt was made to utilise the chlorine directly for the manufacture of bleaching-powder. It was converted immediately into bleaching-liquor. Referring to this more modern form of the process, it appeared that the oxychloride as finally treated contained a large percentage of water. The question therefore arose as to how far the chemical reactions had been determined. Was it supposed that the chlorine resulted only from the action of oxygen on the oxychloride, or did it result in part from the action on the vapour of HCl generated in association? If it resulted from the direct action of air, then Leblanc soda makers would surely have an easy method of utilising their spare HCl by means of a little magnesia. The process might possibly be improved by moulding the magnesia into blocks suitably arranged so as to be alternately converted into oxychloride by HCl and then decomposing by heat, with the result of the production of chlorine.

Mr. J. W. Swan thought it would be useful if Professor Dewar could state the relative cost of the apparatus for this process and the old Weldon process; and also to what extent the HCl was actually condensed.

Professor Dewar in reply said: With regard to the question put by Sir Henry Roscoe, that was the point which first struck me and led to my investigation of the nature of the reaction in the furnace. Of course the practical reply to that question is that no user of the process on a large scale would ever allow his yield of chlorine to go below 5 per cent. As to the assumed difficulty of making bleaching powder from such chlorine, I think the testimony we have had to-night from so high an authority on the subject as Dr. Hewitt, confirming as it does what he said before the Newcastle Section in April, 1885 (this Journal, vol. iv. 311), quite settles the question. If Dr. Hewitt could make 36 per cent. bleach from gases containing only 5 per cent. of chlorine *by weight*, there would surely be no difficulty in dealing with these gases in which the chlorine averages 5 per cent. *by volume*. Moreover, Mr. Mond has always scouted the idea that any real difficulty attached to this point. But even if any such difficulty exists now it will disappear when we succeed, as we certainly shall, in increasing the temperature of the furnace and thus obtaining a quicker decomposition and a higher percentage of free chlorine. I have already made to M. Pechiney the suggestion which Dr. Wright has made to night—namely, that the supply of air should be graduated. With respect to the suggestions made by Mr. Kingzett, I would remark that the oxychloride does not need to be made into blocks; it is a natural property of the material to be somewhat too "blocky." In practice it has been found necessary to use it in small pieces, so that air may thoroughly permeate the mass. Mr. Swan's question is a most pertinent one. I have already stated that the plant for this process will be more expensive than is the plant for the old Weldon process. In fact, M. Pechiney estimates that, taking the unit of chlorine production at one ton per day, the cost of plant at Salindres for the old Weldon process would be 60,000fr., and for the new process 120,000fr. —that is to say, exactly double. The diagrams shown to-night are not drawn to scale. They are merely illustrations for the purpose of this paper. I may say, however, that the chambers of the decomposing furnace are three metres high, one metre long, and 0·08 metre wide. The hydrochloric acid at present lost could undoubtedly be recovered if it were worth while to do so: but at Salindres they are in the happy position of having a very extensive area and no alkali inspector, and therefore this loss does not trouble them. With respect to the possibility of Stassfurt becoming a centre of the chlorine industry, I should like to quote a few words of my distinguished predecessor in office. In his able address to this Society in July, 1886, Mr. Muspratt said: "If chloride of magnesium is used to replace salt as the raw material for chlorine, this great chemical industry will, of necessity, have its seat in Stassfurt, and not in Lancashire." I think, therefore, that my views on that point are well supported. I of course admit that the process has its difficulties, but I believe that those difficulties will be overcome. For instance, the attainment of a higher temperature in the decomposing furnace will obviate the present loss of chlorine as hydrochloric acid. The oxychloride before desiccation contains 6 equivalents of water; after desiccation it contains only 3 equivalents. If the drying were stopped earlier scarcely any hydrochloric acid would come off in that operation; but we cannot do that until M. Pechiney has carried out his improvement in heating the furnace. Then with respect to the remaining difficulty of undecomposed oxychloride. That will be no great drawback where the process is worked continuously, because these small portions of oxychloride are easily separated from the residues and are worked again. Supposing the process in work at Stassfurt, there will be an accumulation of cheap magnesia which will have been heated strongly, and will therefore be very dense. This magnesia will contain some 2 or 3 per cent. of chlorine, and will therefore be in a condition to form an excellent cement, setting quickly and with a hard, white surface. As Dr. Wright has suggested, such a cement will probably find useful applications, and may thus constitute a source of profit.

Liverpool Section.

Chairman: J. Campbell Brown.

Vice-Chairman: F. Hurter.

Committee:

E. G. Ballard.
Ernest Bibby.
Eustace Carey.
H. Deacon.
J. C. Gamble.
S. Hamburger.
D. Herman.
J. W. Kynaston.
E. K. Muspratt.
G. Shack-Sommer.
Jas. Simpson.
A. Watt.

Local Sec. and Treasurer: W. P. Thompson, 6, Lord Street Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held 5th December, 1887, in the Chemical Theatre, University College.

DR. J. CAMPBELL BROWN PRESIDING.

MISCELLANEOUS COMMUNICATIONS.

Dr. J. Campbell Brown said that he had brought some specimens of native indigo plant from Matacong, off the coast of Africa, and some indigo products, whilst a gentleman had been good enough to send a specimen of wild African indigo. The African indigo plant was extremely rich in indigo, and it was extensively used by the natives. They brought it down to the coast in the form exhibited (which was a number of conical masses of leaves) for their own use. It was very rough, and as far as he could make out it was matted together by cow-dung, and they used that for dyeing their own goods. The process they followed was similar in its essentials to that employed in India and elsewhere. They extracted it with alkali in such a way that fermentation took place; this developed the indigo, reduced it and dissolved the white indigo, and as far as he understood the natives on the African coast gave the goods rather a prolonged dipping. It was interesting to know, also, that although the specimen submitted contained a great deal of indigo it was difficult to get all the indigo blue from it. Dr. Kohn has worked this out, and found that the difficulty arose from the fact that the indigo was partly converted into indigo-brown, and that led him (Dr. Brown) to endeavour to ascertain how it got into that condition, and then he found out that the leaves were mixed with something like cow-dung. It had been put up in that form apparently for convenience of carriage. In that way it had got during carriage a strong fermentation and heating set up by the presence of the cow-dung and by the climate. In cases of what might be called "over-fermentation," not only was indigo blue formed from indican, but the continued fermentation made indigo brown. There were on the table specimens of indigo brown, indigo blue from indigo plants, and some artificial indigo made from coal-tar. It was also interesting to note that in different parts of the world where the climate is similar, indigo plants grow and flourish.

Mr. W. P. Thompson exhibited some samples of prepared paper for bank cheques. The cheques are printed in black or any other colour, but the paper was impregnated with chemicals in such a manner that no matter what liquid was put on to try to take out ordinary writing ink, the paper would change colour with the liquid, though unaffected by water. The samples he had got, if washed with caustic soda solution, oxalic acid or other acid, or bleaching powder solution, would entirely change colour, showing clearly the tampering. This prepared paper was being largely used in France in making cheques, coupons, bonds, etc. Envelopes have also been made with this paper, so that tampering with them could easily be detected.

The Chairman: Is the colour printed on the cheques?

Mr. W. P. Thompson: No, it is in the white paper itself. It is printed with ordinary printer's ink. If oxalic acid were put to the paper, it would immediately change colour, as shown in some of the specimens exhibited smeared with the three aforesaid solutions.

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ULTRAMARINE.

BY HERBERT J. L. RAWLINS.

Lapis-lazuli, the native form of ultramarine, is a somewhat rare mineral found in Prussia, China, Persia, and one or two other localities. It is generally of an earthy bluish-grey colour, but the purest varieties are of a deep rich blue. It is associated with iron pyrites, generally in small glittering crystals, and this gave rise, at one time, to the idea that the blue colour was due to the presence of iron.

To procure the blue colour free from the earthy matter accompanying it, the mineral is first reduced to a fine powder, which is mixed with resin, wax, and linseed oil, worked into a paste. The mass is then placed in a cloth and kneaded under water. The first portion of the colouring matter expressed is generally dirty; but afterwards the brighter blue makes its way through the cloth, and last of all an inferior quality. All these qualities are carefully collected and classified.

This operation is a very tedious one, and though several others have been suggested, no better one has been found. The resulting blue pigment is certainly of great stability and purity of tone, but costs about 20s. per ounce.

Discovery of a Process of Manufacture.

For a long time the composition of this body remained a mystery. "What is lapis?" asks Sir Hugh Evans in the "Merry Wives of Windsor," and until half-a-century ago chemists were echoing his question and asking each other "What is lapis-lazuli?" The analysis could give no clue as to the cause of the blue colour. To prepare it artificially became a great object, and the efforts in this direction were stimulated by the offer of prizes, amongst which was one of 6000 francs, offered by the "Société d'Encouragement" of France, to be awarded to the discoverer of a method of making ultramarine, provided it did not cost more than 90s. per lb. How strange it seems to think of this in these days when the value has fallen to less than half that price per cwt.!

As early as 1814 two German chemists, Tessärt and Kuhlmann, had observed the formation of a blue product in soda kilns and calcination kilns, but Guimet, in 1828, first discovered how it was produced, and gained the 6000 francs prize. He did not, however, publish his method, and grew immensely rich, although the price sank to about 16s. per lb. In 1828 he was producing at the rate of 120,000lb. annually.

About the same time, or, as is positively asserted by some, even prior to Guimet, Gmelin made the same discovery and published his researches in full, thus perhaps laying the foundation stone of the present supremacy of Germany in this manufacture.

Chemical Constitution.

In spite of the valuable discoveries of Hoffmann, Unger and others, our knowledge of the chemical constitution of ultramarine is very limited and uncertain, many different theories having been advanced regarding the cause of the blue colour.

According to Wilkins, ultramarine is composed of two portions, one of which consists of two silicates of alumina with sulphite and sulphide of sodium, and is constant in its composition; the other being a mixture of variable quantities of sand, clay and oxide of iron, with sulphuric acid. The blue colouring principle he considers to be a compound of sodium sulphite and sulphide. Another ingenious theorist, Stein, in two papers published in the *Jahresberichte* in 1871 and 1872, concludes that blue ultramarine contains sulphurous, and not thio-sulphuric acid, that neither sulphites nor thio-sulphates are necessary to its composition, and that it owes its colour to the presence of black sulphide of sodium, which is formed at high temperatures by the action of sulphide of sodium on alumina—admitting, therefore, that it is not a chemical compound, but merely a mechanical mixture, the blue colour of which is due to the bodies composing it.

Brunner considers ultramarine to be a compound of aluminium silicate, with sodium sulphate and sulphide, while Brünlin regards it as a double silicate of aluminium and sodium, in combination with pentasulphide of sodium. Green ultramarine he considers to be the same double silicate in combination with bisulphide of sodium.

Again, according to Ritter, ultramarine contains a double silicate, not only associated with polysulphide, but also with thiosulphate of soda: and Schülzenberger, on the other hand, considers that it is a mixture of a double silicate with sulphite and monosulphide of sodium.

Endemann considers that the blue colour is due to a "colour nucleus," consisting of unchanging proportions of aluminium, sodium, oxygen and sulphur, in each variety of ultramarine the proportion being different, while the rest of the sodium and aluminium, and the whole of the silica, merely act as a vehicle necessary to the preparation and existence of the colour. He considers that this "colour nucleus," in the case of white ultramarine, which he calls the "mother-substance in the manufacture of blue ultramarine," has the formula $AlNa_4O_2S_2$. By the action on two molecules of this of sulphurous acid gas Na_2O is removed, and green ultramarine $Al_2Na_6O_3S_4$ is formed, which then, by the action of oxygen, which forms sodium sulphate, passes into the pure green compound, having the formula $Al_2Na_4O_3S_3$. In the "indirect process" of manufacture green ultramarine is converted into blue by being burnt with sulphur. By this means Endemann considers that more sodium and sulphur are removed, and blue ultramarine $Al_2Na_2O_3S_3$ is formed. He considers that the other portion, not included in the "colour nucleus," differs in different samples. In one which he mentions it has about the composition $3Al_2O_3.5Na_2O.16SiO_2$.

But of all chemists who have worked on this subject none has done more to increase our knowledge of "the blue marvel of inorganic chemistry," as he himself has called it, than Reinhold Hoffmann. His position of manager of the Marienberg Ultramarine Works, near Benscheim, in the Grand Duchy of Hesse, renders his acquaintance with the manufacture perfect, and his untiring researches on the subject have been well rewarded by results both interesting and valuable. He considers ultramarine to be a double silicate of sodium and aluminium, together with bisulphide of sodium, the variety poor in silica, characterised by its paleness and purity of tint, and easy decomposition by acids, having the formula $4(Al_2Na_2Si_2O_8)+Na_2S_4$; while that rich in silica, characterised by its dark and somewhat reddish tint, and more difficult decomposition by acids, has the formula $2(Al_2Na_2Si_3O_{10})+Na_2S_4$. He also considers it very doubtful whether green ultramarine is really a chemical compound, and indeed it is now generally considered that the colour is only due to small traces of sodium salts in very intimate mechanical mixture with the blue variety, for by heating the green body for some time at 160° with water, in closed tubes, it is converted into the blue product, and small traces of sodium compounds are found in solution in the water; and further, on heating blue ultramarine strongly with sodium sulphate and charcoal—that is, acting upon it with sodium sulphide—the green variety is formed.

In a paper by Knapp, an abstract of which appeared in the *Journal of the Chemical Society* for March, 1880, there are some curious facts recorded with regard to the colouring agent. It was noticed that when silicic acid was replaced by boracic acid, a blue, nearly as stable in its properties as that of ordinary ultramarine, was produced. It was found that a blue could be obtained without alumina being introduced. Hence silica without alumina, and alumina without silica, can be employed with a certain amount of success. The blue, however, formed without silica, is not so strong or stable as that formed with it.

One very curious property which ultramarine possesses is its power of giving up its sodium in exchange for other metals. Thus, by heating blue ultramarine with a concentrated solution of silver nitrate in sealed tubes to 120° for fifteen hours, a dark yellow *silver* ultramarine is produced, containing about 46·5 per cent. of silver. This corresponds to about 15·5 per cent. of sodium, which is just about the amount that the original body contained.

When this body is heated with an aqueous solution of sodium chloride to 120° in sealed tubes, about three-quarters of the silver is replaced by sodium, but the other quarter cannot be so replaced; in fact, blue ultramarine, when heated with silver chloride, takes up silver, and becomes green. But by heating silver ultramarine with sodium chloride in the dry way, at rather a higher temperature, the whole of the silver is replaced by sodium, but the ultramarine thus regenerated does not equal the original body in colour. The change is probably due to the loss of sulphur in the formation of the silver ultramarine.

If in the above experiment potassium chloride be substituted for the sodium salt, and the temperature not allowed to exceed 400°, a bluish-green *potassium* ultramarine is formed. *Barium* ultramarine is a yellowish-brown product, *zinc* ultramarine is violet, and *magnesium* ultramarine is grey. These may all be obtained by acting on the yellow silver ultramarine with the corresponding metallic chloride.

From the experiments of Dollfus and Goppelsröder some very striking differences have been brought to light between the three types of colour which they examined—namely, the blue, green and violet—in their behaviour with various reagents. Thus, an aqueous solution of caustic soda or potash does not act on the blue or green, but turns the violet to blue, and when heated with carbonic oxide the same result ensues. Many other reagents have the same effect on the violet variety, but when acted upon with sodium sulphide, the green turns grey, and when heated with potassium chlorate becomes darker and loses its brightness of colour. Dollfus and Goppelsröder attempt no explanation of these facts, but simply state them as results of their observations, and profess their inability to give any chemical formulæ for the three ultramarines, though they consider that there is sufficient proof that each has its distinct constitution. They give as their opinion, however, that they are double silicates of aluminium and sodium, in which a part of the oxygen is replaced by sulphur.

I may here mention that violet and red ultramarines are more bodies of scientific interest than of any practical use, as their colouring power is not sufficiently great. The violet variety may be prepared by exposing the underground blue product to chlorine gas under a high temperature, while the red may be obtained from the violet by acting on it, under a low temperature, by dilute nitric acid fumes.

INDIRECT PROCESS OF MANUFACTURE.

The first artificial method of producing ultramarine was that known as the "Indirect Process"—that is, first the manufacture of green ultramarine; and, secondly, its conversion into blue. It was carried out as follows:—

An intimate mixture of Glauber's salts, China clay, and coal or resin, finely ground together, was placed in crucibles and baked or burned in an oven for about six hours. It was then transferred to iron trays, and heated with flowers of sulphur to the point where the sulphur took fire, when it was allowed to burn itself out. By this second process the green was converted into blue. It was then washed, ground with water, and settled out, the first deposit being of a darker shade than the second, and the colour becoming lighter as the powder settled was finer in grind. This is essentially the method employed now at many German works, those at Marienberg, for instance, and produces what is known as "sulphate ultramarine," distinguished by its pale shade and almost *greenish* blue tint.

The Manufacture as Carried out in Muffle Furnaces.

There are, however, some objections to the indirect process, and it was considered advisable to find a plan by which ultramarine could be made in bulk in a muffle furnace. The following is a method which is employed at the present time in some of the German works:—

A mixture of China clay, carbonate of soda, sulphate of soda, sulphur, sand and charcoal or resin, finely ground together, are placed upon the floor of a muffle furnace, being pressed down so as to present an even surface. The mixture is then entirely enclosed with fire-clay tiles, the spaces between which are filled in with thin mortar. When the oven is so charged the front is built up, a small hole being left for watching the temperature of the flue between the tiles and the top of the furnace, and for drawing samples during the process, which is done through a corresponding hole in the front of the fire-clay tiles, temporarily closed with a fire-clay stopper. The oven is now heated—slowly at first, and afterwards more strongly, so that at the end of eight or nine hours it is at a dull red heat. It is kept at this temperature for about 24 hours, when the heat is raised so that a clear red glow is obtained, which is kept up to the end of the operation.

For the purpose of taking a sample, an iron spoon borer is introduced through the hole left in the enclosing tiles, turned round, and pulled out. The contents are laid on a clean tile, and quickly covered with another tile, on which a second quantity is placed, and allowed to remain exposed to the air. If the oven has been sufficiently heated the covered sample should appear of a bluish green, and no longer brown or yellow, while the second sample should be rather bluer. If this be the case, the oven is heated slowly for another hour, and then all communication with the outer air cut off. It is allowed to cool and then opened, when the contents should appear as a beautiful blue mass, the lower portion of which, however, is of a greenish tinge. Both parts are now treated alike, but worked up separately, the greenish blue portion making an inferior article. The finishing process is as follows:—

The raw ultramarine is ground in upright mills, and then repeatedly boiled for about ten or fifteen minutes at a time in cast-iron boilers, being all the time agitated by a mechanical stirring arrangement. It is then allowed to settle, and the water drawn off with a siphon. As soon as the powder settles into a hard compact mass it has been sufficiently washed, and it is then dug out. The part next to the bottom of the boiler is generally coarse and of poor quality. It is carefully separated from the upper portion, which is transferred to wet mills of the ordinary description, and there ground for from six to twelve hours, during which time about 150lb. can be treated in each mill. The ground colour from these mills is then collected in a large tub, and allowed to settle for four hours, during which time the coarsest particles fall to the bottom. The liquid is then passed through a series of tubs, in each of which it is allowed to stand for a period of time, lengthening as the quality settled out becomes finer, the last settling requiring about three weeks. The various qualities are then dried and sifted, when they are ready for the market.

The blue produced by this operation is of a good quality, but there are some objections to the process which have given rise to another in which the ultramarine is produced direct in crucibles similar to those used in the indirect process.

Direct Process in Crucibles.

This is conducted as follows:—The mixture of raw materials consists of about 100 parts of China clay, 90 of carbonate of soda, 110 of sulphur, 20 of charcoal, and a quantity of infusorial earth, varying according as the ultramarine produced is desired to be rich or poor in silica. These are finely ground together, in which process great care must be observed, as much depends upon its being properly carried out. The mixture is then filled loosely into crucibles provided with flat circular lids, which are fixed on with mortar containing clay. This is allowed to dry, and the crucibles are then ready for firing, which process is conducted in ovens generally constructed so as to contain several hundred crucibles, which are arranged in rows, one above another.

The mixture undergoes a very curious change of colour while in the ovens. When put in it is greyish white, and during the process of burning it becomes successively brown, green, blue, violet, red and white in the order named. These changes are, according to Guimet, due to oxidation. The brown appears with the blue flames due to the combustion of the sulphur, the green just after the sulphur flames have ceased, and the blue is first formed at a temperature of about 700°—*i.e.*, a bright red heat. If, after this, heat be still applied and air freely admitted, the mixture becomes first violet, then red or rose coloured, and finally white. When this white body is heated to redness with carbon or other reducing agents, the red, violet, blue, green and brown colours (according to the amount of reducing agent employed) may sometimes be reproduced, though the reaction is by no means a certain one.

If brown ultramarine be removed from the oven, and allowed to remain exposed to the air, it immediately takes fire and burns to an inferior blue colour. The same thing occurs with the green body. Even if the brown product be completely cooled before being exposed to the air, it will, as soon as the air is allowed to reach it, get hotter and hotter, until it is glowing, when it will burst into flame and become blue. Attempts have been made to preserve the brown colour, which is of a beautiful chocolate tint, but have always failed. In one instance, when this was tried, the colour was put immediately into water, and treated like the ordinary blue variety, and as long as it was kept moist no change was apparent. After being washed and wet ground the moist powder was put into a cask, where for some time it was allowed to remain undisturbed. At the end of about three weeks it was noticed that the mass was hot, and on being turned out of the cask and broken up it was found to be at a glowing heat in the interior.

After the oven has been fired for several hours it is carefully closed at every point where air might enter, and allowed to cool for four or five days. The exact length of time during which the ovens are fired, and the amount of air admitted, depend upon various circumstances, one important one being the state of the weather. Thus, on a dull, foggy day, when the draught in the chimney is not good, a longer time is required. Of course, no rule can be given for this, and it is the experience required in the management of the oven that makes the manufacture so difficult to carry out successfully, the early efforts of a manufacturer not unfrequently resulting in the loss of a whole ovenful of raw material. As soon as the oven has cooled the crucibles are taken out, and the contents of each turned out in a solid mass, which must be carefully cleaned with a knife of any badly burned portions, and afterwards broken up and thrown into a cask along with the contents of other crucibles.

This forms what is known as crude raw ultramarine. It contains about 15 per cent. of sulphate of soda, which must be removed before the colour is fit for sale.

For this purpose it is washed with hot water in large tubs, after which it is ground in wet mills to an impalpable powder, and allowed to stand for about an hour in a large tub, in order to remove the coarsest particles and dirt which are sure to be present. It is then removed to another tub, where it settles for four or five hours, and from this it passes to others, where it stands for various lengths of time, increasing, of course, as the powder to be settled becomes finer, the last settling occupying three or four weeks, and producing the strongest quality that can be obtained—that is to say, it will bear mixing with more of a reducing medium, such as mineral white, than would a former settling, for the mixture in each case to be of the same depth of colour.

The water, after the final settling, still continues about five per cent. of ultramarine. This would take five or six months to settle, and as this time could not generally be given to it, it is precipitated with lime water, which has a sort of coagulating influence upon the particles, which can then be removed by filtration. It is a curious thing that this last quality is quite different to the one preceding it, being very inferior in both colour and strength.

After settling, all the various qualities are dried on kilns, and sifted through fine brass wire sieves by means of a fan, which breaks up the lumps and forces the particles through the meshes of the sieve, which must be very close—about 100 to the inch—in order that the ultramarine may be perfectly smooth and free from lumps or grit of any sort. When finished, it should be in the form of an impalpable powder—the finer qualities so fine, indeed, as to feel almost *buttery* when rubbed between the fingers. After this process the different qualities and shades are mixed to certain standards, and are then ready for sale.

The uses of ultramarine in the arts and manufactures are very numerous and important. The most important, from the point of view of quantity, is the manufacture of "square blue" for washing purposes. In the preparation of this article the ultramarine is generally mixed with bicarbonate of soda and some glutinous material, to help it to retain its shape, and is then pressed into the well-known form of small square or oblong blocks.

It is also used largely in the manufacture of blue paint and printing ink and in the preparation of blue mottled soap. The way in which it is employed in the last-named manufacture is worthy of remark. It is added to the soap while it is in a molten state and just before it is allowed to cool, and thoroughly mixed with it, so that the whole mass is of a pale blue tint. If a small quantity of this be removed from the boiler and cooled quickly, it remains of a uniform tint, but in the case of the whole boiler full, where the cooling is very slow, the action is entirely different. Just at the point of cooling, when the soap is going to set hard, the ultramarine—to use a technical expression—"strikes" and goes into the form which gives to blue mottled soap its well-known appearance.

In the manufacture of paper ultramarine also plays an important part. It is here used not only for producing blue shades, but also as a bleaching agent, to counteract the yellow, when white paper is made.

Another important use is in the calico manufacture, where it is used both in the printing of blue patterns and in the finishing of goods. In the case of calico printing, it is mixed with albumen and printed on to the calico, which is then subjected to the action of steam, the albumen being by this means coagulated and each grain of ultramarine surrounded by an insoluble envelope, so that it cannot be washed out of the calico.

The growth in the manufacture of ultramarine has been very remarkable, especially when it is considered how little the process is understood chemically, and what care and patience—to say nothing of the equally important item of capital—are required in the starting of a manufactory. Commencing less than 50 years ago in the works of Guimet, at Lyons, who produced 120,000lb. annually, there are at the present day nearly 40 manufactories at work in various parts of the world—chiefly in Germany—producing about 20 million lbs. per year. The following figures will give some idea of ten years' growth of this industry—from 1862 to 1872:—

	1862.	1872.
No. of manufactories	24	32
Men employed	964	1929
Tons manufactured	3556	8585

From the above numbers it will be seen that in these ten years the manufacture more than doubled itself, the fact being due, however, not so much to the increase in the number of works, which was only one-third, as to the enlarged capabilities of those existing in 1862. Thus, in the works of Dr. Leverkus, near Cologne—the first works ever started in Germany—the number of men employed had, during these ten years, more than doubled, while the output had trebled, and in the case of the Marienberg Works the difference was even more striking, the number of hands employed and the quantity turned out per annum having nearly quadrupled.

Such is a short sketch—from both a chemical and a practical point of view—of this much used, but little understood, body. I have not attempted to go very deep into its chemistry. It was not within the intention of this paper to do so, and besides, to tell the truth, I was rather afraid to plunge into such a troubled sea of contradictory theories. "Patience," says the French author, in, surely, the most extraordinary mixture of metaphors ever put together—"Patience is the crutch by the light of which we follow the road to knowledge without losing the thread of it." Well, it is to be hoped that this will soon come true in the case of the researches on the question of the composition of ultramarine, for if patience has ever been expended upon any subject, it is upon this. Gmelin, Scheurer-Kestner, Stein, Hoffmann, Scheffer—these and many other names make up the brilliant list of those who have endeavoured to wrest this secret from Nature, and yet to-day we are obliged to echo the words written by Hoffmann ten years ago, and to say, "The time has not yet come when a well-grounded theory can be formed with regard to the chemical constitution of ultramarine, or to its physical properties with regard to light—that is, its various colours."

DISCUSSION.

Dr. S. **Hamburger** said that some years ago a discussion took place in a German technical paper as to whether ammonia soda was applicable to the manufacture of ultramarine. Some manufacturers contended that it was, whereas others found ammonia soda not suitable at all. He should like to hear the lecturer's opinion on that point. Again, he had always understood that it was Vauquelin who first noticed ultramarine on bricks in black ash furnaces, and that it was Dumas who gave an explanation of its formation. Dumas added that there was not the least doubt that one day ultramarine would be made from silica, alumina and sulphide of sodium. This suggestion led Engelhart, who translated Dumas' works into German, to commence experiments in that direction, but he died before they were completed. His assistant Leykauf continued his work, and is entitled to the credit of having taught the world how to make ultramarine on a manufacturing scale. Gmelin's experiments did not go beyond the laboratory scale, while Guimet kept his process secret.

Mr. Thompson asked whether the blue colour in kyanite was due to ultramarine and also whether the colour of the sapphire (which generally had a little silica in its composition and was mainly alumina) was likely to be caused by ultramarine? He fancied himself, with regard to the sapphire, that it was more likely to be caused by cobalt, because traces of cobalt had been found in the sapphire mines in the Southern States, but it had struck him that possibly, as there was silica nearly always present, it might be the silica combined with alkali and sulphur that had done the thing, especially, moreover, as the sapphire was always found there in extinct volcanoes, or in volcanic eruptive rocks. Therefore, there was plenty of sulphur for the purpose of forming ultramarine. The blue corundum or sapphire was found in some mines almost to the exclusion of any other colour, but not sufficiently clear to be gems (he had found one sapphire himself which weighed about 10lb., but too opaque and flawed to be of value as a gem), but in other corundum mines there was not the slightest trace of blue, it was all yellow, red brown, white, and grey. In one—Buck's Creek—mine, where it was all grey, except a little blue in one place, kyanite came up in great quantity and it was all blue, or blue and white, just the same colour as ultramarine.

Dr. J. C. Brown said in connection with Mr. Thompson's question, he would also like to ask whether ultramarine was ever transparent.

Mr. Thompson said with regard to the sapphire he believed the colouring matter might be opaque. If they took sapphires and carefully examined them, they would find that the colour is hardly ever uniformly spread over the stone. He had found sapphires which had the colours red, blue, yellow and white all in the one stone, and the blue, when it is found in a stone, is usually in streaks. Well, if they took a very little ultramarine and stirred it up in water, that water would be transparent and blue and to all appearances uniform, much more uniform than the sapphire. In the same way the blue crystal of corundum might be uniformly blue to all appearance and yet be coloured by ultramarine or other opaque colour. To begin with, cobalt blue was opaque and there was very little doubt that sapphire was coloured by cobalt blue or ultramarine, because the colour was so staple.

Mr. S. G. Rawson asked whether the lecturer had ever noticed the formation of crystals of ultramarine, which, he understood, had been prepared in single-refracting crystals belonging to the regular system. As regards the grinding of the ultramarine, did prolonged grinding much alter the colour, because in the case of vermillion the longer the grinding was continued the brighter was the colour.

Dr. Hamburger said he did not mean to say that ammonia soda did not produce ultramarine, but his point was rather whether it was equally suitable and whether the finished product was of the same or an inferior quality. As far as he could remember, the discussion in the German technical papers did not result in anything definite, and the question was left open, whether ammonia soda could replace Leblanc soda as a raw material for the manufacture of ultramarine.

Mr. S. Muspratt said with regard to the ammonia soda, if Reckitt's blue was an ultramarine, he knew for a fact that ammonia soda was used in it.

Mr. Bateson said he had always understood that the objection to the ammonia soda was that it was more voluminous than the Leblanc soda, and therefore the pots could not receive the same weight of charge, and owing to the greater porosity the heat penetrates less easily to the centre of the mass.

Mr. Rawson did not think the lecturer had quite understood his question on the fineness of the grinding. He did not refer to the quality of the ground raw materials as depending on the fineness of their grinding together, but whether the finished product depended on it. He understood that imperfect grinding was quite fatal to the production of the colour.

Mr. Rawlins, replying to Dr. Hamburger, said that, with regard to the use of ammonia soda, it had frequently been used in the manufacture of ultramarine, and was constantly used, he understood, but he himself had not much experience of it. As far as he could make out, it certainly produced ultramarine, but of a darker shade than that made with Leblanc soda. Mr. Rawlins, continuing, said it could not be supposed, in works where the Leblanc soda was used, that ammonia soda could conveniently be substituted, for of course a works when established had to adhere to its known standards and shades, and it would not do for them to change their raw materials, though the ammonia soda produced a very good ultramarine. As regards the discovery of ultramarine, the first works started anywhere were Guimet's. He (Mr. Rawlins) had with him a little historical list containing the dates at which the various works established before 1866 or a little later had been started. It was drawn out by Hoffmann, who, as he stated before, was the manager of large ultramarine works, and he put down Guimet's, which were started in 1829, first on the list. Dr. Leverkus started in 1834. He (Mr. Rawlins) knew that the discovery of ultramarine had been attributed to different people. He had mentioned Guimet because it had generally been considered, as far as he had heard, that Guimet and Gmelin were the two who discovered it from a manufacturing point of view. With regard to Mr. Thompson's question, he could not tell him about kyanite, but he did not think it was at all likely to be the case with sapphire. He had heard of crystals of ultramarine, but had never seen any, and he knew they were very difficult to prepare and very rare. He had mentioned that the grinding had to be done very thoroughly, because the better it was mixed and the finer it was ground, the better was the ultramarine produced. If it was badly mixed it was quite fatal to getting a good result. Mr. Rawlins said that grinding lightened the colour. Raw ultramarine must be ground before it was practicable to use it at all. For instance, a coarse ultramarine could not be used for printing calico. Therefore it was necessary to grind it both for the sake of the colour and for the sake of the way in which it was applied. It was increased in value by grinding because it made it stronger and finer. Before grinding it was of a dark colour, but after grinding it became lighter and brighter. They would notice the two bottles (specimens submitted) marked respectively "dark shade" and "light shade." These were practically the same ultramarine—*i.e.*, the same original bulk of ultramarine, but these were two of the settlings. The very dark one was an early settling and the light one a long settling that took three weeks.

Mr. J. Macdonald asked which one had the finest particles?

Mr. Rawlins: The pale one.

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NOTE ON A FEW INDIAN DYES AND METHODS OF DYEING BY NATIVES.

BY H. S. ELWORTHY, F.C.S.

In the district in which I am engaged—namely Rohilkund, N.W.P.—there are no extensive dyeing operations carried on, the few places that there are being on the smallest scale, and the dyes they use being of the simplest description.

Cotton goods are almost the only kind dyed, as the Hindoos do not wear woollen clothes, and silk and linen are obtained ready dyed from other districts.

Aniline dyes are fast replacing native dyes on account of their greater ease of application, German and English aniline dyes of all colours being readily obtained in the bazaars, many of them being adulterated by over 50 per cent. of their weight with dextrin or British gum. Although these colours are not as fast generally as their own, still their ready application and comparative cheapness, owing to their intense colorific power, is causing them to replace the others more and more completely.

As is stated at first the dyeing operations are carried on in the most primitive fashion, the shop generally consisting of a small room open in front, with a mud floor and perhaps a small verandah outside. The room itself may range from 8 to 12 feet square, and in this all their work is carried on.

Their dye becks and vats are common earthen vessels unglazed, known as *nauds*—large open pans holding 15 to 20 gallons; *khoondas*—flat dishes holding about 1 to 1½ gallons; and *gharrus*—a kind of earthen pot with a rather narrow mouth. Their furnace consists of two little mud walls, with sometimes a copper or iron pan as a boiler, but usually the earthen vessels are used for this.

Their dyes are dried flowers, fruits, barks, roots, and seeds of trees, with occasionally iron salts, ochres, etc. They use a few different kinds of gum produced locally and also occasionally gum resins as colouring matters or mordants. Their favourite mordants are alum and tree barks. These things are invariably dissolved in water, neither spirits nor acids being used. The cloth, if new, is not bleached in any way, being simply washed thoroughly, generally without soap or alkali, dried or not and placed in the dyeing vessel.

Almost the only chemicals which they use as far as I have been able to ascertain are alum, called *phut kurri*, ferrous sulphate, or *hura kussees*, lime or *chuna*, *puppree* or *sujji mittee* crude carbonate of soda containing from 5 to 30 per cent. of carbonate of soda, with small quantities of sulphate and chloride, castor oil and molasses. *Mooltani milli*, a kind of fullers earth, is also used occasionally.

The dyers here seem to have but a very vague conception of anything but the most elementary colours, attempts rarely being made to obtain different shades, and it is almost impossible to get an exact colour or shade twice over.

I shall not mention the aniline dyes beyond saying that they are simply dissolved in water, the cloth dipped in once or more until the required amount of colour is obtained, sometimes drying between the dips. No mordant is used with them, as far as I know.

I will now give a few of the methods used with their own dyes.

Blue.—This is a colour very largely used here, perhaps more than all the rest combined, and it is in this district invariably done with indigo, no aniline dye being used. The method is as follows:—10oz. of indigo are very finely ground up in a flat dish with crude carbonate of soda, and water the grinding continued until the indigo is in the finest possible state of division, the coarser particles being removed by elutriation and reground again and again. Ten pounds of lime from native limestone or *kunka* (a nodular limestone or calcareous tufa, consisting principally of carbonate of lime with a large proportion of clay, oxide of iron and alumina), and 2¼lb. of crude carbonate of soda are mixed with about 7 or 8lb. of water, well stirred and then strained through grass placed on top of a naud (large open pan); this filtrate, consisting principally of caustic soda, is then mixed with the ground indigo; 2oz. of good, stone lime and 1oz. of molasses (which they say causes it to become ready quickly) are added, and it is then allowed to stand overnight and it is ready in the morning. The cloth is dipped two or three times into this liquor, being allowed to dry between each dip. This is said to yield a fast colour. No copperas is used for the purpose of reducing the indigo, though it is possible that the iron in the kunka (impure limestone), which is largely in the ferrous state, may reduce a portion of it. That it is not entirely reduced is clearly proved by the deep blue of the dye liquor. The men seemed quite unable to explain the *rationale* of the process, and the reason why they used kunka instead of a purer form of limestone. All they knew was that it had been handed down from father to son and other limestone could not be used to replace the kunka.

For Wool.—10oz. of indigo, 1½lb. crude carbonate of soda and 2 to 2½oz. of molasses are mixed with 10 to 12 gallons of water and allowed to remain for 10 or 15 days according to temperature. It is then ready for dyeing without further preparation. No lime is used in this for wool dyeing.

Light Blue.—The cloth is dipped once in indigo liquor and dried. Half-an-ounce of turmeric ground fine is put in enough water to cover the cloth (say 4yds.), the latter being at once put in and left therein for half-an-hour, being occasionally moved about. It is then wrung out and dried without washing. The cloth is now green; 4oz. of *anar* or *naspal* (dried pomegranate fruit, *punica granatum*), are boiled with 2lb. of water till one-fourth is evaporated, and after cooling the clear liquor is decanted, and the cloth dipped in twice, drying between each dip; 2oz. of alum are dissolved in enough water to cover the cloth, the latter quickly dipped in, wrung out and dried.

Black.—Cotton goods are first dyed by passing three or four times through indigo liquor and then dried. The following dye liquor is then made up:—*Harra*, the fruit of a tree *Terminalia chebula*, which is one of the fruits exported from India under the name of *Myrabolans*, 4oz.; anar (pomegranate), 8oz.; and water, 4 or 5lb., are boiled together until one-fourth has evaporated, then allowed to cool and strain through cloth. Copperas, 4oz., is dissolved in the strained liquor, and the cloth dipped in and well rubbed, then well wrung out, dried and again passed through the liquor, dried, washed, and is finished.

Another recipe.—Harra (myrabolans) 4oz., water 2lb., boiled together till about one-fourth has evaporated and allowed to cool. When cold the clear liquor is decanted into another vessel; the cloth is dipped twice in this liquor, drying between each dip. It is then put into a solution of 2oz. of copperas in water and finally wrung out, dried and then washed.

Red.—There are a number of different recipes for red dye, some of them giving a fine fast colour, but many of them are unable to stand washing. Among others the following dyes are used:—*Munjeet* (*East Indian Madder, Rubia Cordifolia Linn.*) *Al* the root of *Morinda Tinctoria* or *M. Eliptica*; Harra (Terminalia Chebula fruit): *Kaifal* or *Kaifala*, a species of red bark which I am unable to trace. Many others are used in different places, but these are about the only ones here.

One recipe is as follows for 4yds. of cloth:—Harra, 8oz. coarsely ground and put into enough water to cover the cloth, which is then well rubbed about in the liquor without further preparation. After half-an-hour to one hour the cloth is well wrung out and dried; 8oz. of alum are dissolved in the same quantity of water, and the cloth quickly wrung through this and dried for three or four days; it is then well washed in the river *Dhobie* fashion—that is, dipped into the water, then raised over the head and brought down on the flat stone with a vigorous swing: 8oz. of *Al* ground up in cold water is allowed to remain in the sun for a day, then just brought to a boil and while still hot the cloth is dipped in, wrung out and hung up in the sunshine to dry. It is again well washed and passed through the *Al* solution once more. A final washing and drying complete the operation.

Khaki-Maju—a fruit, botanical name unknown to me—one fruit for 4yds. of cloth well ground, two anar fruits also well ground are put into enough water to cover the cloth, and 4oz. of Mooltan earth, a kind of fullers earth, added. The cloth is then well rubbed in this liquor for an hour or more, after which it is wrung out. A pinch of copperas is put into enough water to cover the cloth and the latter wrung through quickly; 1oz. of alum is put into the original dye liquor with the maju, etc., and the cloth put in once, wrung out and dried.

Yellow.—There are also a number of ways of dyeing yellow yielding different shades and also of various degrees of fastness. *Thoun*, the seeds of *Cedrela toona (Roxb) Harsinghar*; the flowers of *Nycthanthis Arbor tristis*; *Kusum* or *Safflower Carthamus tinctorius*, *Al*, *Morinda tinctoria*, (also used for dyeing red and green) turmeric, *usare* or *revana* (a kind of gum resin), and many others. For 4yds. of cloth the following are taken:—8oz. of thoun, well washed and the dirt allowed to settle, are boiled in enough water to cover the cloth, and when cold strained through cloth. The goods are dipped in for a few minutes and then wrung out and dried; 2oz. of alum are put into the water containing the thoun, the cloth again dipped in, wrung out and dried. This colour is not fast.

For a fast yellow for 4yds. of cloth:—4oz. of turmeric or harsinghar are put in enough water to cover the cloth, which is then well rubbed in the liquor for about 15 minutes and then wrung out and dried. When dry, it is thoroughly washed in the river until all smell of turmeric is removed: 1lb. of mango bark, bark of *Mangifera Indica*, is well ground up and put into the same quantity of cold water, and the cloth steeped in this for one hour and again wrung out and dried; 4oz. of *anar* and 4oz. of *thoun* are boiled in water and when cold strained through cloth. The goods are put in the clear liquor and after remaining a quarter of an hour wrung out and dried. 1oz. of alum is finally disolved in the water with the anar, etc., the cloth just dipped in, wrung out and dried.

The method of stamping or printing cloth in use here is, as might be expected, extremely simple. The blocks of wood, cut to the desired pattern, are usually small, rarely exceeding 6 or 8 inches in length by 4 or 5 inches in breadth. The colours having been prepared and thickened to the required density, are spread upon a piece of banät or felt, and the block is pressed on this and then applied to the cloth, the operation being repeated as often as necessary. The calico printers here use a kind of gum called dhaura, which is obtained from *Anogeissus Latifolia* (Wallace), and which they consider superior to the Indian gum arabic obtained from *Acacia Arabica Willd*, the babool tree of the native. Dr. Watts, in the "Economic Products of India," says of the dhaura gum: "It is extensively sold for use in calico printing: it occurs in clean, straw-coloured elongated masses, sometimes honey coloured or even brown from impurities. As an adhesive gum, it is inferior in strength to gum arabic, in consequence of which it commands a much lower price in Europe; the more so, since it is nearly always mixed with the bark of the tree, sand, and other impurities, and adulterated with the brown tears, which are probably derived from some other species of *Anogeissus*. In India, the reputation of this gum stands high with the calico printers, especially of Lucknow, and it is probable it possesses some specific peculiarity justifying the preference, since it is used with certain dyestuffs, such as with haldi (*Circuma longa*), while gum arabic or babool is used with madder (*Rubia Cordifolia*). Dhaur or bakli (dhaura) gum is generally collected in April." I can confirm what Dr. Watts says about this gum, and it is probably on account of the tannin which all the samples I have examined contain, as shown by the black colour given with ferric salts, that it is preferred in some cases and not in others.

In my opinion, it would be found a useful gum in the dyeworks of England, yielding a thick viscid liquid much superior to dextrin or British gum, and being at the same time cheaper than gum arabic. I find that when mixed with a small proportion of hydrochloric acid, the liquid gum keeps good for several months even in this climate, and although its adhesive qualities are slightly lessened by this addition, it answers very well for labels, etc. Another gum occasionally used by the printers is the dhak of Dhaka, from *Butea frondosa* (Roxb.), which occurs in small ruby-coloured grains, which dissolve freely in water to a clear red solution, but having very little adhesive power. The colour has been extracted and used as a dye, but not with much success, I believe.

The colours printed here are few in number, and for the most part kutcha, or not fast. I will mention one or two.

Yellow.—Scraps of iron are put into a naud, or large earthen pan, and the pan filled up with water. Say, take 10lb. of iron, 10lb. of water, and ½lb. of molasses, and allow to remain 4 to 15 days, according to the weather. 2½lb. of copperas is boiled in the water that is poured off from the sediment of the iron scraps till 8lb. are left, and when cold, enough dhaura gum is mixed with it to thicken it for printing; it is then added to the deposit from the iron, and the mixture strained through cloth. It is now ready for use. 1¼lb. of sujj (crude carbonate of soda), or 1¼lb. of good stone lime are mixed with about 10lb. of water. After the deposit has settled, the clear liquor is poured off and the cloth is dipped in; it is at once taken out and wrapped up well in a cloth and kept until the colour comes out properly, and then taken out and dried. After washing it is ready. This is said to be a very fast colour.

Black.—For 10yds. of cloth, take ½lb. of hurra broken up fine and mix with enough cold water to wet the cloth; to this add ½lb. of milk. The cloth is put into this liquor without previous straining and well rubbed about for half-an-hour, then well wrung out and allowed to dry in the sun. The cloth is then printed with the iron liquor prepared as for the previous recipe. The ground of the cloth is of a slightly greenish-yellow colour. After drying, it is thoroughly washed and again dried. ½lb. of *Al* (Morinda tincturia) is roughly ground and added to enough water to cover the cloth, and the latter put in and well boiled; it is then allowed to stand all night, and next day wrung out and dried. After washing, the ground is white, while the black colour is very fast.

Green.—½lb. of *naspal* (pomegranate fruit) is boiled with 2½lb. of water till 2lb. remain, and the clear liquor poured off. ½lb. of turmeric is well ground and mixed with this liquor and well strained through cloth. Enough dhaura gum, say about 6oz., is then mixed with the liquid to thicken it. A little indigo is well rubbed up in a *khoonda*—a flat earthen pan—and mixed with the thickened liquor, a piece of cloth being marked with it from time to time until the right shade is obtained.

Red.—Another recipe—for printing. First treat the whole cloth with hurra as in previous recipes. Then 4oz of alum is dissolved in 2lb. of water and a piece of "*Gairu*" stone, a kind of red ochre, rubbed in the vessel until the water reddens, and enough dhaura gum added to thicken it for printing. The cloth is stamped with this, and allowed to dry in the sun for from four to eight days and then washed. ½lb. of "al" is ground up in water and stood in the sun for a day, then just brought to a boil, and while still warm the cloth is wrung through and dried. This operation is repeated once more, the cloth being finally washed and dried. It is a fast colour.

I regret that, owing to the part of the country in which I am situated, I have been unable to obtain any information about the beautiful colours that are used in many parts of India—such as in the Punjaub, Kashmere, etc.—except what has been already published, and which is therefore accessible to the members of this Society.

I have obtained a few specimens of crude dyestuffs, which I forward for the inspection of those interested, and shall be pleased to furnish samples or information on any point as far as possible.

DISCUSSION.

Dr. Brown said that the mode of dyeing black with iron (referred to in the paper) was something like *inking* the cloth. He also noticed that they seemed to use soda in India with the indigo, while in Africa they appear to use potash. He was sure the Society was very much obliged to Mr. Elworthy for bringing the dyestuffs before the meeting and for his interesting paper.

Glasgow and Scottish Section.

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Local Secretary:
G. G. Henderson, Chemical Laboratory,
University of Glasgow.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

The First Meeting for this Session was held in the Societies' Rooms, 207, Bath Street, Glasgow, on Tuesday, 1st November, 1887.

MR. J. J. COLEMAN IN THE CHAIR.

CHEMICAL EDUCATION.

INTRODUCTORY ADDRESS BY J. J. COLEMAN, F.R.S.E., F.I.C., F.C.S.

After referring to the spread of chemical education in recent years, and to the rise of technical colleges, Mr. Coleman said: As members of the Society of Chemical Industry we are chiefly concerned with chemistry as applied to industrial processes, called technical chemistry—technological chemistry or chemical technology, or simply applied chemistry, and which by many is considered a distinct department outside the science of chemistry proper. The line of demarcation between the two has, however, always been hazy, notwithstanding the able way in which Professor Odling has dealt with it in his recent Presidential Address to the Institute of Chemistry. I much prefer to take a different standpoint, and to view the chemist, who concerns himself with research as requiring his education to be in theoretical chemistry, combined with chemical manipulation, and he who concerns himself with chemistry applied to manufacturing operations as requiring his education to be theoretical chemistry combined with chemical engineering.

Now, research chemistry may be in the region of pure science or the region of applied chemistry, and there are a great number of young men who, by physical constitution, or an inquiring mind, are naturally predisposed to remain within the walls of the laboratory, and to confine themselves to manipulative processes, and who shrink from contact with the rough men and the rough processes of a manufacturing business. It is as well, perhaps, that such should be the case; indeed, I have heard of chemical works where the laboratory chemists are not allowed to interfere with the men outside. Even in these cases a little knowledge of chemical engineering must at times be of incalculable benefit to the research chemist, as enabling him to explain intelligently to managers and foremen not only the nature of the processes, but to discuss with them the steps necessary for carrying them out on a large scale.

Some knowledge of chemical engineering is then advisable for a research chemist, and not only advisable, but absolutely essential for a so-called chemical technologist or technical chemist who undertakes the management of men and works—men who, after the type of the late Sir W. Siemens, Walter Weldon, Percy Gilchrist, Sir F. Abel, Sir Lowthian Bell, have shown to this generation what applied chemistry can be made to accomplish. The progress of chemical technology abroad, the flight of some of our chemical industries to German soil, such as that of aniline colours, has been attributed to the skill of the foreign chemists in research, but I would ask, is there not something more than this; has not engineering progressed in Germany *pari passu* with chemistry; and may not success abroad in such matters be attributed as much to good engineering as good research? But just as good civil engineering implies a knowledge of various branches of physics and constructive art, so does chemical engineering require a similar basis. This is fully brought out by the regulation of the new Glasgow and West of Scotland Technical College, which provides that for diplomas in chemical engineering students are to take a three years' course—namely, chemical lectures, natural philosophy, and drawing the first year; chemical laboratory, chemical lectures, applied mechanics and building construction the second year; and chemical technology, drawing, and laboratory practice the third year. Turning to Owens College, Manchester, the course recommended is four years. Probably this is the nearest to the curriculum of the Glasgow College; but, notwithstanding its complexity and length, the course does not include the important subjects to a chemical engineer of applied mechanics and building construction. Drawing is, however, as in the case of the Glasgow College, made very prominent, which indeed is but the carrying out of the weighty words of Sir H. Roscoe, who, in addressing the Manchester Section in 1884, said: "Instruction in mechanical drawing must be of great value to the manufacturing chemist. So strongly do I feel this, that in our instruction in chemical technology in Owens College, this latter subject is made obligatory."

Turning to the calendar of the University College, London, you will find the following words: "It must be remembered that the study, however ample, of pure and applied chemistry, is not sufficient for the successful carrying out of manufacturing operations, even when they are chiefly chemical in character: a fair knowledge of mathematics pure and applied, of physics and mechanics and of mechanical drawing is necessary for all engaged in manufacturing operations. Professor Graham does not, however, lay down any hard and fast line as to what lectures a student should take, or how many years he should work.

I have examined also the calendar of the Yorkshire College, Leeds; of the Firth College, Sheffield; of the Mason College, Birmingham; the University College, Dundee; the College of Science, Durham; and the University College, Bristol: but in none of these calendars is there any mention of applied mechanics and steam, building construction, or freehand, geometrical, or mechanical drawing being necessary for the proper education of the chemical technologist. In most cases they recommend the curriculum of the Institute of Chemistry, which does not include these subjects. I think it would be worth while the authorities of the Institute of Chemistry considering whether there should not be examinations in at least some of these subjects, so as to ensure future fellows being more practical and useful than heretofore in guiding and directing the industries of the country.

In regard to the literature of chemical engineering, it appears to me that little has been done in its systematic treatment. Just as research chemistry wanted a Michael Faraday to write a book on chemical manipulation, or civil engineering wanted a Macquorn Rankin to write a treatise on this subject, so, to my mind, does the chemical technologist want a good treatise on chemical engineering, which will treat of fuel, furnaces, retorts, stills, vacuum pumps, ice and cold air machines, the construction of tanks, roofs, sheds and other chemical plant, with all kinds of rules, tables and data connected with thermodynamics and the science of heat, etc., and the calculations necessary for the multitudinous requirements of the manufacturing chemist.

To my mind the study of the general principles upon which all kinds of plant is constructed is a necessary preliminary to the study of special branches of technology. Some able manufacturing chemists, including Mr. Muspratt and Mr. Ludwig Mond, have expressed an opinion in a discussion at the Liverpool Section of our Society that technology proper cannot be taught properly in colleges. I will not go so far as to endorse this—on the contrary I believe that the highest class of technical education will probably be the working out of special problems under the guidance of the eminent men who occupy our professional chairs, provided the student has had a preliminary and comprehensive education, not only in the principles of chemistry proper, but that of chemical engineering, also.

Passing from these educational questions to the practical matters more immediately concerning our Section, it appears to me that there is considerable room for improvement, both in the number and quality of our communications, and I may add in the attendance at our meetings for their discussion. In this respect we should do well to imitate the activity and enthusiasm of such bodies as the Iron and Steel Institute, the various Gas Institutes, and I may also add of the Civil Engineers, where problems connected with the prosperity of the various industries are vigorously attacked and discussed with right good will, not only by the practical men connected with the works, but by those whose wealth and commercial activity place them at the head of these important industries.

The time is not far back when the very name of manufacturing chemistry suggested secrecy and mystery, and even at this day I am afraid chemists are not exactly of the give-and-take kind of people who get on best in the world. I am one of those who think that not only the progress of the chemical industries generally, but success individually, is very much promoted by free intercourse and friendly emulation of those connected with them. No doubt when a man spends time, money and labour in improving a manufacture he is entitled to some little monopoly, but the State steps in here and grants it on very reasonable terms. By the new Patent Amendment Act provisional protection for a whole year can be had for the modest sum of five pounds, and this surely is of importance in getting new processes and appliances discussed so as to assess their value, and prevent useless waste of money. I hope that the proprietors of private works and directors of companies will allow, from time to time, young chemists to bring before our Society descriptions of their various processes and methods, as most of our technical dictionaries and encyclopaedias are 10 or 20 years behindhand in their descriptions of manufacturing processes.

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CRITICAL EXPERIMENTS ON THE CHLOROPLATINATE METHOD FOR THE DETERMINATION OF POTASSIUM, RUBIDIUM AND AMMONIUM, AND A RE-DETERMINATION OF THE ATOMIC WEIGHT OF PLATINUM.

BY W. DITTMAR, LL.D., F.R.S., F.R.S.E.; AND JOHN M'ARTHUR.

Professor Dittmar said:—A complete account of this investigation was communicated to the Royal Society of Edinburgh, at their last meeting in the summer of this year, in the form of a memoir, which we hope will appear in last Session's transactions or proceedings. My apology for soliciting your attention to-night for a brief summary of the results is that, on the occasion referred to, the memoir was "read" only in the most technical sense, so that what I communicate to you now is really made public for the first time.

The analytical methods referred to in our heading are infected with numerous sources of error, amongst which, until lately the uncertainty of our knowledge of the combining constant Pt played a not unimportant part. This uncertainty it is true has been removed to a great extent by a most meritorious investigation of Seubert's, which is published in

Liebig's *Annalen* for 1881 (vol. 207, pp. 1 *et seq.*). There can be no doubt that his value—Pt = 194·8 (O = 16) is considerably nearer the truth than Andrew's number 198, which until lately was adopted by all chemists. But it does not follow that in, for instance, the analytical determination of chloride of potassium as metallic platinum, the factor 2KCl : Pt = 0·7657, as calculated from Seubert's Pt and Stas' number for KCl, affords a more nearly correct result than even the factor 0·7525, which follows from the old atomic weights, K = 39 ; Cl = 35·5 ; Pt = 198.

The experience of analysts rather goes the other way. This, of course, goes no hair's breadth towards invalidating Seubert's result ; it only shows that those analytical factors which by theory are equal to $K_2 : Pt$; $K_2 : PtCl_6K_2$; $2NH_3 : Pt$, etc., etc., must be determined directly, and separately for the several methods. This is what, in a limited sense, we have endeavoured to do. But a purely empirical determination of the factors would have been of comparatively little use. If, for instance, the analyst's factor for the reduction of platinum to chloride of potassium differs from the ratio 2KCl : Pt, the causes of the difference must be ascertained, and this naturally leads to an inquiry into the true value of the chemist's Pt. We accordingly took up this enquiry, and in this sense our investigation joins on to Seubert's ; which, of course, was welcome to us as an excellent basis for our own work.

In our memoir we begin by detailing the methods which we used for the preparation of the necessary reagents ; on the present occasion I confine myself to a few remarks on what goes universally as *chloride of platinum.*

To the present day I believe a considerable minority of chemists believe that this well-known preparation is simply a hydrate of $PtCl_4$, although it has long been shown that it is chloroplatinate of hydrogen, $PtCl_6H_2$, equal, of course, to $PtCl_4 + 2HCl$, but the 2HCl cannot be removed by heat without at least partial reduction of the $PtCl_4$ to $PtCl_2$.

In preparing our chloroplatinic acid we at first used the well-known aqua-regia process. But the reagent, when made in this way, however carefully, is liable to be contaminated with the nitroso-body $PtCl_6(NO)_2$, which, from a syrupy solution of the crude reagent, sometimes separates out on cooling in small yellow crystals which look almost like a chloroplatinate. On addition of water the crystals are dissolved and decomposed with formation of chloroplatinic acid and evolution of nitrous acid ; but from our experience it appears questionable whether it is possible to completely destroy the nitroso-body by even repeated alternate evaporation with hydrochloric acid and water respectively. We therefore, in the later stages of our research always prepared our reagent by the action on metal of chlorine and hydrochloric acid, as described in our memoir, and also in my "Exercises on Quantitative Analysis," p. 310. After the section on the reagents we pass to a

SERIES OF EXPERIMENTS ON THE COMPOSITION OF CHLOROPLATINATE OF POTASSIUM

as produced under what we may call analytical conditions. In a first set of seven experiments designated as Nos. I., II., III., IV., V., V*a.*, VI., the general *modus operandi* was about as follows :—An exactly known weight of chloride of potassium weighed out as a gravimetrically standarised solution was mixed with a quantity of chloroplatinic acid solution containing an exactly known weight of metal, so adjusted that it was either very nearly equivalent to or slightly in excess over the chloride of potassium. The solutions were in all cases pretty concentrated. Sometimes the precipitate produced was simply allowed to settle, then washed by decanting filtration, first with small instalments of water, then with strong alcohol ; in other cases the reagent-moisture was evaporated to a very small volume and the residue treated with strong alcohol to remove the excess of chloroplatinic acid. From the united filtrates (after removal of the alcohol from the alcoholic part) the platinum was reduced out by hydrogen in the wet way and weighed after ignition ; in the filtrate the small quantity of chloride of potassium which had escaped precipitation was determined as chloroplatinate of potassium, so that the weights of platinum and chloride of potassium in the original precipitate of chloroplatinate could be calculated from the corrected data of the synthesis.

The chloroplatinate precipitate, after having been dried at a definite temperature or successively at a series of temperatures, was weighed and analysed. In some cases only the fixed chlorine and the platinum were determined (to check the result of the synthesis) ; as a rule, however, also the total chlorine and consequently, by difference, the loose chlorine was determined. In a few cases the water, which was found to cling to those chloroplatinates most tenaciously, so that some of it remains even at 150° C., was determined directly by a method detailed in the memoir.

In a special experiment (No. VII.) a very large excess of chloride of potassium was used in preparing the chloroplatinate, and the mode of collecting the latter suitably modified.

In a third set of experiments (Nos. VIII., IX. and X.) the characteristic feature was that, in the preparation of the chloroplatinates a very large excess of chloroplatinic acid was used (about 1·6 times Pt per 2KCl). In the first experiment of this kind (No. VIII.) the two reagents were simply mixed as concentrated solutions, the precipitate was filtered off and washed with, first chloroplatinic acid solution, and with strong alcohol. In other three (IX., XI., and XII.) the mixture was evaporated to a magma, and this, after cooling, first lixiviated with chloroplatinic acid solution, and then washed with strong alcohol (Mr. Tatlock's mode of treating analytically obtained $PtCl_6K_2$). The chloroplatinates of this set showed the remarkable peculiarity that their weights became constant, very promptly, even at the low temperature of 100° C., and that the preparations thus dried contained only minute proportions of water.

In true chloroplatinate of potassium every 2KCl = 149·18 parts are operated with Pt parts—*i.e.*, one atomic weight of platinum. The corresponding weights of platinum in our preparations were as follows :—

Set I. Platinum slightly if at all in excess over the chloride of potassium.—Pt = 195·67 to 196·95 ; mean of 7 results = 196·23.

Set II. The (one) chloroplatinate produced by adding to $PtCl_6H_2$ a large excess of KCl.—Pt = 194·65. This last result, however, is easily explained by assuming that the preparation contained carried down chloride of potassium. Calculating from the loose chlorine we found for 4 × Cl parts of the latter 186·78 parts of platinum and 1·011 times K_2Cl_2 of chloride of potassium, which seems to us to be the correct mode of interpreting the analyses.

Set III. A chloroplatinate (VIII.) made by precipitating chloride of potassium with a large excess of chloroplatinic acid.—Pt = 195·87.

Chloroplatinates made by evaporating chloride of potassium with a large excess of chloroplatinic acid, lixiviating with chloroplatinic acid and then washing *with alcohol.*—Pt = 195·59 : 195·82 : 196·01 : mean 195·81.

In the case of two experiments of Set I. the chloroplatinates obtained, after having been analysed, were *recrystallised* from hot water, and in both the crystals and mother liquors, the platinum, the fixed chlorine and the total chlorine determined. The crystals were found to contain less loose chlorine than twice the fixed, and the weight of platinum combined with 2KCl was lower than that present in the original chloroplatinates. It amounted in one case to 195·48, in another to 195·54 parts. The mother liquors contained free chloroplatinic acid and free hydrochloric acid besides chloroplatinate of potassium. Obviously the original chloroplatinates, in addition to $PtCl_6K_2$, contained surplus platinum in the form of, presumably, $Pt(OH)_6H_2$. By the action of the water part of the chlorine of the $PtCl_4$ was eliminated as HCl and its place taken by an equivalent of OH or oxygen : the free hydrochloric acid formed served to dissolve away the hydroxide of platinum as chloroplatinic acid. Assuming all the surplus platinum to have been dissolved away, the above numbers 195·48 and 195·54 should be close approximations to the true atomic weight of platinum.

No doubt it is the water present as hydroxyl which, in ordinary chloroplatinates of potassium, clings so fast to the salt on drying ; the chloroplatinates made in the Tatlock style are relatively free of such water and consequently presumably of oxidised platinum ; hence we thought the best thing we could do would be to prepare a large quantity of such chloroplatinate, and after having analysed it, to subject it to a series of recrystallisations and analyse the recrystallised products. We were not quite able to carry out our original programme, partly through want of time, but chiefly through want of material. What we did do is stated in our memoir ; suffice it here to say that a salt derived by many successive crystallisations from chloroplatinates X. (I. and II.) gave for 2KCl parts, Pt = 195·60 ; and the chloroplatinate recovered from the mother liquors, after having been recrystallised from hydrochloric acid, gave Pt = 195·37. The mean value derived from the analyses of all our recrystallised salts, as far as we permitted them to vote, was 195·50.

After having arrived at this result, we submitted Seubert's report to a careful critique, which led us to the conviction that his analyses of chloroplatinate of potassium, if properly interpreted, fall in as well, and that his analyses of chloroplatinate of ammonium fall in better, with our number 195·5 than with his own adopted number 194·8 (O = 16).

In regard to our experiments on the chloroplatinates of *rubidium* and *ammonium*, I here satisfy myself with stating that that remarkable tendency of a precipitate of chloroplatinate of potassium to carry down platinum as chiefly hydroxide, if produced in the *absence* of any large excess of chloroplatinic acid, is greatly intensified in the case of rubidium and not by any means absent from the ammonium compound. Rather than doing more I will now pass to what, for my present audience, is the most important part of our work—namely, our

Critical Experiments on Finkener's and Tatlock's Methods for the Determination of Potassium by Means of Chloroplatinic Acid.

Finkener's Method.—As Finkener's method is not much known to British chemists, we begin in our memoir by shortly describing it, assuming, to fix ideas, that we had to deal with a mixture of sulphates and chlorides of potassium, sodium and magnesium.

To determine the potassium a known weight of substance is dissolved in water and the solution mixed with a little more chloroplatinic acid than the potassium demands for its conversion into chloroplatinate, and enough of sulphuric acid to convert all the foreign bases into normal sulphates. The mixture is heated on a water-bath and, if necessary, some water is added to bring all the chloroplatinate into solution. The solution is evaporated on a water-bath to the consistence—after cooling—of a magma. This is allowed to cool, mixed with a sufficiency of ether-alcohol (2 vol. of absolute alcohol and 1 of absolute ether) and allowed to stand, well covered, until the precipitate has settled completely. The precipitate then is washed with ether-alcohol until all that is soluble in this liquid is removed. The residue contains all the potassium as chloroplatinate and most of the sodium, etc., as sulphate. For the determination of the potassium in it Finkener gives us the choice between the following two methods :—

(*a*) The precipitate is heated in hydrogen gas, which reduces the platinum to the metallic state, the sulphates and chloride of potassium are washed away, and the platinum is ignited and weighed.

(*b*) The foreign sulphates are extracted by means of a cold saturated solution of sal-ammoniac, and after their complete removal the residual chloroplatinate (+ NH_4Cl) is ignited in a crucible in an atmosphere of hydrogen gas, so that ultimately a mixture of chloride of potassium, platinum and charcoal (from the filter) remains. The chloride is extracted by water, the platinum collected on a filter, ignited and weighed. In this case, of course, we have the option of determining the chloride of potassium in its aqueous solution, either quite directly or indirectly by determining its chlorine.

Finkener, in his memoir, quotes a number of test-analyses which all gave very fair and some very exact results. But for reducing his platinum weight to K_2O, KCl, etc., he used factors based upon the old atomic weight of platinum, and these factors, as we now know, were too low, the one corresponding to $K_2O:Pt$ by nearly two per cent. of its value. Hence the precision in his results must have been due partly to a compensation of errors. We have made a very large number of experiments with the view of ascertaining the nature and magnitude of these errors, and, if possible, eliminating them by suitable modifications. Our general method was this :—

Starting with a synthetically prepared solution containing an exactly known weight of chloride or sulphate of potassium, associated with approximately known quantities of sulphates or chlorides (or both) of sodium or magnesium (or both)—the proportion of impurities was made to vary from nil to many times the weight of the potassium salt—we applied the Finkener process, and, besides weighing the platinum, which, according to the theory of the method, should measure the given potassium, determined the small quantities of the latter metal which had passed into the ether-alcohol or other liquors obtained. In the earlier stages of the research we generally applied the sal-ammoniac form of the process, and always took care to collect, weigh and *analyse* the crude chloride of potassium produced. No test experiment of this kind was accepted as complete and satisfactory unless all the several instalments of potassium when added together came up, as nearly as possible, to the weight of potassium started with in the synthesis. Even in our memoir we give only a very condensed report on our work ; on the present occasion it would be a mistake to do more than formulate our conclusions. One of these is that the Finkener process (sal-ammoniac form) affords an excellent means for collecting and concentrating even the minutest quantities of potassium diffused throughout a mass of sodium or magnesium salts. Only, to obtain exact results, one must take care to work up the sal-ammoniac liquors for potassium, and supposing all the potassium to be collected as chloride, this chloride must not be accepted as pure KCl (which it never is), but be analysed for potassium by, say, the Fresenius method, which in such cases is perfectly reliable and probably the best that could be employed. In this manner minute percentages of potassium, which would simply escape any other method and not be found at all, can be determined with a (for such cases) high degree of relative precision. The Finkener process, therefore, affords an excellent means for testing other forms of the chloroplatinate method by determining the small quantities of potassium which slipped through their meshes. In this sense among others we have used it extensively. Passing now to the process as a means of determining relatively large percentages of potassium, I cannot do better than shortly describe the form of the process which we adopted finally for such purposes.

The substance solution is mixed with a volume of standard sulphuric acid so adjusted that it little more than suffices to substitute a half SO_4 for every Cl of the clorides, and with about 1·25 times the calculated volume of chloroplatinic acid solution, and, if necessary, enough of water so that the whole of the chloroplatinate of potassium passes into solution at a boiling heat. The solution is then evaporated to a magma and next mixed with, say, 20cc. of absolute alcohol and allowed to stand for five minutes (covered, of course). 10cc. of ether are now added and the mixture is allowed to stand for half-an-hour under a small bell-jar on a ground glass plate, when the mixture is ready to be filtered. The precipitate, however, in addition to chloroplatinate of potassium, contains a small quantity of foreign chloroplatinates, which, as we found, can be eliminated by what we have come to call *re-crystallisation*. The mixture (of sulphates and chloroplatinate), after having received a final wash with pure *ether*, is allowed to dry up in the air; it is then re-dissolved in hot water and re-Finkenerised; the surplus platinum is retained in the mother liquor. For a time we thought that the addition of a few drops of sulphuric acid would be an improvement, as giving the sodium, etc., a better chance of coming out as sulphate; but direct experiments showed that the results then became less exact. The purified mixture is dissolved in hot water, the solution transferred to an Erlenmeyer flask, the platinum reduced out in the wet way (see Dittmar's "Exercises in Quantitative Analysis," p. 28), collected, ignited and weighed.

The weight when multiplied with 0·76084 gives a very close approximation to the weight of chloride of potassium to be determined. This factor was deduced from a special series of test-analyses, to which I shall again have to refer after having treated of the

Tatlock Method.—This method, before an audience of Glasgow chemists, need not be described, but I doubt whether its essential points are as generally appreciated as they ought to be.

According to Tatlock, to determine the potash in a mixed potash salt, a known weight is dissolved in water and next evaporated down to a magma with a certain prescribed quantity of chloride of platinum, which is far in excess of what would be needed theoretically even for the conversion of pure chloride of sodium into chloroplatinate. The residue is allowed to digest in a certain proportion of five per cent.* platinum solution, so adjusted that in the case of pure NaCl a 17 per cent. solution of platinum is produced. This liquor is allowed to act for an hour and the precipitate is then washed with, first, small instalments of the five per cent. reagent, and finally with 95 per cent. alcohol. It is then dried at 100° and weighed. The weight multiplied by 0·3056 gives the weight of chloride of potassium to be determined.

Tatlock's method at first sight would appear to waste an unnecessarily large amount of platinum solution. Why not, one might say, separate out the potassium with a moderate excess of platinum from a very concentrated solution, wash the precipitate very cautiously with small instalments of water and ultimately with alcohol to get it ready for the drying chamber? We have tried this modification, but have found that nearly 10 per cent. of the potassium escapes precipitation. If Tatlock's directions be strictly followed the loss is far less.

It will also *not* do to continue the washing with chloride of platinum solution until every trace of sulphate is proved to be removed. With substances rich in SO_3 this cannot be accomplished without losing a considerable fraction of the potassium; with Tatlock's *modus operandi*, on the other hand, the sulphuric acid, contrary to what some might expect, goes almost completely into the alcoholic washings.

According to our determinations, 100grms. of a five per cent. solution of chloroplatinic acid dissolve, in the cold 0·23grm. of chloroplatinate of potassium, hence Tatlock's method, in all cases, must necessarily leave some of the potassium in the filtrate. But the quantity of potassium thus lost, in most practical cases, is small, and is compensated for to a surprising extent by the positive errors inherent in his method.

At a time when we had not yet arrived at this conviction, we instituted a special series of test analyses for ascertaining what results the Finkener and the Tatlock methods respectively would bring out with mixtures of chloride of potassium, chloride of sodium, and sulphate of magnesia, containing respectively 95, 82, and 33·3 parts of chloride of potassium in 100 of anhydrous mixture.

A known weight of pure chloride of potassium was weighed out, dissolved in water to a known weight, and quantities of this standard solution representing convenient definite weights of KCl weighed out immediately in so many different bottles. On the other hand, pure—*i.e.*, potassium free—standard solutions of chloride of sodium and of sulphate of magnesia were prepared and kept ready for use. To produce, for instance, a solution of 95 per cent. salt, the contents of one of the KCl bottles was mixed with the proper volumes of magnesia and chloride of sodium solution. In this manner we produced eight solutions of each kind; four were analysed by means of our form of the Finkener method, the other four according to Tatlock. In the case of the Tatlock analyses, we always determined the potassium left unprecipitated by means of Finkener's method, and reduced the chloroplatinate, after having weighed it, with hydrogen in the wet way, and weighed the platinum, so that each of our analyses afforded the data for a calculation of the quantity of chloride of potassium combined in the precipitate with 2KCl parts of chloride of potassium —*i.e.*, for what, by theory, should be the atomic weight of platinum. The several values for "Pt" thus obtained lay remarkably close to 196. The mean of the Finkener experiments was 195·98; that of the Tatlock experiments was 196·25. For the reduction of Pt to 2KCl, the factor 0·76117; for that of $PtCl_6K_2$ to K_2Cl_2, Mr. Tatlock's factor, 0·3056, was employed, and in both series a satisfactory agreement between analysis and synthesis attained. At the end of the work, however, we

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*Meaning a solution containing 5grms. of metallic platinum per 100cc.

calculated the factors from our own experiments, and found for the factors corresponding theoretically to K_2Cl_2 : Pt and K_2Cl_2 : $PtCl_6K_2$ the values 0·76084 and 0·30627 respectively. On recalculating all our analyses with these factors and comparing the results with the values demanded by the synthesis, we found that in each of the two series one experiment was infected with an exceptionally large error, amounting to about 2mgrs. in each case. All the rest of the errors were far less. In the Tatlock series they were as follow :—

	95 per cent	82 per cent.	33 per cent. Salt.
Errors	0·26 to 0·28	0·06 to 0·49	0·03 to 0·1mgr.
Per about	0·61	0·52	0·215grm. of KCl.

In the Finkener series they were respectively :—

	0·07 to 0·5	0·17 to 0·33	0·18 to 0·7mgr.
Per about	0·75	0·65	0·26grm. of KCl to be determined.

The methods, as we see, are about at a par in point of precision ; but how far may the percentage of potash in a salt sink before the Tatlock method becomes inapplicable ? We made a special series of of experiments in this direction, and found that the line must be drawn somewhere below the 10 per cent. salt. With a 10 per cent. salt, while the Finkener method gave exact results, the Tatlock gave a deficit of about 2 per cent. of the quantity to be determined—9·8 instead of 10, which is still pretty fair.

Summary of Results.

(1.) The value Pt = 194·8 (O = 16), which Seubert deduced from his analyses of chloroplatinates, is too low ; his own analyses, if properly interpreted, show that the true value lies, by a considerable fraction of a unit, higher.

(2.) According to our own analysis of chloroplatinate of potassium, the true "Pt," though, perhaps, a shade below, lies close to 195·5. This number falls in perfectly well with Seubert's analyses likewise, and consequently *at present* constitutes the most probable value of the constant.

Method.	Symbols.	Theoretical Factors.			D. and McA.'s Empirical Factors.	Notes.
		Values Calculated for				
		Pt = 194·8	195·5	196		
Ta.	$2KCl : PtCl_6K_2$	0·30707	0·30665	0·30633	0·30627	(1)
Ta	2KCl : Pt	0·76571	0·76307	0·76112	0·76016	(2)
F	2KCl : Pt	0·76571	0·76307	0·76112	0·76084	(1)
N	$2NH_4Cl : PtCl_6(NH_4)_2$	0·24123	0·24081	0·24057	0·2389	(3)
N	$2NH_4Cl$: Pt	0·54934	0·54737	0·54598	0·5459	(4)

Notes.—(1) Refers to the chloride of potassium in the substance.

(2) Refers to the chloride of potassium in the chloroplatinate-precipitate.

(3) and (4) Refer to the sal-ammoniac to be determined, not to that contained in the chloroplatinate-precipitate.

(3.) Taking "Pt" as meaning the number which must be substituted for Pt in the calculation of the ratios, $2KCl : PtCl_6K_2$; 2KCl : Pt ; $2NH_4Cl$: Pt, etc., in order to obtain the correct factors for reducing analytically obtained chloroplatinate or chloroplatinate-platinum to chloride of potassium, etc., even our number, 195·5, is too low ; 196 affords in general a better approximation. But Pt, if taken in this sense, is no constant at all. Those factors must be determined quite directly by standard experiments. The results of our own standard experiments are given, and contrasted with the theoretically calculated ratios in the above table. The entries "Ta" refer to Tatlock's methods ; the entries "F" to our own form of Finkener's method : the entries N to the customary platinum process for the determination of ammonia

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FREE ACID IN SUPERPHOSPHATES.

BY WILLIAM W. MELLON.

It is well known that superphosphates and similar dissolved manures invariably contain a certain amount of free acid, but some diversity of opinion exists with regard to the amount usually present and the composition of this constituent of manures.

Having estimated the free acid present in a large number of samples of manures during the last four and-a half years the results obtained are offered as a contribution on the subject.

The estimations were performed by titrating with standard alkali a solution of the manure containing about 1grm. of the sample in 100cc., to which a few drops of methyl orange had been added. Monobasic phosphate being neutral to methyl orange, the amount of standard alkali required to neutralise the solution is equivalent to the free acid present. For convenience in comparing the results the free acid is stated as H_3PO_4.

The average amount found in 485 samples of manures of various kinds examined by this method was equal to 8·54 per cent. H_3PO_4 ; the highest being 16·36 per cent., and the lowest 2·36 per cent.

The solutions of manures in which the free acid was determined were obtained by stirring up 10grms. of the sample with water in a beaker and transferring to a 500cc. flask. The flask was filled to the mark with water, allowed to digest for a couple of hours with occasional shaking, and filtered. (Method A.)

Several methods of extracting the soluble portion being in use in the analysis of manures, a number of experiments were performed in order to ascertain if the percentages of free acid and "soluble phosphate"* were affected by the method of extraction adopted. With this object in view the free acid and soluble phosphate were estimated in solutions of manures obtained by Method A, and also in solutions obtained by the method adopted by the Association of Official Agricultural Chemists for the season 1884—85.† About 2grms. of the sample are washed on a filter with small successive quantities of water, the residue transferred to a beaker, rubbed to a paste with a rubber-tipped rod, washed back on to the filter and washed thoroughly. (Method B.)

The results, which are given in the following table, show that the amount of free acid is generally higher in the B solutions, this result being more noticeable in manures made from roughly ground materials, or when an insufficient quantity of acid had been used in the first place to dissolve the phosphate, and is probably due to the rapid removal of the acid solution in the filter from the undissolved phosphate with which it was in contact.

With respect to the soluble phosphate the experiments show that the B solutions give slightly lower results with manures which do not contain ferric oxide—such as dissolved bones and bone ash, and higher results with mineral superphosphates containing ferric oxide.

The larger amount of phosphoric acid found in the B solutions of mineral superphosphates is due to the fact that ferric phosphate is soluble only in somewhat concentrated acid solutions.

On treating the sample, with small successive quantities of water, as in Method B, filtering after

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*Tricalcic phosphate rendered soluble, is meant by the term "soluble phosphate."

†Chemical News, 51, 19.

each addition, the ferric phosphate is carried through the filter in solution and its phosphoric acid included in the soluble, whereas the dilution required by the other method before filtering precipitates a portion of the phosphoric acid as ferric phosphate, which is included in the insoluble phosphate.

	Method A		Method B.	
	Free Acid per Cent. as H_3PO_4	Soluble Phosphate per Cent.	Free Acid per Cent. as H_3PO_4	Soluble Phosphate per Cent.
1. Dissolved bones	3·72	26·52	4·42	26·31
2. „ bone ash	3·44	38·81	3·62	38·67
3. „ „ „	10·20	38·67	11·08	38·18
Mean	5·79	34·67	6·37	34·39
4. Mineral superphosphate	7·84	24·85	8·02	25·27
5. „ „	8·82	27·92	8·82	28·89
6. „ „	8·82	27·61	8·72	29·10
7. „ „	9·02	25·74	9·02	26·66
8. „ „	12·64	32·34	12·74	32·78
9. „ „	9·30	26·52	9·22	27·00
10. „ „	6·86	18·91	6·94	19·42
11. „ „	7·74	26·72	7·71	26·91
12. „ „	9·32	20·94	10·98	21·27
13. „ „	6·28	20·79	6·86	21·79
14. „ „	9·22	25·55	9·22	25·87
15. „ „	7·16	22·76	7·54	21·70
Mean	8·58	25·06	8·82	25·56

The amount of free acid in manures is obviously an important factor in determining their condition, yet no definite amount can be assigned in all cases as a limit which should not be exceeded, as the maximum quantity that may be present in a manure without impairing its condition varies with the raw phosphate used.

The average amount of free acid found in well-dissolved manures made from various phosphates is given in the following table. The manures were all in a dry friable condition, and the mineral phosphates used were ground so that 96 per cent passed through a sieve of 60 meshes to the inch.

Phosphate.	Free Acid as H_3PO_4.	Insoluble Phosphate %
Ground bones	2·81	4·82
Bone ash	7·55	1·91
Belgian phosphate	7·26	1·85
Port Royal „	9·91	1·57
Bull River „	10·21	2·33
Morgan River phosphate	10·32	1·68
Somme phosphate	12·56	1·62

The amount of free acid in manures is also to some extent affected by the strength of the acid used to decompose the phosphate.

With regard to the quantity of acid employed the manufacturer will, as a rule, use as much as is consistent with a dry product; but, other things being equal, the maximum quantity of o.v. can be used only when it is diluted to the strength best adapted to the phosphate under treatment.

This is illustrated by the following experiment with Canadian apatite:—Three portions of a sample of Canadian apatite were each treated under precisely similar conditions, with 63 per cent. o.v. diluted to 108°, 112 and 120° T. On testing the resulting superphosphates the following results were obtained:—

63 per cent. o.v. at	108° T.	112° T.	120° T.
Soluble phosphate	28·06	27·50	21·63
Free acid „ as H_3PO_4	10·42	11·46	17·24
Condition of manure	Good	Fair	Damp

A number of samples were examined, and an effort made to determine the composition of the free acid always present in manures.

It seems to consist mainly of phosphoric acid, with smaller amounts of hydrofluosilicic, hydrofluoric and (occasionally) sulphuric acids. The latter was found only in damp samples containing a large amount of free acid. It was detected by treating the sample with methylated spirits on a filter fitted with a Piccard's filtering tube, the filtrate was evaporated to dryness, water containing a few drops of HCl added and the sulphuric acid precipitated with baric chloride. The conflicting opinions held with regard to the presence of free sulphuric acid in manures may probably be attributed to the absence of a reliable method of estimating or detecting free sulphuric and phosphoric acids in presence of each other, in solutions which also contain soluble sulphates and phosphates.

The method frequently proposed for the estimation of free sulphuric acid in presence of soluble sulphates, which depends on the precipitation of the sulphates only on the addition of alcohol to the solution, is inapplicable in the presence of monocalcic phosphate. In the presence of this salt the alcohol precipitates not only the sulphates, but also more or less of the free sulphuric acid, which combines with the lime of the monocalcic phosphate, free phosphoric acid being liberated.

In order to test the accuracy of the method 3cc. of normal sulphuric acid = 0·147grm. H_2SO_4 were run into a somewhat concentrated solution of superphosphate, and about seven times its bulk of methylated spirits was added. After standing two hours the alcoholic solution was filtered, the filtrate evaporated to dryness, some water and a few drops of HCl were added, and the sulphuric acid in the solution estimated with baric chloride. The amount found was equal to 0·048grm. H_2SO_4, showing that 0·099grm., equal to 67·35 per cent. of the sulphuric acid added, had been precipitated on the addition of alcohol. Similar results were obtained when absolute alcohol was substituted for the methylated spirits; the free sulphuric acid precipitated in a number of experiments varied from 42 per cent. to 83 per cent. of the sulphuric acid added to the solution. This process is therefore incapable of demonstrating the absence of free sulphuric acid in manures.

On the other hand, the method used for the detection of free sulphuric acid in presence of sulphates, which relies on the blackening of the residue obtained on evaporating the solution to dryness with a little cane sugar, cannot be employed in presence of free phosphoric acid, which also decomposes cane sugar with formation of a black residue.

The presence of free hydrofluosilicic and hydrofluoric acids in manures seems to have escaped observation. In the ordinary course of manure analysis, in which the moisture is determined by heating the sample for several hours in the water oven, they are volatilised and reported as "moisture." The average amount of volatile free acids found in 14 samples was equal to 2·30 per cent. H_3PO_4—the highest being 3·96 per cent., and the lowest 0·96 per cent. They were estimated by evaporating a solution of the manure to dryness in a platinum basin, the residue was dissolved in water to which a known amount of standard acid had been added, and the solution titrated with standard alkali. The loss of free acid on evaporation equals the total volatile acidity, stated as H_3PO_4. The free hydrofluosilicic acid was estimated by evaporating to dryness a solution of the manure to which some potassic sulphate, neutral to methyl orange, had been added, the residue was dissolved in standard acid and titrated as before. The increase in the amount of free acid as H_3PO_4 after evaporation with potassic sulphate, as compared with the amount found on evaporating the solution of manure alone, is equivalent to the free hydrofluosilicic acid present.

The amount found in the few samples tested comprised about two-thirds of the total volatile acidity.

The above results were obtained from manures manufactured by Mr. G. H. Anderton, Howden, Yorkshire, to whom the writer is indebted for the facilities afforded in carrying out the experiments.

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The Second Meeting of the Fifth Session of this Section was held in the Rooms, 14, St. Andrew Street, Edinburgh, on Tuesday, 6th December, 1887.

MR. E. C. C. STANFORD, F.C.S., IN THE CHAIR.

THE SUPPLY OF ALCOHOL FOR MANUFACTURING PURPOSES.

BY D. B. DOTT, F.R.S.E., F.I.C.

It is now over thirty years since the Act of Parliament was passed permitting the use of duty-free methylated spirits, and we have become so accustomed to the idea of that familiar mixture that it is difficult to imagine things being otherwise—nearly as difficult possibly as it would be to persuade the Revenue authorities that a change in their system is desirable. Yet the systems in vogue in other countries have been altered, sometimes for the better, and our own Government may one day see its way to amend the law regulating the use of alcohol in the arts and manufactures. Presumably everyone knows how the law at present stands. The original Act has been amended by two subsequent Acts, and there are several General Orders of the Board of Inland Revenue bearing on the subject, but the net result of the regulations may be shortly stated. Every form of ethyl alcohol used or sold in the country must pay duty calculated on its equivalent in proof spirit, but to encourage manufacturers a mixture of alcohol with 10 per cent. of wood naphtha is allowed to pass duty free. This naphtha is often called methyl alcohol, but it contains so large a proportion of acetone, along with higher ketones, methyl acetate, allyl alcohol, and malodorous pyroligneous substances, that it can hardly be called even crude methyl alcohol. An admixture of pure methyl alcohol would be no barrier to the use of the mixture as a beverage. Wherefore the Excise will only permit the use of a decidedly crude and impure wood naphtha for methylating, and a sample of the naphtha proposed to be used must first be approved by the Chemical Department at Somerset House. After being passed, the naphtha is kept under official lock and key, and only allowed to be used for mixing in presence of officers of Inland Revenue. The resulting methylated spirit has a disagreeable taste and odour, and always more or less colour, which increases on keeping. It is, of course, entirely illegal to submit the spirit to any process of purification, even the preparation of anhydrous methylated spirit being held to be a clear breach of the law. The mixed spirit can only be used in such branches of manufacture as are approved by the Board. Its use is not allowed in the preparation of compounds from which alcohol can easily be obtained. For instance, if a simple process for converting ether into alcohol were known, it is certain the Board would not permit the use of methylated spirits in the preparation of ether.

We have often heard of the great benefits that have accrued by the wise and beneficent legislation which authorised the use of methylated spirits, but much might be written on the extent to which manufacturers have suffered by being compelled to use that same spirit while neighbouring nations had a supply of pure alcohol at or near the same price. I have not sufficient acquaintance with manufactures in general to go fully into this question, but can only touch upon those points which are more within my own knowledge and experience. It has first to be noted that miscible naphtha is a more expensive article than rectified spirit, so that (apart from duty) methylated spirit costs more than pure alcohol. Then it must be remembered that for many purposes the 10 per cent. of naphtha is simply 10 per cent. of useless matter. That is to say, that in these cases methylated spirit would require to be 10 per cent. cheaper than the pure spirit in order to put them economically on a par. So far as I know, there is no purpose for which methylated spirit is so well adapted as is pure spirit, and we have all grades of unsuitability up to those cases in which it cannot be used at all. Methylated spirit is generally supposed to be specially suitable for making varnishes, yet I have heard of a fastidious gentleman who insisted on the polish applied to his furniture being prepared with pure alcohol, on account of the bad smell of the usual preparation. For purposes of extraction, purification by crystallisation, and the like, methyl spirit is very objectionable, because of the persistent empyreumatic odour it leaves on evaporating, which odour it is difficult and sometimes impossible to get rid of. Again, when we employ rectified spirit as a solvent we know that we are using what is to all intents and purposes a mixture of ethyl alcohol and water, but when we employ methylated spirits we are using a mixture of several, and to some extent unknown, solvents. In certain operations that is a matter of real importance. In the preparation of chloroform methylated spirit is not so ill adapted as might at first be supposed. A certain amount of chloroform is formed from the acetone present in the naphtha, and by special means of purification a product is ultimately obtained which cannot be distinguished from that prepared from pure alcohol. Yet there can be no question that, *cæteris paribus*, pure alcohol would be a preferable raw material even in this instance, as there would then be no suspicion of certain impurities, and the medical profession would have more confidence in the compound. In the formation of ether by the action of sulphuric acid on alcohol at a high temperature, the methylated is a poor substitute for the pure spirit. Not only does the product contain a certain amount of ethyl oxide in solution, but secondary products are formed which render the ether unsuitable for inhalation and internal use, though it may be employed for local anaesthesia. On the other hand, there are manufactures in which the products formed from the naphtha are so difficult to separate from the alcoholic product that the chemist who has only methylated spirit at his disposal is hopelessly handicapped as compared with the chemist who has pure alcohol to work with. For instance, when chloral was first introduced into medical practice it was found impracticable to obtain a satisfactory product by the action of chlorine on methylated spirit, for which reason principally chloral did not become an article of British manufacture. Doubtless one who was well acquainted with a great variety of manufactures could frame a much stronger indictment against methylated spirits than can I, but what has been said is sufficient to show that if the chemist could obtain pure alcohol free of duty it would be an immense advantage. In this connection it may be interesting to quote a few sentences from an article* by Dr. Squibb, who was actively engaged in the investigations which preceded the passing of the American Spirit Law, and who himself uses annually a large quantity of alcohol in his pharmaceutical processes:—"The proposed law proceeds on the theory that this methyl-alcohol once added to the clear spirit, permanently and irrecoverably spoils it for drinking purposes. This is a great fallacy which should be clearly recognised at the start, for the methyl-alcohol can be taken out with comparative ease, and the proposed law acknowledges this by forbidding its being taken out and by providing a penalty against taking it out . . . . There is probably not a single use to which alcohol is put that would not be more or less obstructed and hurt by the presence of the methyl—just as every adulterated substance is injured by the adulteration—while in a very large number it would be more objectionable than in drink; and for a still larger number of the better and more important uses methylated spirit could not be used at all. . . . . Again, it is not conducive of true economy and fair dealing to attempt by law to damage the purity of, or to spoil or defile any substance for any purpose, and all such attempts must lead to loose principles of action and to various forms of fraud."

The question then arises—Can any method be devised by which a chemical manufacturer might be allowed the use of duty-free alcohol in his manufactures? Speaking generally, there are two ways in which this could be done:—1st. The manufacturing operation might be conducted "in bond," nothing being allowed to go in or out without the intervention of the Excise officials. 2nd. A drawback of the full amount of duty might be allowed on all alchohol which the authorities were satisfied had been converted into compounds from which alcohol could not be recovered. Mr. John Williams (of Messrs. Hopkin Williams) has endeavoured to induce the Inland Revenue authorities to consent to the preparation of absolute alcohol "in bond," but so far without success. At present it is impossible to produce absolute alcohol remuneratively in this country, for the obvious reason that duty has to be paid on the alcohol, which is inevitably lost in dehydrating, while the imported article escapes that part of the tax. If the Excise authorities can hardly be persuaded to give their consent in such a simple case as that of absolute alcohol, it would be difficult, indeed, to induce them to consent to cases in which more or less complicated compounds resulted. They would live in a perpetual dread that alcohol was escaping them in some form or other, and so evading duty. Assuming an operation which could be performed in a short time before an Excise officer, or which could be performed under official lock and key, and in which all the alcohol as such was completely destroyed, there would be no obvious reason why the duty previously paid on the alcohol should not be recovered. Such a case, however, is entirely exceptional, if not merely hypothetical. As a rule, a considerable amount of pure alcohol is recovered in any chemical operation in which it is used. That would require to be checked, and, along with the examination of the other products, would throw an amount on the Department which would be fatal to any such method of procedure. Conceivably a workable plan for the use of duty-free alcohol in manufactures might be devised, if protected by sufficient regulations and penalties, but it is hardly within the region of present practical politics.

In considering whether there is any other way of reaching the desired end, we naturally turn to the latest legislation on the subject—namely, the new Spirit Law of Germany, the provisions of which are, briefly, as follows:—The *denaturirte spiritus*, which corresponds to our methylated spirit, is prepared by adding to 100 parts of alcohol 2 parts of wood spirit and 1 part of pyridine bases. Tests are given to define the quality of these substances. The wood spirit is examined as to colour, specific gravity, boiling point, mixibility with water, content of acetone, and behaviour with bromine; the mixed pyridine bases are examined as regards colour, behaviour towards cadmium chloride, boiling point, miscibility with water, contained water and volatility. Having put this paper together on rather short notice, I have not had time to prepare a sample of this German mixed spirit. I should think, however, that it must be quite as disagreeable to the taste as our own methylated spirit, while for most manufacturing purposes, the 2 parts of naphtha and 1 part of mixed pyridine bases would be far less objectionable than our 10 per cent. of naphtha. But the most important difference between the German law and our own is this: that while our Board of Inland Revenue has one hard and fast rule from which no departure is permitted, the German Customs make many concessions and exceptions for the convenience of manufacturers, and to the benefit of the national trade. For instance, the manufacturers of fulminating mercury are allowed a mixture of alcohol with $\frac{1}{2}$ per cent. turpentine or 0·025 per cent. bone oil. Makers of aniline colours are allowed a mixture containing 0·025 per cent. bone oil. For the preparation of the alkaloids, spirit with $\frac{1}{2}$ per cent. of turpentine or 0·025 per cent. of bone oil is permitted. Similarly, for the preparation of chloroform, iodoform, ether and chloral, the mixture with 0·025 per cent. of animal oil is permitted. For the manufacture of tannin, salicylic acid and salicylates, 10 per cent. of ether is added to the alcohol. Makers of white lead and acetate of lead are allowed the bone oil mixture. The stock of alcohol in the German pharmacies was measured some time ago by the Customs authorities, with the intention of allowing the pharmacists untaxed alcohol, but I have not been able to ascertain whether that provision is to be continued. It is certain that some such arrangements as those above noted would be very advantageous to our British manufacturers. It is equally certain that the Revenue Department would look upon them with great disfavour and regard them as dangerous, not only because it is a conservative department, but also because these mixtures could more readily be purified and rendered drinkable than their well-tried methylated spirit. I believe, however, that these German rules proceed on a good principle, and that similar regulations might be introduced in our own country

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* Ephemeris, ii. 498.

with benefit to trade and no loss to the Revenue if properly safeguarded.

I venture to suggest a method which meets most of the objections to the use of ordinary methylated spirits, and which I think might be made acceptable to the legislative authorities. Let a second quality of methylated spirits be legalised, to be used only by licensed manufacturers. This sprit would be prepared by mixing alcohol with 5 per cent. of commercially pure methyl-alcohol. Such admixture would not interfere with the use of the alcohol for almost any purpose. On the other hand, it would be difficult to separate and could easily be detected by analysis, so that the fraudulent disposal of the spirits would be extremely difficult. Of course, the removal of the spirit from one place to another would only be accomplished by permit, and anyone other than a licensed manufacturer having such spirit in his possession would be liable to a heavy penalty. It might be found desirable to restrict a manufacturer to only one kind of the methylated spirit: or, at any rate, not to allow the use of both kinds in the same premises. A doubt might arise as to whether it would be permissible to use the finer methylated spirit and alcohol in the same premises, but I think if any improper use of the spirit was made severely punishable, there would be little danger of the Revenue suffering. If the State could see its way to legalise this superior quality of methylated spirits, then it would be free to deal with the ordinary methylated spirits, and by adding poisonous pyridine bases or otherwise, so increase its disagreeableness as a drink that a peculiarly objectionable form of illicit traffic would be greatly reduced. Such is a brief outline of a scheme which I believe to be quite practicable, and which, if worked out in detail and legalised, would be decidedly beneficial to the manufactures of the country.

DISCUSSION.

Mr. Stanford said that this was a subject which had created a great deal of talk both on this side and the other side of the Atlantic, where they also complained of the duty on spirit. He did not see—and he had expressed the view repeatedly—any valid reason why manufacturers should not have duty-free spirit when it was necessary for the manufacture of fine chemicals. As for the idea entertained at the time by Messrs. Hofmann, Graham and Redwood—*i.e.*, that the addition of methylated alcohol of a very disagreeable character would prevent the drinking of the spirit—it was known by everyone that this view was entirely out of the question, as he did not believe it was possible—or scarcely possible—to add anything to the spirit nasty enough to prevent men from drinking it.

Mr. Beilby considered that this was a subject on which the Society should use its influence as a Society, and he would propose that it should take up this subject and make such representations to the proper authorities as would bring the matter under notice again in a proper and efficient manner. He moved, therefore, that the matter be referred to the Committee of the Section for consideration.

Mr. D. B. Dott, in seconding the motion, said it would be preferable to have the use of duty-free spirit if the Government could be persuaded to grant that. But perhaps some alternative scheme, such as he had proposed, might be conceded with greater readiness by the Government, and this would be a step in the right direction, although not so good as having command of pure alcohol for manufacturing purposes.

NOTE ON THE ACTION OF BLEACHING AGENTS UPON WRITING-INK AS A MEANS OF DETECTING FRAUD.

BY ROBERT IRVINE, F.R.S.E., F.C.S.

It is well known that ordinary writing is easily removed when it is acted upon by bleaching agents. Advantage is taken of this fact by unscrupulous persons desirous of altering documents, cheques and banknotes, for improper purposes; hence the number of fugitive inks and supposed untamperable papers in use to meet this difficulty.

A curious and interesting case of supposed fraud came under my notice in the form of a document, which was written upon the fly-leaf or second page of a sheet of legal paper: the margin of the first page containing the stamp, date and water mark of a will purporting to have been written about twenty years ago. The document or will was thus written upon paper bearing both on stamp and in watermark a date which gave it the semblance of age. The appearance of the document gave rise to suspicion, and I was asked if it was possible to tell the age of the writing, and if the writing had been executed at one and the same time, and if so at what time?

This was, of course, impossible, as I was not allowed to treat the document itself; I had, therefore, to make experiments upon writings the dates of which I knew.

I selected writing one day, six months, twelve months, two years, six years, fourteen years and twenty-two years old, and exposed these writings to the action of a very dilute solution of ordinary bleaching powder in water; the specific gravity was about 1001. In six minutes the newly-written matter had disappeared; in from nine to twelve minutes the writing of six months ago had disappeared; in twenty minutes the writing of two years had partly disappeared: in a like time the writing of six years ago was not greatly affected; fourteen years ago very slightly: and twenty-two years hardly affected at all (indeed old writing seems hardly affected by such a weak solution, even after hours' exposure).

Peroxide of hydrogen acts more slowly, but gives more definite results. Other reagents give effects which help (although sometimes in a contrary manner to that I have indicated) to establish the fact that ordinary writing-ink, which is a compound of gallic and tannic acids with proto-salts of iron, becomes more stable (presumably by oxidation), and consequently is less or more affected by chemicals, which act upon the organic colouring matter of the ink. There are great varieties of writing inks, chromium and vanadium salts being sometimes substituted for the iron salts. There are also black and coloured inks, prepared from coal-tar dyes; but thinking it highly improbable that any documents intended for preservation would be executed in such evanescent inks, I did not investigate their behaviour under such treatment. When ink is thus bleached or apparently removed most of the iron contained in the compound remains mordanted with the fibres of the paper; consequently, writing so tampered or dealt with can be restored by the application of gallic or tannic acid. The writing is thus reproduced almost in its original depth of colour. It is delicate work (especially in the civil legal aspect of the case to which I have referred) to determine in a reliable manner the age of any particular writing, and it is necessary that the following precautions be carefully observed:—1. The inks must be those known as ordinary writing-inks prepared from iron and chromium salts and galls. 2. Writing dried by means of blotting paper is naturally more easily removed than writing which is allowed to dry on the surface of the paper; and light writing is somewhat more easily removed than coarse and heavy writing. 3. The bleaching solution must be exceedingly dilute, otherwise the action is so rapid and powerful that both old and new writings are removed almost simultaneously. 4. The action must be carefully watched so as not to be too long continued. Lastly, very old writing which has become brown by age, although it resists the action of weak solutions of bleaching powder and peroxide of hydrogen, will show signs of giving way almost instantly when acted upon by diluted nitric, hydrochloric and oxalic acids.

Although I have only made use of a well-known process and materials to obtain the results I have indicated, still I think such a simple means of detection may act as a check to frauds which are becoming only too common. There was a most interesting paper read before the Literary and Philosophical Society of Manchester in the Session of 1879 and 1880, by Mr. W. Thomson, F.R.S.E., which I commend to the study of anyone wishful to carry this investigation further than I have been able to do. In it the author gives many curious and interesting facts in connection with the behaviour of writing inks under the influences of various chemical compounds.

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NOTE ON SACCHARINE.

BY D. A. SUTHERLAND, F.I.C., F.C.S.

It might be as well for me at the outset once more to call attention to the spelling of the commercial name of this substance—saccharine, not saccharin—as I observe in certain notes recently published in this country this latter wrong spelling is adhered to.

Saccharin was discovered by Peligot,[*] and is obtained by boiling invert sugar, dextrose or lævulose with lime, and is also obtained from molasses of beet sugar. Its taste is not sweet, but saline and bitter. Its formula, according to Scheibler,[†] is $C_6H_{10}O_5$.

Saccharine, which is the subject of these few notes, was discovered by Fahlberg and Remsen in 1879, and is chemically benzoylorthosulphonic imide.[‡]  $C_6H_4 <^{CO}_{SO_2}> NH$. It is, as you know, a toluene derivative prepared from coal tar. It is unnecessary for me to refer to its manufacture and numerous uses; these have already been most completely described in our Journal by Ivan Levinstein,[§] and more recently by the distinguished discoverer, Dr. Constantin Fahlberg.[‖]

I desire to note briefly one or two points which so far as I know have not been much commented on. The action of heat, the percentage of ash, and the tests.

Firstly, I would note that there is considerable difference between the samples of saccharine in the market. Within the past month or two the makers, Messrs. Fahlberg, List & Co., have intimated that they can supply orders for any quantity up to one ton.

I noticed a discussion in a chemical journal a week or two ago, as to the percentage of ash on ignition. One observer[¶] notes results varying from 0·6 to 2·9 and 6·6 per cent., and another observer[**] notes 6·67 per cent. Other statements were made, some of which I will refer to in this paper, but it is to be regretted that the acidity was not given in each case.

Having in hand three samples of saccharine, I resolved to see what difference, if any, there was between them and those above referred to.

The samples were obtained as follows:—I. From Germany; II. From druggist in usual way; III. From Messrs. Wilson, Salamon & Co., the London agents, and I would here like to acknowledge their frankness and courtesy in supplying samples and in giving any information.

Action of Heat.—2grms. of each sample were treated at 100° C.: indeed the temperature (maintained with steam) rarely exceeded 95° at any time.

Contrary to the statement in the journal referred to—viz., that "a temperature of 100° C., even if maintained for some time, has no perceptible effect on saccharin(e); it loses no weight, and undergoes no physical change"[††]—in each case my samples, almost instantly, on placing them in the heater gave off a slight sublimate which adhered to the watch-glass with which they were covered. Moreover, after three hours, had decreased in weight as under:—

Sample I.—1·75 per cent. loss } Other samples after
„ II.—2·05 „ „ „ } 24 hours—loss about
„ III.—2·75 „ „ „ } 7 per cent.

The increased loss in III. is probably due to moisture, as it had not been bottled, but merely wrapped in paper.

But that the loss in the other cases is not due to moisture, several things show—firstly, the sublimate being weighed nearly equals the loss, and the acidity loses in proportion to the loss instead of increasing as it would have done otherwise.

To the acidity I shall refer later on, as also to the nature of the sublimate. The samples were now ignited: one of them (I.) being first heated on a sand bath, a microscope slide received an amorphous sublimate from 130—140°, another slide from 145—150° received a copious sublimate of acicular crystals and amorphous matter, and these crystals also collected on top of the new brownish mass of saccharine (several measuring from 6 to 7mm. in length). At 160—170°. appearance was dark-brownish in colour; 180—190° it fused; and subsequently melted to a clear yellow liquid which boiled very soon afterwards.[‡‡]

It was then heated gently and ignited over the open flame. While heating in the sand bath it gave off a very sweet vapour which could be tasted several feet away.

The ash, after complete ignition, weighed:—

I.—1·63 per cent. } Average of two results.
II.—5·68 „ „ }
III.—Not enough of sample for ignition.

This residue is also noticed further on.

The Sublimate at 100° C. These crystals correspond exactly in appearance and grouping with those obtained by cooling a hot aqueous or alcoholic solution of saccharine.

I have reproduced a rough sketch of some of these. Fig. 1, Nos. I. and IV. show sublimate as on watch-glass—I. being near edge of glass and IV. in the centre. No. III. shows crystals from aqueous solution; the crystals will be noticed as invariably in tufts. Benzoic acid from aqueous solution is shown in II. for comparison.

The crystals have a sweet taste, and seem indubitably saccharine itself. This loss is important in affecting estimations of moisture if done in the ordinary way.

The residue after ignition consists of sodium salts, mainly sulphate, the ash from II. showing 5·05 per

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[*] Compt. Rend. 90, 153. [†] Ber. Deutsch. Chem. Ges. 13, 2212.
[‡] This Journal, 1887, p. 589. [§] 1886, p. 75. [‖] This Vol. p. 587.
[¶] Pharm. Jour. Vol. xviii. pp. 337, 416. [**] *Ibid.* xviii. p. 377.

[††] Pharm. Jour. xviii. p. 337.
[‡‡] The melting point taken in capillary tube was 200·5° C.

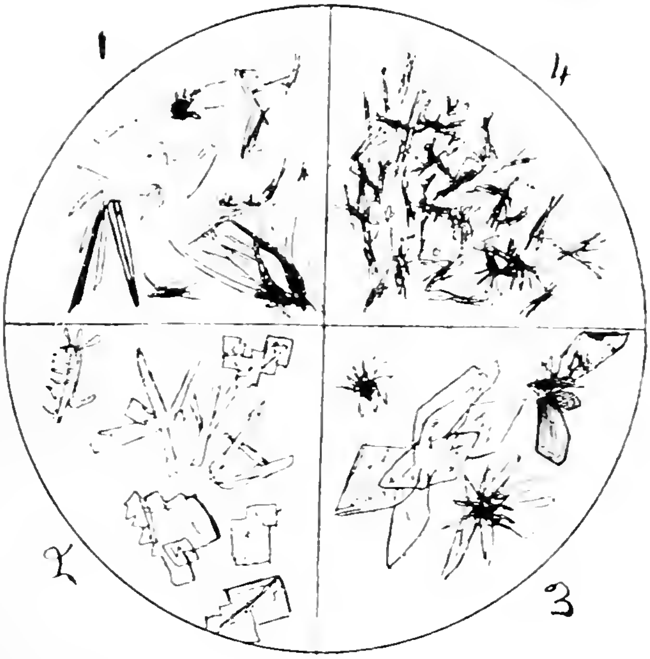

FIG. 1.

(Magnified 100 Diameters.)

I. Sublimate at 100° C. Isolated crystals at edge of watch-glass.

II. Benzoic acid from aqueous solution.

III. Saccharine from aqueous solution.*

IV. Same as I. Crystals at centre of watch-glass.

*Except in case of the larger group, the crystals are shown laterally.

FIG. 2.

Sublimate at 100° C.

(Magnified 200 Diameters.)

cent. Na_2SO_4 when estimated with barium chloride; and comes, I suppose, from sodium ortho-toluene-sulphamido-benzoate which has not been completely separated from the saccharine.

Nevertheless this would seem to be a somewhat important point for wholesale buyers. As to the presence of iron in ash as noted in the journal referred to, there was no trace shown in any of my samples when tested with freshly prepared $K_4Fe(CN)_6$ or KCNS.

The acidity was estimated with 1grm., decinormal Na_2CO_3 and NH_4HO being used with litmus and phenolphthalein as indicators.

I. required 17·0cc. = 87·11 per cent. of saccharine,
II. " 18·1cc. 88·02 " "

The ash of II. taken as sulphate and calculated to sodium salt of saccharine makes up nearly the difference.

But there is a discrepancy in No. I. probably due to presence of the ammonium salt from Fahlberg's sulpho-benzoic acid recovery process.

Tests.—The crystalline sublimate, together with the sweet fumes, etc., given off on heating, are characteristic.

Fusion with caustic alkali yields salicylic acid.

Potassium ferro and ferric cyanides give greenish coloured precipitates on boiling—the latter, as already noted, being so delicate a test, that a 1 in 1000 solution gives a very characteristic apple-green colour. These precipitates are soluble in caustic alkali and reprecipitated on addition of acid.

I have to apologise for these somewhat incomplete notes. I should like to have given complete analyses as well as to have noted other points, but these, I trust, will be given by someone who has more opportunity and time to devote to the subject.

In reply to a question of the Chairman, Mr. SUTHERLAND said: The solubility in water is—in cold water (15·5° C.), barely 0·1 per cent.; in boiling water fully 1 per cent. A 1 in 1000 solution, however, has a very sweet taste, and even a 1 in 10,000 solution has a perceptibly sweet taste.

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NOTES ON THE ANALYSIS OF SOME MINERAL OIL GASES.

BY JAS. B. MACARTHUR.

THE destructive distillation of mineral oils for the production of illuminating gas is a process which this Society is already so well acquainted with, that any detailed account of it is quite superfluous on the present occasion.

The various forms of apparatus now in use give substantially the same results, and are worked at such a heat as will give a yield of from 85 to 100 cubic feet of 50 to 60 candle gas from each gallon of oil used, equal to 22,000 or 28,000 cubic feet of gas per ton of oil.

The oil used may be Burning Oil of 0·80 to 0·81 sp. gr., or the cheaper Intermediate Oil of 0·84 to 0·87 sp. gr.

It is well known that these mineral oils consist of a complex mixture of hydrocarbons, principally members of the olefine and normal paraffin series. In passing through a red-hot retort (the most suitable temperature for which seems to be about 800—1000° Centigrade), the oil readily breaks up into gas, the illuminating principles of which have been shown by the exhaustive researches of Armstrong and Miller to consist principally of members of the olefine, benzene, and pseudo-acetylene series, with mere traces of true paraffins or other saturated hydrocarbons.

This almost complete absence of the higher paraffins from ordinary high-heat oil gas led me to inquire whether an oil gas produced at a lower temperature would also be destitute of paraffins among its illuminating constituents, and more especially, whether paraffins would be found in the gas which is produced during the distillations, with open steam, to which mineral oil is subjected in the ordinary course of refining.

In these distillations, as has already been communicated to this Society, there is always produced a considerable amount of permanent gas—frequently as much as 1 cubic foot per gallon of crude oil distilled.

With crude shale oil, or, as in the case of the gases which have here been examined, in the first distillation of once-treated shale oil, the gas begins to be evolved when about two-thirds of the oil charged into the still have been distilled over.

At successive stages of the distillation, it is found to vary considerably in illuminating power and in composition. The first portion of gas formed is the product of the decomposition of the oil at the lowest possible temperature under the conditions, and, as will be seen from the following results of its analysis, is very rich in heavy hydrocarbons. As the distillation progresses, and the temperature of the still rises, the gas becomes poorer, less luminous, and contains hydrocarbons of a lower carbon density, until at the end of the distillation, when only spongy "coke" remains in the still, the luminosity of the gas which continues to come off is reduced to 10 or 15 candles, and the total carbon density of the gas to little over unity.

The gas as sampled at the end of the condensing worm was in all cases saturated with naphthas of low boiling point, which are also the decomposition products of the heavy oil.

In all cases the samples for analysis were collected over water, and were left for some time at a temperature of 50—55° F. to deposit any condensed naphtha.

For the sake of comparison, analyses were also made of ordinary high temperature oil gas produced from intermediate oil of 0·86 sp. gr. in a small iron retort. In the case of Nos. 6 and 7, as reported below, the temperature of the retort was purposely raised much beyond that usually employed for oil gas making, so much so in fact that the iron retort was quickly burned out.

The gas apparatus at my disposal for these analyses was of somewhat primitive form, and unavoidable errors may have crept in; but the fair agreement of the amount of oxygen consumed and contraction in volume after explosion, with what is demanded by theory for olefines and paraffins of the carbon density found, shows that these errors have not vitiated the results to any serious extent.

Great difficulty was experienced in finding a suitable absorbent for members of the paraffin series which could be applied after the removal of the olefines, etc., by bromine. It was necessary to effect their absorption in order to determine the vapour density of these heavy paraffins, to examine the residual gas, and especially to test for free hydrogen. Alcohol was deemed unsuitable owing to the difficulty experienced in removing its vapour from the scrubbed gas, and recourse was made to mineral oil of about 0·87 sp. gr., which had previously been deprived of its dissolved air by heating and steaming. This was still a somewhat imperfect absorbent, and its action on the lower members of the paraffin series was feeble. Marsh gas, as made from acetate of soda and slaked lime, and purified by caustic soda and bromine, was found to be absorbed to a considerable extent, but it was difficult to ensure its complete absorption. No attempt was made in the ordinary analyses to absorb this first member of the series, and to avoid doing so a uniform treatment of five volumes of oil per 100 of gas was adopted, though this probably left some of the next higher member, ethane, also unabsorbed. Treatment with a larger proportion of oil would have complicated the results by dissolving a considerable amount of the marsh gas, and by reducing the carbon density of the absorbed paraffins to such an extent that no true indication of the illuminating paraffins present in the gas would be obtained.

The candle power stated is only approximate, and the sp. gr. of the gases was roughly estimated by observing the rate of diffusion of the samples through a minute orifice, and comparing it with that of air under the same conditions.

The results are as follow :—

LOW TEMPERATURE GAS FROM STILLS.

	No. 1.	No. 2.	No. 3.	No. 4.
Sample taken at—	Beginning of Gas Production.	Middle of Gas Production.	Near Coking Stage.	Fully Coked.
Sp. gr. of gas, air = 1·00	1·10	1·05	0·67	—
Luminosity in candles	30, 35	30, 35	25, 30	10, 15
Vols. CO_2 after combustion per 100 of gas	229·0	215·1	134·2	101·1
Bromine absorption ..	20·0	18·0%	8·0%	3·5%
Carbon density of olefines	4·24	4·05	3·51	—
Oil absorption of residue per 100 of original gas	—	19·4	9·0	—
Carbon density of absorbed paraffins	—	4·30	3·00	—
Vols. CO_2 on combustion per 100 of residue	—	93·8	94·8	—

HIGH TEMPERATURE OIL GAS.

	No. 5.	No. 6.	No. 7.
Heat used in Retort—	Dull Red.	Bright Red.	Bright Orange.
Cub. ft. of gas per gal. of oil	102·3	120·0	158·0
Cub. ft. of gas per ton of oil	26,650	31,260	42,160
Luminosity in candles	50, 60	40	20, 25
„ Sperm equivalent" per ton of oil	5025	4336	3252
Sp. gr. of gas, air = 1·00	0·69	0·56	0·50
Vols. CO_2 on combustion per 100 of gas	137·5	103·7	68·6
Bromine absorption	27·9%	20·1%	6·0%
Carbon density of olefines	2·66	2·57	2·1 (?)
Oil absorption of residue..	2·0	2·6	0·9
Vols. CO_2 on combustion per 100 of residue from oil absorption	83·2	60·2	56·0

The low carbon densities of the high temperature gases, Nos. 5, 6, and 7, especially after removing the heavy hydrocarbons, show the presence of free hydrogen. This gas occurs almost of necessity, from the decomposition of the paraffins into the less highly hydrogenated olefines, and from the formation of coke. At lower temperatures, these high-boiling paraffins break up into lower olefines and paraffins, which latter may be largely represented in the case of this still gas by CH_4. Sample No. 7 of high heat gas was repeatedly scrubbed with oil after the removal of the olefines in the usual way, when 100 vols. of the residue gave only 32 vols. of CO_2, the hydrogen being 131·1, which agrees well with a mixture of two volumes of hydrogen and one volume of marsh gas

In the low temperature gas from stills, the presence of free hydrogen was also proved. In sample No. 2, the brominated gas was thoroughly scrubbed with oil, the combined absorption being 71 per cent. One hundred volumes of this residue gave 68 volumes of CO_2, while the oxygen consumed and contraction on exploding agreed well with that required by theory for a mixture of two volumes of marsh gas and one volume of hydrogen. This result (which was confirmed by duplicate trials) would show the presence of about 9 per cent. of free hydrogen in the original gas.

It is hardly possible that this free hydrogen found in the gas from oil stills could be derived from the decomposition of the steam used in the distillation, as the temperature of the still was much too low. When this sample of gas was taken, there was a considerable residue of oil in the still, the bottom being completely covered, as fresh oil had been fed in during the distillation. And if any decomposition of the steam had taken place, any hydrogen thus formed would have been accompanied by an equal volume of carbonic oxide, and this gas, as well as carbonic acid, could not be detected. The free hydrogen had probably been produced from the semi-coked sediment at the bottom of the still, which was nearly red hot when the sample was taken.

In an analysis of similar samples of gas, which was made by Prof. Forster, of London, and communicated to the Gas Institute in June, 1887, free hydrogen was considered to be absent. But in the analysis he quotes, only the olefines were removed, none of the paraffins being absorbed, and the carbon density of the residual gas was 1·31, the hydrogen being 4·62. Though this residue has the composition of pure paraffins, as stated, the same figures would be obtained from a mixture of :

20 vols. propane,
71 vols. marsh gas, and
9 vols. hydrogen,

or even from a mixture of :

65·5 vols. ethane and
34·5 vols. hydrogen,

or from any of a great number of mixtures containing free hydrogen. The carbon density of the residual gas not having been reduced below unity, free hydrogen was not proved to be absent.

The great richness in heavy carbon compounds of this gas produced in oil-refining stills, makes it very remarkable, but, at the same time, its luminosity is disappointing. Thus, sample No. 3 of low-heat, and No. 5 of high-heat gas, have both a carbon density of 1·3, but while the latter is of 50, 60 candle-power, the low-heat still gas is only 30 to 35 candles. A comparison of Nos. 4 and 6 is still more striking, the luminosity of the high-heat gas being always much higher than that of the low-heat gas from stills, the carbon densities being equal. But similar differences in luminosity may be found in comparing marsh gas with a carbon density of 1·0, which has only 5 candle-power, with coal gas, which, with an average carbon density of 0·40, may be of 25 to 30 candle-power. Also, it is stated by Berthelot that hydrogen mixed with 3 per cent. by volume of benzol vapour burns with about 20 candle-power, although it has a carbon density of only 0·09.

The heavy hydrocarbons present in still gas seem to consist of olefines and paraffins, or bodies similar to these, in about equal proportions, and thus it differs altogether from ordinary oil gas, which has practically no heavy hydrocarbons which are not removed by bromine. Thorpe and Young found solid paraffin wax to break up into liquid paraffins and olefines, in about equal proportions, when distilled repeatedly under pressure at comparatively low temperatures : and ordinary shale gasoline, which is the most volatile part of the naphtha recovered by scrubbing the retort gas with oil, was proved to be of similar composition. Its vapour was mixed with air, and the mixture analysed in the usual way. The sample tested was saturated at about 40° F., and burned with about 25 candle-power. The total hydrocarbons present were found to amount to 35·8 per cent. by volume, with an average carbon density of 5·4. The bromine absorption was 18·7 per cent. with a carbon density of 5·5, and the oil absorption of the residual gas amounted to 17·1 per cent. on the original, with a carbon density of 5·3. This shows that the gasoline, as vapourised, contained 52·2 per cent. of vapour of olefines, which is equal to about 52·7 per cent. by weight.

No examination has yet been made of the naphtha which always accompanies the gas from oil stills. This will partly pass away in the gas, even with very thorough condensing power : but towards the end of the distillation, the condenser requires to be kept somewhat warm to prevent choking of the pipes with solid paraffin, and, in consequence, very little of this naphtha arising from the decomposition of the heavy oils, is recovered, and a very considerable loss thus occurs. The quantity of this naphtha is now proportionately less than it was some years ago, as the tendency in oil-refining now is to have as little destruction of the oil in the course of the distillation as possible, and to rely more on chemicals for its purification. But it is impossible to avoid all decomposition in the still, and, in consequence, a quantity of naphtha which—whatever may be its exact chemical composition—is of low boiling point, and therefore of considerable value, is every day being lost in our mineral oil refineries.

Journal and Patent[*] Literature.

I.—GENERAL PLANT, APPARATUS AND MACHINERY.

Improvements in Filter-presses. D. K. Clark, London. Eng. Pat. 11,589, Sept. 11, 1886. 11d.

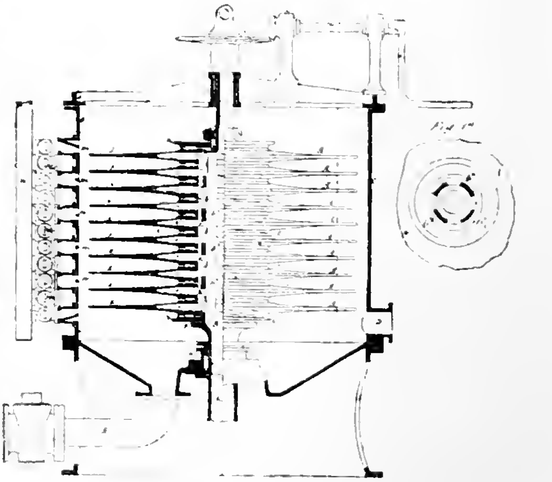
THE diaphragm or body of the filter-press plate, which the patentee has hitherto made in a separate piece from the rim, is in the present instance cast therewith in one. The drainage grooves are made in a radial direction from centre to circumference and these empty into one or more concentric grooves, which, in their turn, communicate with a number of outlet ones, disposed radially and passing through the body of the rim of the plate.
—C. C. H.

Improvements in Filters for Domestic Purposes. C. A. Clapham, Bradford. Eng. Pat. 9527, July 23, 1886. 8d.

THE improved filter consists of a cylindrical vessel, with a contracted orifice at the lower end screwed to receive pipe and covered with a perforated plate. The upper part is precisely similar to the lower part, except that it is screwed on to the body of the filter, thereby compressing the granular carbon between the two perforated plates. Such a filter can be attached to a water tap.—C. C. H.

Improvements in Filters. J. E. Hodgkin and E. Perrett, London. Eng. Pat. 15,158, Nov. 22, 1886. 11d.

THIS class of filter is more particularly intended for removing the solid matter precipitated from a hard water in the process of softening. The figure annexed shows one modification. In the vessel C mounted on a hollow spindle B are a number of corrugated hollow discs A, somewhat resembling the grooved plates of a circular filter-press. The discs are covered with cloths. The turbid water enters the tank at D, filters through the cloth into the corrugations on each plate, into the hollow interior a, and away through b^2 into the hollow spindle B, and thence conducted away by pipe b. The solid matter accumulated on the clothed discs is removed by rotating the whole series by means of the mechanism shown so as to enable jets of water m to play on the surface and wash away the deposit, which escapes through the pipe H. The specification shows two other modifications, in which the hollow spindle B is mounted horizontally.—C. C. H.



Composition for Removing Scale or other Incrustations from the Inside or other Parts of Steam Boilers. J. Brookbanks, North Shields. Eng. Pat. 12,498, Oct. 2, 1886. 4d.

THE composition consists of one part of sulphate of soda, one part of nitre cake and one part of alkali.
—C. C. H.

Improvements in Filter-presses. E. A. Cowper, London. Eng. Pat. 14,415 Nov. 8, 1886. 1s. 1d.

THE improvements described in this specification consist in (1) providing an arrangement of links, chains or ropes, so connecting the chambers that when the follower is withdrawn by means of an endless chain, mechanically worked, the whole chambers are simultaneously opened ; (2) opening or closing the chambers one at a time by means of a sliding friction pawl carried by reciprocating bars ; (3) effecting the tightening of the press by means of the pressure in the interior of the machine, itself acting upon an hydraulic ram forming part of, but larger in diameter than, the head of the machine; (4) expediting

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[*] Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows :—

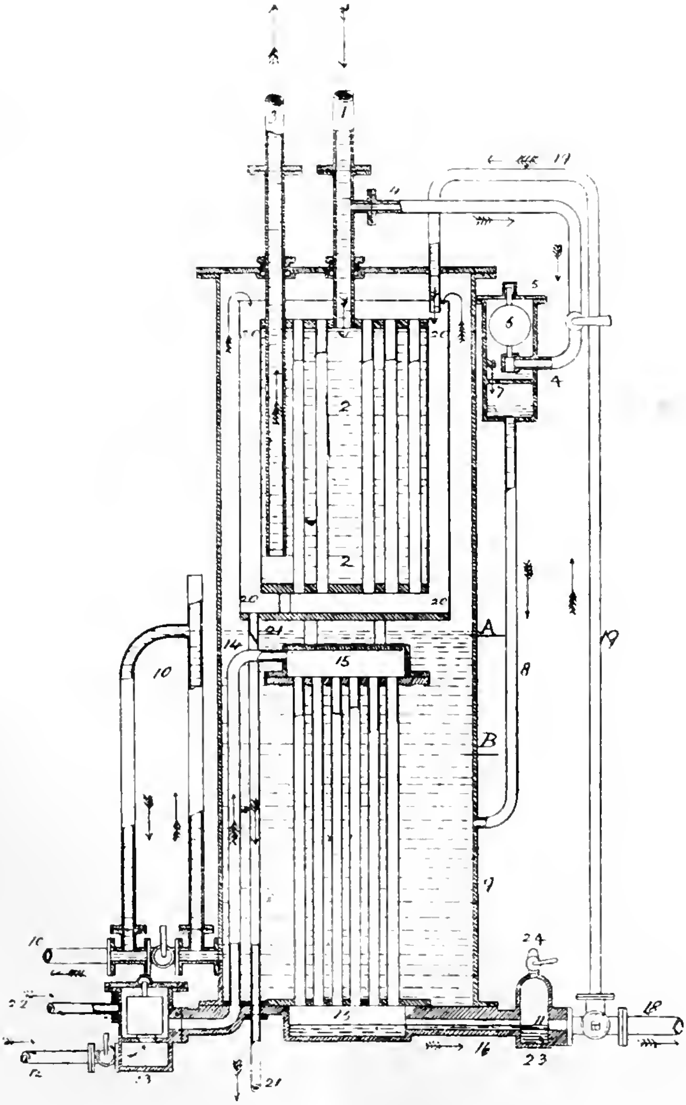
If the price does not exceed 8d.........	½d.
Above 8d., and not exceeding 1s. 6d...	1d.
,, 1s. 6d., ,, ,, 2s. 4d...	1½d.
,, 2s. 4d., ,, ,, 3s. 4d...	2d.

filtration by intermittently injecting air under pressure along with the material undergoing filtration; (5) assisting the removal of the cake from the faces of the chambers by means of springs or projections on the said faces, or by forcing air or water under pressure behind the filtering cloth before the machine is opened.

—C. C. H.

Improvements in Machinery for Producing Distilled Water from Sea or other Impure Water. A. L. Normandy, London. Eng. Pat. 12,419, Sept. 30, 1886. 8d.

THE accompanying figure shows the construction of the improved apparatus. The vessel 9 contains the two tubular vessels, 2 and 15, the lower of which is immersed in impure water undergoing distillation. Steam is supplied from a boiler through pipe 12 and steam reducing valve 13 into 15, where it condenses, passing away through steam trap 23, either by pipe 18 or by pipe 19 into vessel 20, where it mixes with the "secondary condensed water" in the upper vessel. Cold water is supplied through pipe 1 to the upper condenser, and condenses the steam arising from the condensing water in the lower part of the apparatus; this mixes in 20 with that from 15 and is carried by pipe 21 to any desired point. The condensing water in 2 passes away through pipe 3. A portion of the water entering pipe 1 is led through 4, through the float box 6 and by pipe 8 enters the lower point of 9, where, as has been described, it is both distilled and acts as a condensing agent. The concentrated brine passes away through pipe 10. Excess pressure in vessel 9 lowers the water level as from A to B, and thus reduces the evaporative power.—C. C. H.



Improvements in Filter-presses. J. Critchlow, T. Forester, W. Forester, H. Forester, and L. Forester, Longton. Eng. Pat. 2915, Feb. 25, 1887. 8d.

THE filtering cloths are replaced by porous tiles resting and bedded on the drainage faces of the chambers of the filter-press. The tiles or porous composition consist of charcoal, blue clay, ball clay, China clay, flint and stone mixed together with water, formed into cakes and fired.

—C. C. H.

Improvements in and relating to Filtering Apparatus. C. J. Bühring, Hamburg, Germany. Eng. Pat. 3848, March 14, 1887. 8d.

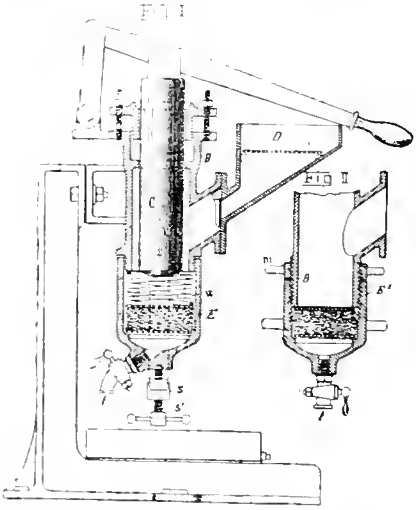
THE new filter is made of enamelled wrought iron and resembles in shape an inverted bottle. The inlet is at the top or large end, which is closed by a loose cover secured by a clip, and the outlet is at the lower and smaller end. The filtering medium consists of a hollow block of carbon, covered with an iron bell perforated at the lower end and surrounded with granulated charcoal. Above this, again, is an asbestos plate, holding coarsely granulated charcoal surmounted by a charcoal plate to break the force of the water. The filter as arranged is directly connected with the water main. Sometimes it is used in conjunction with a pump, in which case a three-way cock is used, so that either filtered or unfiltered water can be drawn as desired.—C. C. H.

Improved Method of and Apparatus for Preventing Corrosion in Steam Boilers. E. M. B. Faull and F. W. Cannon, London. Nov. 22, 1886. 4d.

THE feed water is passed through an iron vessel, in the bottom of which is a zinc plate covered by a perforated iron plate: suspended vertically in the vessel are three plates, two of iron, one of zinc; the zinc plate is connected with the exterior of the boiler by a copper wire, and a return circuit from the outside of boiler to the iron plates. The combination forms "a battery of sufficiently destructive power to destroy any galvanism contained by the feed water."—C. C. H.

An Improved Filtering and Lixiviating Press. C. A. Koellner, Kiel, Prussia. Eng. Pat. 7515, May 25, 1887. 8d.

THE accompanying Figs. show the improved filtering press. B is a force pump, with plunger C fed from hopper D, provided with inlet valve. Below this, and secured thereto by bolts, a screw thread or a stirrup and screw is the filtering chamber E or E^1 in which is compressed by the spring W, or its equivalent in screws, the filtering bed. Reciprocation of the pump plunger forces the liquid through the filtering medium and out by the cock t. The solid matter is left in the filtering chamber, and can be lixiviated in a similar manner.—C. C. H.

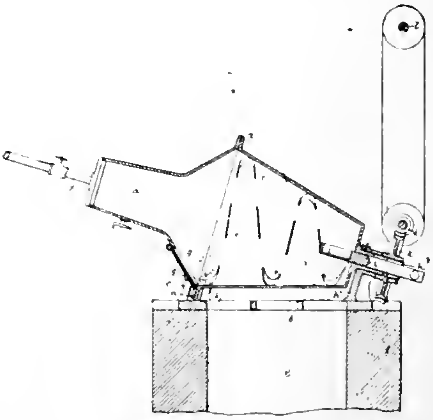


Improvements in Apparatus for Separating by Subsidence Solid Matters from the Liquids in which they are Suspended. W. Macnab, sen., W. Macnab, jun., Forest Gate, and J. Donald, Paisley. Eng. Pat. 7830, May 28, 1887. 8d.

A HORIZONTAL tank is divided into two parts; the first part communicates with the second through holes cut in the separating diaphragm. The first portion of the tank is again divided by vertical partitions, so that any liquid entering the apparatus passes first to the bottom, rising and descending once again before entering the second part of the apparatus. This ensures the thorough admixture of any reagents. In this part a series of sloping shelves are placed alternately reaching to the top and bottom, the distance between them increasing. The spaces between these are filled with sloping shelves parallel to the partitions, the distance between these being greater in the end nearest the entrance to the tank, and *vice-versâ*. A turbid liquid entering the apparatus deposits its solid matter on these subsidence shelves and following an up-and-down course finally becomes quite clarified. The mud slides down the shelves into the lower part of the tank and is removed through cocks.—C. C. H.

Improvements in Apparatus for Calcining, Drying, Roasting or Carbonising Substances or Materials and Extracting Gases, Spirits or Acids therefrom. R. Cunliffe, Pendleton, and J. Lund, St. Annes-on-the-Sea. Eng. Pat. 10723, Aug. 4, 1887.

THE improved apparatus consists of a bottle-shaped vessel a, runnning on friction rollers c c, and a hollow trunnion bearing h, contained by a base plate b and suspended over a furnace c. The neck is fitted with a pipe f for the conveyance of the gases, etc. evolved during distillation to any desired point. A door g serves for the introduction of the material and blades e for its agitation during rotation. Spirits or volatile oils may be introduced through the plug i i^1. The whole is rotated by the worm k^1 and worm wheel k.—C. C. H.



Improvements in the Construction of Filters. R. Clayton, Deepfields. Eng. Pat. 11,035, Aug. 12, 1887. 6d.

THE improved filter consists of a vessel, cylindrical or otherwise, in the interior of which is suspended a second vessel of similar shape, the lower part of which carries the filtering body. This consists of layers of sand, fine and granulated charcoal enclosed between two carbon plates or asbestos cloths.—C. C. H.

II.—FUEL, GAS AND LIGHT.

Improvements in the Use and Construction of what are known as Mantles for Incandescent Gas Lighting. A. Paget, Loughborough. Eng. Pat. 16,581, Dec. 17, 1886. 8d.

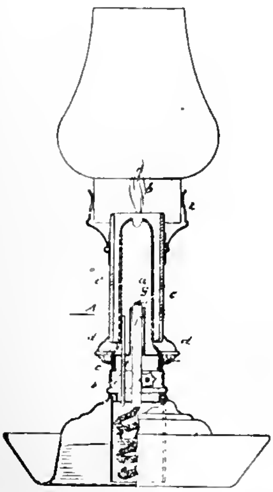
INSTEAD of being suspended by the top, the mantle is supported at the bottom by resting on a ring, collar or shelf round the top of the burner. It may be fastened to this support with shellac, glass or other suitable cement. To prevent side motion, a wire is carried upward from the burner and bent down so as to enter the aperture at the top of the mantle and hold it in position; or this wire may be carried upwards inside the mantle, and answer the same purpose. The mantle may be strengthened by making it of a fabric increasing in thickness or closeness from the top to the bottom and, to ensure an easy fit over the burner or collar without undue slackness, a wire inserted in a "welt" or "slack course" provided for it in the bottom of the mantle. For strengthening purposes, this wire may also be inserted at the top of the mantle.—A. R. D.

Improved Blowpipe Apparatus for Producing Intense Heat and Artificial Light. S. Pitt, Sutton. From J. R. Knapp, New Orleans, U.S.A. Eng. Pat. 9077, June 25, 1887. 11d.

This is an apparatus in which nitrous oxide is used to support the combustion of a jet of hydrogen. The nitrous oxide in liquid form is stored in a cylinder, which forms part of the apparatus. For details of construction, the specification with its explanatory drawings must be consulted.—A. R. D.

Improvements in Apparatus for Burning Heavy Mineral and Other Oils. L. Chandor, St. Petersburg, Russia. Eng. Pat. 12,336, Sept. 12, 1887. 6d.

These improvements relate to the so-called "Tischolin candlestick," described in Eng. Pat. 10,234, Aug. 23, 1885. They consist—Firstly, in the substitution of a metallic, ground or milk glass or porcelain cylinder *c* for the tightly-fitting mantle, which heretofore was placed over the perforated metal cylinder with inner gauze lining. This outer cylinder is not provided with airholes at the top, but stands in a circular cap *d* with airholes *e*. The air entering by these holes is thus warmed as it passes to the upper flame *b*. Secondly, in surrounding the wick tube *f* with another tube *g*. The space between these tubes communicates by the openings *h* with the outside air and thus provides for the combustion of the lower flame *a*. Thirdly, in the use of the small tube *i* which reaches down into the oil reservoir and leads any gases formed there up to the lower flame to be consumed.—A. R. D.



III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Improvements in the Method of and in Apparatus for the Utilisation of Gas Tar. G. Hammond, Lewes. Eng. Pat. 14,395, Nov. 8, 1886. 1s. 1d.

It is proposed to continuously and automatically distil coal tar by means of high-pressure steam in order to recover the illuminating hydrocarbon vapours and convey them to the gas mains for the purpose of enriching and increasing the volume of coal gas in course of manufacture, the residual tar being also used as fuel in the retort furnace or other fires. The specification contains five sheets of drawings.—D. B.

Improvements in Carbonising or Distilling Coal or Shale. J. Young, Stoke-on-Trent. Eng. Pat. 14,840, Nov. 16, 1886. 4d.

By adding sodium chloride to the coal, the coke produced is said to be improved in quality, whilst the resulting gas can be more easily purified. The quantities of illuminating gas and ammoniacal compounds produced are also said to be increased. The quantity of salt to be used depends on the composition of the coal, but in most cases 4lb. of salt to 1 ton of coal will be found to give the desired result.—D. B.

IV.—COLOURING MATTERS AND DYES.

Azo-Colouring Matters from the Paradiamines of Stilbene and Fluorene and their Sulphonic Acids. Dingl. Polyt. J. **265**, 478—479.

As is known, the azo-colouring matters, which are obtained by the combination of *para*-tetrazo-compounds with naphthylaminesulphonic acids, naphtholsulphonic acids or phenolcarboxylic acids, possess the property of dyeing unmordanted cotton and have become during the past few years dangerous rivals to the natural colouring matters.

For their preparation, the *para*-diamines of diphenyl, ditolyl and dixylyl and the derivatives of these bases have been principally employed. Recently, the firm of A. Leonhardt & Co. have proposed *diamidostilbene*, *diamidofluorene* and their sulphonic acids, as the starting-point in the preparation of these azo-dyes.

Diamidostilbene is prepared from *p*-nitrobenzylchloride. This is treated with an alcoholic solution of potash, and the *p*-dinitrostilbene thus obtained reduced with tin and hydrochloric acid, yielding diamidostilbene, a substance which crystallises in needles or plates and melts at 226—227°.

The base is more easily obtained when paranitrotoluene is digested with alcoholic soda. A complicated product is obtained, which, by treatment with tin and hydrochloric acid, is converted into diamidostilbene.

On a large scale, the base is obtained by boiling for a long time 50kilos. of *para*-nitrotoluene with 100 litres of alcohol and 30kilos. of soda solution of 40° B. The spirit is distilled off and the unchanged *para*-nitrotoluene removed in a current of steam. The product remaining behind is suspended in 10 parts of alcohol and heated under an inverted condenser for a long time with 5 parts of concentrated hydrochloric acid and 1 part of tin chloride. After distilling off the spirit, the tin is precipitated by zinc and the new base separated from the concentrated liquid with excess of soda. It is then purified by means of the sparingly soluble hydrochloride.

In order to obtain diamidostilbenesulphonic acid, 50kilos. of sodium *p*-nitrotoluene sulphonate are dissolved in hot water and gradually decomposed with 100kilos. of soda solution of 40° B. This is then diluted with 500kilos. of water and 50kilos. of zinc dust are added little by little. When the solution becomes colourless, it is filtered hot and the *diamidostilbenesulphonic acid* separated by hydrochloric acid as a yellow, sparingly-soluble powder.

Diamidofluorene is prepared by Schultz's method: by the fractional distillation and crystallisation of the portion of coal tar boiling between 290—330°, the fluorene is separated from the other hydrocarbons in this fraction. By treating this with strong nitric acid and reducing the resulting nitro-compound, *diamidofluorene* is obtained; this, with concentrated sulphuric acid, yields *diamidofluorenesulphonic acid.*

From these amido-bodies and their sulphonic acids, the azo-dyes can be obtained by combination with amines, phenols, or their sulphonic or carboxylic acids. The tetrazo-compound, formed by acting on the base or its sulphonic acid with nitrous acid, combines first with one molecule of the respective amine or phenol, forming an intermediate product, which then acts on a second molecule. This property has been employed in order to obtain the so-called mixed azo-dyes, by combining two different amine or phenol molecules with one molecule of a tetrazo-compound.

The following colouring matters were obtained in the above-mentioned manner:—

Dye from diamidostilbene and α-naphtholmonosulphonic acid.—28·3kilos. of diamido-stilbene hydrochloride are dissolved in 5000 litres of water. 24kilos. of hydrochloric acid of 20° B. added, and converted into the tetrazo-compound by the addition of a solution of 13·8kilos. of sodium nitrite in 200 litres of water. This latter is then allowed to act, with frequent shaking, on an alkaline solution of 49·2kilos. of sodium α-naphtholmonosulphonate in 5000 litres of water. After standing some days, the mixture is heated to boiling, the colouring matter salted out, pressed and dried. It dyes cotton a bluish-violet without mordant.

Dye from diamidostilbene and β-naphtholdisulphonic acid.—When the α-naphtholmonosulphonic acid above mentioned is replaced with 69·6kilos. of β-naphtholdisulphonic acid, a colouring matter is obtained which dyes cotton in an alkaline soap-bath greenish-blue. When 1mol. of diamidostilbene is combined with 1mol. of β-naphtholdisulphonic acid and 1mol. of α-naphtholdisulphonic acid, a colouring matter is obtained which, in regard to tint and solubility, falls between the two previous ones.

By further combination of diamidostilbene with α-naphthol, β-naphthol, or β-naphtholmonosulphonic acid, colouring matters are obtained which dye cotton in an alkaline bath, blue to bluish-violet.

A yellow dye is obtained from diamidostilbene and salicylic acid.

From *diamidostilbenesulphonic acid*, other dyes can be obtained in a similar manner; and diamidofluorene also yields technically useful colouring matters with *α-naphthylaminesulphonic acid* or *β-naphtholdisulphonic acid*.

—G. H. M.

On Sulphon-Fluorescein Ira Remsen and C. Hayes. Amer. Chem. J. **9**, 372—379.

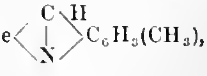
By heating *ortho*-sulphobenzoic acid with resorcinol to 178—185° for about seven hours, the liquid which has at first a clear deep-red colour, begins to thicken and yellow, crystalline plates appear, when the whole soon turns to a thick, nearly solid yellow paste. The mass is extracted with water and the sulphon-fluorescein separated from the aqueous solution by concentrations and re-crystallisation. It forms straw-coloured crystals, ready soluble in water. The aqueous solution is slightly fluorescent, the alkaline solution more so, but nothing like that of fluorescein. Heated to 250° it does not melt, but is decomposed at 300°, forming in part a dark brown flocculent mass insoluble in water and soluble in alkalis, yielding a strongly fluorescent solution. Its composition appears to be analogous to that of fluoresceïn, the CO group being replaced by SO_2. Its crystals contain two molecules of water of crystallisation. An aqueous solution of sulphon-fluorescein decomposes carbonates with the formation of salts. The barium salt forms straw-coloured crystals, the exact composition of which is at present undecided. When sulphon-fluoresceïn is treated with excess of bromine in acetic acid solution, a crystalline dibromide is probably formed. The strongly alkaline solution of sulphon-fluoresceïn becomes colourless when treated with zinc dust, probably forming a substance analogous to fluoresceïn, which owing to its extreme solubility could not be isolated. The decolorised solution is readily coloured again by oxidising agents or by simply allowing it to stand exposed to the air.

—C. A. K.

The Coal-tar Colours and the Revision of the Laws concerning Injurious and Non-injurious Colouring Matters. P. Cazeneuve. Ann. d'Hygiéne, 1887, **18**, 1.

The following colours are considered as non-injurious by the author:—(1) Soluble red (roccellin); (2) the sodium salt of the sulphonic acid of rosaniline; (3) purple red (obtained by the action of the diazo-compound of alpha-naphthylamine mono-sulphonic acid on beta-naphthol alpha disulphonic acid); (4) Bordeaux red B, formed from the diazo-compound of alpha-naphthylamine and beta-naphthol-alpha-disulphonic acid; (5) Ponceau R (from diazo-xylidine and naphthol-beta-disulphonic acid); (6) Orange I (from the diazo-compound of sulphanilic acid and alpha-naphthol); (7) Yellow N S (sodium salt of dinitronaphtholsulphonic acid); (8) Soluble yellow (sodium salt of amido-azo-*ortho*-toluenesulphonic acid); (9) Ordinary Indulin (the sodium salt of the sulphonic acid obtained from the product of the action of amido-azobenzene on aniline); (10) Coupier's blue (sodium salt of a sulphonic acid derivative of violaniline); (11) Acid green (sodium salt of the mono-sulphonic acid of malachite green). The sodium salts of sulphonic acids are not poisonous as a rule, while nitro-compounds (*e.g.*, dinitronaphthol) are poisonous. Methylene blue is injurious. The author proposes regulations in regard to the sale and use of artificial colouring matters in colouring food—viz., that the colours must be free from sodium sulphate and other impurities, whether injurious or not: neither wine, vinegar, beer nor butter should be artificially coloured: and that the manufacturer should be held responsible for the quality and nature of his products.—C. A. K.

Derivatives of Triphenylmethane. C. Ullmann. J. Prakt. Chem. **36**, 246—272.

By the action of benzaldehyde upon mixtures of aromatic amines with their hydrochlorides, diamido-derivatives of triphenylmethane are obtained. Benzaldehyde-aniline and aniline-hydrochloride at 110—120° give rise to the already known *diamidotriphenylmethane*. This body is also formed by heating benzylidine-aniline with aniline hydrochloride. By heating benzaldehyde with *o*-toluidine and its hydrochloride, *diamidodi-o-tolylphenylmethane* $C_6H_5.CH[C_6H_3(CH_3)NH_2.]_2$ [1 : 3 : 4] is produced, though it does not appear to have been obtained in a pure state. On oxidation it gives a bluish-violet colouring matter. By a similar reaction, *p*-toluidine gives rise to *diamidodi-p-tolylphenylmethane* $C_6H_5.CH[C_6H_3(CH_3)NH_2]_2$ [1 : 3 : 6, though the yield is much smaller than in the preceding cases. This compound crystallises from benzene, with ½mol. of C_6H_6, in small, colourless prisms; from alcohol it crystallises in needles. It melts at 185—186° and distils with slight decomposition at about 27—33°. It scarcely has any tendency to form a dyestuff on oxidation. By diazotising and treatment with hydriodic acid it is converted into *di-iododi-p-tolylphenylmethane* $C_6H_5.CH[C_6H_3I(CH_3)]_2$, which crystallises from alcohol in prisms of melting-point 167—168°. When diamidodi-*p*-tolylphenylmethane is distilled with zinc dust it is resolved into *p*-toluidine and methyl-acridine 

$\left\langle \begin{matrix} CH \\ | \\ N \end{matrix} \right\rangle C_6H_3(CH_3)$, the latter of which forms small felted needles, of melting-point 131·5°.

The di-acetyl derivative of diamidodi-*p*-tolylphenylmethane $C_6H_5.CH[C_6H_3(CH_3)NH.C_2H_3O]_2$ crystallises from alcohol in colourless prisms on plates and melts at 217—218°.

The *di-benzoyl derivative* $C_6H_5.CH[C_6H_3(CH_3)NH.CO.C_6H_5]_2$ forms small prisms, which melt at 196°.

—A. G. G.

Cotton Colouring Matters. E. Erdmann. Chem. Ind. **10**, 427—433.

Until quite recently, the only dyestuffs known which had any natural affinity for cotton were a few non-nitrogenous plant-colouring matters (bixin, carthamin, curcumin, etc.) and the strongly basic compounds saffranine and methylene blue. Since 1885 an entirely new class of azo-colouring matters have been introduced which have a very marked affinity for the cotton fibre, which they dye from a neutral or slightly alkaline bath without a mordant. The first cotton colours discovered were all derivatives of benzidine and tolidine, and upon this fact R. Möhlan (*Ber.* 19, 2014) has based a theory that the affinity of these colours for cellulose is a function of the diphenyl group. More recently, however, a variety of other cotton colours have been discovered which do not possess this grouping, so that upon what peculiarity of the molecular structure the affinity for cotton depends still remains undetermined. Amongst the cotton colours which are not derivatives of diphenyl are those derived from diamidostilbene $C_6H_4(NH_2).CH:CH.C_6H_4(NH_2)$ and its sulphonic acids. This base is obtained by reduction of *p*-nitrobenzyl-chloride, or by the action of caustic alkalis and zinc-dust upon *p*-nitrotoluene (Bender and Schultz, *Ber.* 19, 3234; Walter, *Bull. Soc. Ind. de Mulhouse*, 1887, 99). According to a recent patent of the Badische Fabrik (Germ. Pat. 39,955), cotton colours are obtained from the naphthylene-diamine, formed by reduction of alpha-dinitronaphthalene. Further, di-*p*-amido-azobenzene $C_6H_4(NH_2).N:N.C_6H_4(NH_2)$ and *p*-phenylene-diamine also give rise to azo-colouring matters with an affinity for cotton, though those derived from the latter base do not find technical employment on account of their sensitiveness to light. On the other hand, the azo-colouring matters derived from di-*p*-amido-benzophenone $C_6H_4(NH_2).CO.C_6H_4(NH_2)$ and from di-*p*-amidodiphenylmethane $C_6H_4(NH_2).CH_2C_6H_4(NH_2)$ have scarcely any affinity for cotton. Whilst it is the diazotised base which appears to determine the affinity for the fibre of the resulting azo-compound, the shade produced is almost entirely dependent upon the phenol or amine with which the diazo-compound is combined. Thus, with the above-mentioned bases, phenol, phenol-sulphonic acid and salicylic acid give yellows; alpha-and beta-naphthylamine and their sulphonic acids give reds; and alpha-and beta-naphthols and their sulphonic acids give violet to blue shades. The compounds obtained from alpha-naphthylaminesulphonic acid are stronger colours than those from the sulphonic acids of beta-naphthylamine; but the former are more sensitive to acids, which change their colour to blue, whilst the latter are changed to brown. Instead of combining the diazotised diamido base with 2mols. of one phenol or amine, compounds of a mixed type may be obtained by first uniting one N_2 group with 1mol. of a phenol or amine and then uniting the second N_2 group with 1mol. of a different phenol or amine. This is readily done, as the combination of the second N_2 group takes place much more slowly than that of the first. The compounds $R'.N_2.X.N_2.R''$ prepared in this way dye shades intermediate between the colours $R'.N_2.X.N_2.R'$ and $R''.N_2.X.N_2.R''$ obtained by combining the diazotised diamine with two similar mols. of each phenol or amine separately. Thus:—

Congo Corinth B, the colour from

$$\text{Tolidine}\begin{cases}\text{Alpha-naphthionic acid}\\ \text{Alpha-naphtholsulphonic acid}\end{cases}$$

is intermediate in shade between *Benzopurpurin* 4 B:

$$\text{Tolidine}\begin{cases}\text{Alpha-naphthionic acid}\\ \text{Alpha-naphthionic acid}\end{cases}$$

and *azo-blue*:

$$\text{Tolidine}\begin{cases}\text{Alpha-naphtholsulphonic acid}\\ \text{Alpha-naphtholsulphonic acid.}\end{cases}$$

A.—BENZIDINE COLOURS.

1. *Congo red:*

$$\text{Benzidine}\begin{cases}\text{Alpha-naphthylaminesulphonic acid}\\ \text{Alpha-naphthylaminesulphonic acid.}\end{cases}$$

(Actien Gesellschaft für Aniline Fabrication, Germ. Pat. 1884, 28,753). This was the first cotton azo-colour, and was discovered by Böttiger. Cotton yarn is dyed from a bath containing 3 per cent. of borax, 5 per cent. of salt and 4 per cent. of green soap. For printing, a solution of

300grms. of Congo Red,
100 ,, ,, caustic soda liquor (36° Bé.),
in 1500 ,, ,, water,

is added to a mixture of

1000 grms. of gum tragacanth,
1200 ,, ,, flour,
300 ,, ,, white soap,

and boiled. Congo red is very sensitive to acids, by which it is turned blue. Its aqueous solution gives a blue precipitate on the addition of a trace of any acid, on which account it is employed as an indicator in alkalimetry.

2. *Chrysamine:*

$$\text{Benzidine}\begin{cases}\text{Salicylic acid}\\ \text{Salicylic acid}\end{cases}$$

(Fr. Bayer & Co., Germ. Pat. 1884, 31,658).

This yellow colouring matter is very sparingly soluble in water, but dissolves more readily in a solution of soap. Aqueous caustic soda dissolves it very easily, forming a red solution of the basic salt. Cotton yarn is dyed from a bath containing 1 per cent. of chrysamine, 10 per cent. of phosphate of soda, and 2½ per cent. of soda. For printing, the following mixture is employed:—

1500grms. of water.
1200 ,, ,, flour.
1000 ,, ,, gum tragacanth.
300 ,, ,, white soap.
300 ,, ,, chrysamine.

Chrysamine is extraordinarily sensitive to traces of iron and copper salts, which change its colour to brown. Knecht has found that chrysamine acts as a mordant towards basic aniline colours.

3. *Azo-orseilline:*

$$\text{Benzidine}\begin{cases}\text{Alpha-naphtholsulphonic acid}\\ \text{Alpha-naphtholsulphonic acid}\end{cases}$$

dyes wool an archil shade. Dissolves in conc. H_2SO_4 with a blue colour, which becomes violet on addition of water.

4. *Benzidine-blue:*

$$\text{Benzidine}\begin{cases}\text{Beta-naphtholdisulphonic acid R}\\ \text{Beta-naphtholdisulphonic acid R}\end{cases}$$

(G. Schultz, *Ber.* 17, 462) has no technical value.

5. *Deltapurpurine:*

$$\text{Benzidine}\begin{cases}\text{Beta-naphthylamine-}\ \delta\ \text{-sulphonic acid}\\ \text{Beta-naphthylamine-}\ \delta\ \text{-sulphonic acid}\end{cases}$$

(Fr. Bayer and C. Duisberg, *Ber.* 19, 1426).

6. *Yellow-paste:*

$$\text{Benzidine}\begin{cases}\text{Sulphanilic acid}\\ \text{Phenol}\end{cases}$$

dyes cotton from a hot bath a greenish yellow, but is a weaker colour than chrysamine. It dissolves in conc. H_2SO_4 with a reddish-yellow colour.

6. *Congo G R:*

$$\text{Benzidine}\begin{cases}\text{Alpha-naphthionic acid}\\ m\text{-sulphanilic acid}\end{cases}$$

dyes cotton a yellowish scarlet.

8. *Congo Corinth:*

$$\text{Benzidine}\begin{cases}\text{Alpha-naphthylaminesulphonic acid}\\ \text{Alpha-naphtholsulphonic acid}\end{cases}$$

dyes a Corinthian red.

9. *Brilliant-congo G:*

$$\text{Benzidine}\begin{cases}\text{Beta-naphthylaminedisulphhonic acid}\\ \text{Beta-naphthylaminemonosulphonic acid}\\ \text{(Brönner's)}\end{cases}$$

is dyed best with the addition of potash. It is stable towards dilute acetic acid.

B.—TOLIDINE COLOURS.

1. *Benzopurpurine B:*

$$\text{Tolidine}\begin{cases}\text{Beta-naphthylaminesulphonic acid.}\\ \text{Beta-naphthylaminesulphonic acid.}\end{cases}$$

This red-colouring-matter was the first tolidine derivative that came into the market. It dyes from a bath containing 10 per cent. of potash or phosphate of sodium.

2. *Benzopurpurine 4 B:*

$$\text{Tolidine}\begin{cases}\text{Alpha-naphthylaminesulphonic acid.}\\ \text{Alpha-naphthylaminesulphonic acid.}\end{cases}$$

(Germ. Pat. 35,615.)

Its shade is almost the same as that of Congo red, and, like the latter, it is changed by acetic acid.

3. *Deltapurpurine 7 B.*

$$\text{Tolidine}\begin{cases}\text{Beta-naphthylamine-}\delta\text{-sulphonic acid.}\\ \text{Beta-naphthylamine-}\delta\text{-sulphonic acid.}\end{cases}$$

(Fr. Baeyer & C. Duisberg, *Ber.* **19**, 1426.)

4. *Azo-blue:*

$$\text{Tolidine}\begin{cases}\text{Alpha-naphtholsulphonic acid.}\\ \text{Alpha-naphtholsulphonic acid.}\end{cases}$$

(Fr. Bayer & Co., Germ. Pat. 1885, 35,341.)

This dyestuff forms a dark-coloured powder, which dissolves in water with a bluish-violet colour, changed to red by alkalis, but unaffected by acids. Conc. H_2SO_4 dissolves it with a pure blue colour. Cotton is dyed from a bath containing soap and 10 per cent of sodium phosphate of soda (also in some cases sulphate of soda). It gives dull reddish-blue shades.

5. *Rosazurine G and B* (Fr. Baeyer & Co.) are prepared from tolidine and alkylated beta-naphthylaminesulphonic acids.

6. *Congo Corinth B:*

$$\text{Tolidine}\begin{cases}\text{Alpha-naphthionic acid}\\ \text{Alpha-naphtholsulphonic acid}\end{cases}$$

dyes a bluer shade than the corresponding benzidine colour.

7 *Congo 4 R:*

$$\text{Tolidine}\begin{cases}\text{Alpha-naphthylaminesulphonic acid}\\ \text{Resorcinol}\end{cases}$$

dyes very beautiful shades, but is even more sensitive to acids than Congo, being slowly decomposed even by carbonic acid.

8. *Brilliant Congo R:*

$$\text{Tolidine}\begin{cases}\text{Beta-naphthylaminedisulphonic acid}\\ \text{Beta-naphthylaminemonosulphonic acid}\\ \text{(Brönner's)}\end{cases}$$

(Actiengesellschaft, Germ. Pat. 41,095.)

dyes cotton slowly; the colour is stable towards dilute acetic acid.

C.—DIANISIDINE COLOURS.

Benzoazurine:

$$\text{Dianisidine}\begin{cases}\text{Alpha-naphtholsulphonic acid}\\ \text{Alpha-naphtholsulphonic acid}\end{cases}$$

is the bluest azo-colour yet brought into the market. Cotton is dyed an indigo-blue shade with 5 per cent. of colour.

D.—DIAMIDOSTILBENE COLOURS (A. Leonardt & Co.)

1. *Hessian Purple N:*

$$\text{Diamidostilbenedisulphonic acid}\begin{cases}\text{Beta-naphthylamine.}\\ \text{Beta-naphthylamine.}\end{cases}$$

2. *Hessian Purple B P* and *D* are derived from diamidostilbenedisulphonic acid and the various naphthylaminesulphonic acids.

3. *Hessian Yellow:*

$$\text{Diamidostilbenedisulphonic acid}\begin{cases}\text{Salicylic acid}\\ \text{Salicylic acid}\end{cases}$$

dyes a redder shade than chrysamine.

4. *Brilliant Yellow:*

$$\text{Diamidostilbenedisulphonic acid}\begin{cases}\text{Phenol.}\\ \text{Phenol.}\end{cases}$$

Very similar in shade to Hessian yellow. Alkalis change its colour to red, forming basic salts.

5. *Chrysophenine* is an alkyl derivative of the preceding compound. It is unaffected by alkalis.

—A. G. G.

Chromogenic Properties and Preparation of the Oxyanthraquinones. C. Liebermann and S. v. Kostanecki. Annalen, **240**, 256—304.

THE authors, by a method which they call the "rufi-reaction," and which consists in condensing two molecules of benzoic acid or its substitution products by means of concentrated H_2SO_4, have succeeded in preparing a number of anthraquinone derivatives. They find that of the oxybenzoic acids, the meta-oxy-compounds most readily undergo condensation and this they ascribe to the greater stability of the acid towards the concentrated H_2SO_4 and at high temperatures. Of the compounds prepared in this way the following may be mentioned:—

Meta-oxybenzoic acid condenses with benzoic acid to form oxyanthraquinone, according to the following equation:—

$$C_6H_5CO_2H + C_6H_4(OH)CO_2H = 2H_2O + C_{14}H_8O_3$$

At the same time oxybenzoic acid condenses with itself, so that a number of isomeric dioxyanthraquinones are formed—viz., anthrarufin, erythroxyanthraquinone, anthraflavinic acid and *m*-benzdioxyanthraquinone, which may be separated by means of the different solubilities of the barium salts or of the acetyl derivatives. The latter method is used in the separation of monoxy- from benzdioxyanthraquinone.

Benzoic acid condenses also with symmetrical dioxybenzoic acid to form xanthopurpurin and anthrachryson. The former is separated from the latter by its solubility in benzene, or by that of its barium compound in water.

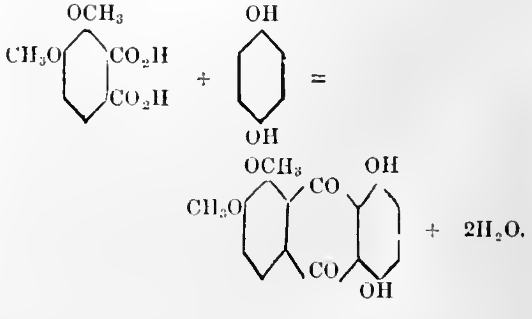
By heating *m*-oxybenzoic acid and gallic acid with concentrated H_2SO_4 to 150°, a variety of condensation products are formed. Of these rufigallic acid is the chief product and in smaller quantities two isomeric tetraoxyanthraquinones. The two latter may be separated by their different solubilities in benzene. The condensation of symmetrical dioxybenzoic acid and gallic acid yields a pentoxyanthraquinone, together with by-products formed by condensation of each acid with itself. By a method analogous to the above, the authors have prepared a series of homologues of the oxyanthraquinones by means of the homologous oxy-acids. Thus, for example, *m*-oxytoluylic acid and oxybenzoic acid yield dimethylanthrarufin $C_{14}H_4(CH_3)_2O_2(OH)_2$ and dimethylanthraflavinic acid isomeric with the former. In addition to these two a third isomeric dimethyl-*meta*-benzdioxyanthraquinone occurs in the product in small quantity. In the same way dimethylanthrachryson and methylanthragallol have been prepared from cresorsellinic and *o*-toluylic acids, and the latter also by condensation of gallic acid and toluylic acid, in which case four isomeric methylanthragallols are formed. Dimethylanthragallol is prepared from xylylic acid—

$$C_6H_3(CH_3)_2CO_2H\ [CH_3 : CH_3 : CO_2H = 1 : 3 : 4]$$

and gallic acid, and trimethylanthragallol from durylic acid and gallic acid.

The authors find that the solution of the oxyanthraquinones in concentrated H_2SO_4 give (absorption) spectra which are characteristic of the different isomeric bodies. Also the methyl homologues indicate by this means the oxyanthraquinone from which they are derived, giving almost identical spectra with the oxyanthraquinone. In this way they have been able to determine the constitution of chrysophanic acid, which is a derivative of chrysazin.

Hemipinic acid condenses with quinol (hydroquinone) to form the dimethyl ether of quinalizarin, according to the equation:—



On heating this compound with HCl, quinalizarin is obtained, which, according to its mode of formation, is a tetrahydroxyanthraquinone.

Similarly hemipinic acid combines with cresol to form the dimethylether of methylhydroxyalizarin.
—J. B. C.

VI.—DYEING, CALICO PRINTING. PAPER STAINING AND BLEACHING.

Improvements in the Mode of Producing Certain Colours on Cotton, Linen and other Textile Fabrics. L. Hamel, Manchester. Eng. Pat. 1775, June 22, 1870 (Second edition). 6d.

To reduce the cost of indigo dyeing, the cloth is first padded in a solution containing per gallon from 1 to 16ozs. of aniline salt and from one-eighth of an ounce to 4ozs. of chlorate of potash, according to the weight of the cloth and the depth of the shade required. After drying, the usual resist indigo colours (preferably with addition of a little resin paste) are printed on and the pieces are aged for two or more days at a temperature of about 80° F. The cloth is then dyed in indigo in the proportion of from 2 drachms to 2ozs. of indigo to the pound of cloth, according to the quality of the indigo, the pattern and the depth of shade required. In this way patterns in white, blue, green, orange, yellow, red and black on a blue ground are produced much cheaper than heretofore. (The use of chlorate of potash as described in the final, is not stated in the provisional specification.)—W. E. K.

Improvements in Dyeing and Printing Aniline Black. T. Holliday, Huddersfield. From W. J. S. Grawitz, Paris, France. Eng. Pat. 3073, August 3, 1878 (Second edition). 6d.

The invention relates to the development of aniline black on textile fibres by the action of chromic acid on a mixture of a chlorate and a salt of aniline; small quantities of chromic acid, one part to 10,000, or even 100,000 parts by weight of the aniline mixture being sufficient, larger quantities acting with increased rapidity. To prevent the black forming in the vessels in which the mixture is contained, the mixture of chlorate of potash and aniline salt may be rendered alkaline, preferably by ammonia, and the salt of chromic acid added at the time of use. For a printing colour

1000	parts of	water,
200	„	starch.
80	„	chlorate of potash,
130	„	hydrochloride of aniline,

are mixed and heated to 90° C., and when cold one-tenth of a part of chromate of potash or ammonia is added. After printing the goods are aged by warm damp air, by steaming or other suitable means. For dyeing purposes the larger portion or the whole of the starch is omitted. The process may be modified by applying to the fibre first the chromic acid or its salts and afterwards the mixture of chlorate and aniline salts. Any chromate can be used from which during the operation chromic acid is set free. The claim is "the improvements in dyeing and printing textile fibres aniline black by the action thereon of chromic acid in the presence of chloric or perchloric acid on aniline substantially as described."—W. E. K.

Improvements in Dyeing Fabrics and in Materials and Apparatus therefor. E. Boursier, Brussels, Belgium. Eng. Pat. 7740, May 27, 1887. 8d.

This invention relates (*a*) to the composition of the dye-bath and (*b*) to the arrangement of the apparatus used. It is specially applicable to the dyeing of silks, ribbons and velvets, preserving the fineness, suppleness and brilliancy of the fabrics, not only with new goods, but also in the case of old stocks that require to be re-dyed. The dye-bath, which is used cold, consists of oil of naphtha (petroleum naphtha), "benzine" or other hydrocarburetted liquid, to 100 parts of which are added 12 parts of a mordant containing 59·3 per cent. of margaric, oleic or stearic acid, 27·1 per cent. of pure alcohol and 13·6 per cent. of "volatile alkali." As tinctorial material, alcoholic solutions of the aniline colours are employed, with an addition of 5—10 per cent. of the above oil mordant. From 1—6 per cent. of this alcoholic solution is added to the hydrocarburet bath, according to the shade required. The dye vessel is cylindrical in shape and has a central shaft to which are attached movable discs, which can be fixed at any desired point on the shaft by means of screws. These discs carry arms radially arranged in the form of a regular polygon of which the shaft is a centre and provided throughout their length with small hooks on to which the fabric is hooked by its selvidge spirally around the shaft. With narrow ribbons it is necessary to fix one selvidge only, with wider goods the fabric is fixed by both selvidges to a pair of discs. The dye vessel has a close fitting cover, through which the upper end of the shaft passes and by means of a crank the goods are rotated within the dye vessel until the dyeing is completed. After dyeing, the shaft and the goods it carries is transferred to a second similar vessel, but with open ends, and is rotated at a speed of from 700 to 1200 revolutions per minute by a band and pulley attachment. The goods thus dried are subjected to a "fixing" operation, "essence of naphtha" alone or with a little acetic acid being used. After again drying as before, the goods are ready for the usual finishing processes.—W. E. K.

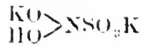
Improvements in Dyeing Yarn and other Fibrous Materials, and in Means or Apparatus employed therein. T. Sampson and F. H. Jealous, Lawrence, U.S.A. Eng. Pat. 12,358, Sept. 13, 1887. 8d.

The apparatus consists of an arrangement by which the yarn is dyed in stationary receptacles or dye vessels, through which the dyeing liquors are caused to circulate. For convenience of handling, the yarn is carried in bags, which are lowered into the cylindrically-shaped dye-vessels, and suitable flanged covers are provided, which so press upon the bags as to cause the liquors to pass uniformly through the whole mass of yarn. Three or more of these dye vessels are fixed in a vat, being sustained above the bottom of the vat by a partition plate, which also divides the vat into an upper and a lower chamber. There are openings at the bottom of the dye vessels and also in their covers, so that the communication between the upper and lower chambers of the vat is through the interior of the dye vessels themselves. The dye liquor is placed first in the upper chamber, from this pumped into the lower chamber and being forced through the interior of the dye vessels comes again into the upper chamber, this circulation of the dye liquor being continued until the dyeing process is completed. The lower chamber is supplied with upright stand pipes, through which the dye liquor passes and is conveyed to the upper chamber whenever the pressure in the lower compartment exceeds a certain maximum limit. At the bottom of the vat is a pipe, by means of which the dye liquor can be run off into a closed tank when the operation is over and through which also the dye can again be forced up into the vat when dyeing a fresh supply of yarn.—W. E. K.

VII.—ACIDS, ALKALIS AND SALTS.

Action of Sulphurous Acid on Nitrous Acid. F. Raschig. Annalen, **241**, 161—252.

The following series of salts have been prepared by Fremy and were subsequently studied by Claus. These have been further re-investigated by the author and a different formula assigned to them. If neutral solutions of KNO_2 and K_2SO_3 be mixed, crystals separate out which have the formula $N(SO_3K)_3 + 2H_2O$. This nitrilosulphonate of potassium on boiling decomposes, yielding potassium amidosulphonate NH_2SO_3K. If the nitrilosulphonate moistened with dilute H_2SO_4, be exposed for a day, washed with cold water and crystallised from dilute ammonia solution, the imidosulphonate is formed, $NH(SO_3K)_2$. The author has not isolated a corresponding sodium compound, for, on account of its ready solubility, it does not crystallise from solution; but if to the solution KCl solution be added a salt of the formula $N(SO_3K)_2.SO_3Na$ separates. Potassium hydroxylamine disulphonate is prepared by first obtaining the sodium compound and then adding KCl solution to this. Sodium nitrite, finely powdered, is dissolved in the least possible quantity of water, ice added, and sodium bisulphite solution in the proportion of two molecules to one of the nitrite allowed to run in and stirred, potassium chloride is added and the whole allowed to crystallise. It may be recrystallised from (a slightly alkaline) solution in hot water. The compound decomposes on standing into hydroxylamine monosulphonic acid, $HO.NH.SO_3H$, and potassium sulphate. This compound decomposes on boiling with water for some time, or more quickly in slightly (HCl) acid solution in sealed tubes, at 130°, into hydroxylamine. The disulphonate may be completely converted into hydroxylamine sulphate by boiling the strong aqueous solution with water, according to the equation $2HON(SO_3K)_2 + 4H_2O = (NH_3OH)_2SO_4 + 2K_2SO_4 + H_2SO_4$. Free hydroxylamine may also be obtained by adding to an acidified solution of the disulphonate an excess of alkali. In titrating an acid solution of hydroxylamine with permanganate, the author finds that more permanganate is used than corresponds to the oxidation to N_2O, according the equation $2HONH_2 + 2O = N_2O + 3H_2O$. This is due probably to the formation of hyponitrous acid, which splits up into N_2O and H_2O on the one hand, and is oxidised further to nitrous and nitric acid on the other. If the titration is done with hydroxylamine sulphate in the boiling solution, the reaction is very definite, and the amount of O required corresponds to the formation of NO. The titration may also be accomplished with ferric sulphate, which is deoxidised by the hydroxylamine. The amount of ferrous salt is then determined By acting upon a strongly alkaline solution of KNO_2 with SO_2 a compound of the formula—

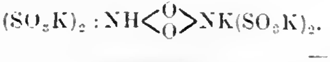


$$\begin{matrix} KO \\ HO \end{matrix}\!>NSO_3K$$

is obtained. If excess of alkali be added to this salt, potassium sulphite is formed. Potassium sulphazinate is formed by adding to a cooled alkaline solution of KNO_2 a solution of $KHSO_3$. This compound has the formula $KHN_2O_2(SO_3K)_2$. It decomposes on standing into hydroxylamine sulphonate of potassium and KNO_2. The author explains the formation of these compounds by the supposition that condensation occurs between potassium bisulphite with the unsymmetrical formula $H.SO_2.OK$ and nitrous acid, thus:—

$$(HO)_3 : N + H.SO_2.OK = (HO)_2 : N.SO_2.OK + H_2O.$$
$$(HO)_2 : N.SO_2.OK + H.SO_2.OK = HO.N : (SO_2.OK)_2 + H_2O$$
$$HO.N : (SO_2OK)_2 + H.SO_2.OK = N : (SO_2OK)_3 + H_2O.$$

Sulphazotinate of potassium is obtained in crystals by passing SO_2 into a strongly alkaline KNO_2 solution. It has the formula $K_5HN_2S_4O_{14} + H_2O$. It dissolves in strong potash solution, and on addition of alcohol a crystalline powder separates, having the formula $K_6N_2S_4O_{14} + H_2O$. This the author names basic potassium sulphazotinate. The faintly acid solution of the neutral salt yields on boiling aqueous hydroxylamine-sulphonate of potassium $KHN_2O_2(SO_3K)_4 + 2H_2O = 2HONHSO_3K + K_2SO_4 + KHSO_4$. With CO_2 a different reaction occurs, $KHN_2O_2(SO_3K)_4 + H_2O + CO_2 = 2HON(SO_3K)_2 + KHCO_3$. To sulphazotinic acid, the author, from the method of synthesis, gives the following formula:—



$$(SO_3K)_2 : NH\!<\!\begin{matrix} O \\ O \end{matrix}\!>\!NK(SO_3K)_2.$$

—J. B. C.

Improvements in the Manufacture of Fluoride of Aluminium and the Double Fluoride of Aluminium and an Alkali. L. Grabau, Hanover, Germany. Eng. Pat. 13.654, Oct. 25, 1886. 6d.

THIS invention relates to the preparation of fluorides and fluorine double compounds by the action of suitable quantities of an alkaline fluoride on a peculiar solution prepared from aluminium sulphate or alum. A solution of either of the latter two salts is mixed with pulverised fluor-spar and heated; the greater part of the alumina combines with fluorine, while gypsum is simultaneously formed. The remaining sulphuric acid is, however, no longer present as aluminium sulphate or alum, but in chemical combination with the aluminium fluoride, so that the solution can be designated an "aluminium fluorine sulphate solution." This is the peculiar solution mentioned previously. If this solution be mixed with as much of an alkaline fluoride as is equivalent to the sulphuric acid combined with alumina and lime, the mixture evaporated, heated and lixiviated with water, the residue consists of aluminium fluoride. To prepare the double fluorides, "aluminium fluorine sulphate solution" is mixed with as much fluoride of sodium or potassium as is necessary for converting all the aluminium into the double fluoride and the small quantity of dissolved gypsum into calcium fluoride. The whole mixture is then evaporated to dryness.—S. H.

Improvements in the Distillation of Ammoniacal and other Liquors, the Concentration of Liquids and Salts in Solutions, and in the Means or Apparatus employed therein. S. H. Croll, London. Eng. Pat. 15,391, Nov. 25, 1886. 8d.

IN concentrating ammoniacal or other liquors, the solutions flow into a series of superposed receiving vessels contained in a vertical still. The lowest receiver is provided with suitable means of drawing off its contents. Underneath the still a fireplace for smokeless fuel is arranged, the combustion gases of which are made to pass over the surface of the liquors. In the case of a liquid requiring its vapour to be treated for partial or complete absorption, the gases and vapours are drawn into a chamber or second vessel, where they are treated with the suitable reagent or passed through absorbent matter. If noxious gases are given off by the liquor, they may be burned in the fireplace. In other cases they may be sent directly into the chimney. If it be desired to force the vapours from the liquors below the surface of an absorbing agent in another chamber, an exhauster must be used.—S. H.

Improvements in Treating Solutions of Chloride of Calcium, so as to obtain Chloride of Magnesium and other Products. W. P. Cochrane and W. Bramley, Middlesbrough. Eng. Pat. 15,498, Nov. 27, 1886. 6d.

HYDRATED MAGNESIUM CARBONATE is charged into a series of closed vessels, whilst a solution of calcium chloride is run through the vessels, passing from one to the other, carbonic acid being at the same time injected into the mixture. Magnesium chloride is gradually formed in solution and calcium carbonate precipitated. The solution of magnesium chloride is treated for the manufacture of hydrochloric acid, chlorine and magnesia therefrom, while the precipitated calcium carbonate may be utilised for the decomposition of ammonium chloride. The hydrated magnesium carbonate requisite for this process is obtained by treating sodium bicarbonate with magnesia (Eng. Pat. 13,762, 1886).—S. H.

Improvements in the Manufacture of Sulphate of Soda and Bleach in one Operation under High Pressure, and in the Construction and Use of Apparatus for that Purpose. H. Burns, Leith. Eng. Pat. 15,488, Nov. 27, 1887. 8d.

SULPHUR or pyrites are burnt in a close blast retort, and the sulphurous acid given off led into a condenser and then into a closed vessel containing cold water, which absorbs the sulphurous acid. This solution is run into a close boiler and heated up to the boiling point, whereby all the sulphurous acid is again liberated. It is mixed with an additional amount of air and forced through sodium chloride contained in a retort and kept at a high temperature. The salt is decomposed, giving off hydrochloric acid which is led into a mixing condenser, to be mingled with double its quantity of air, the mixed gases being forced through a second decomposing

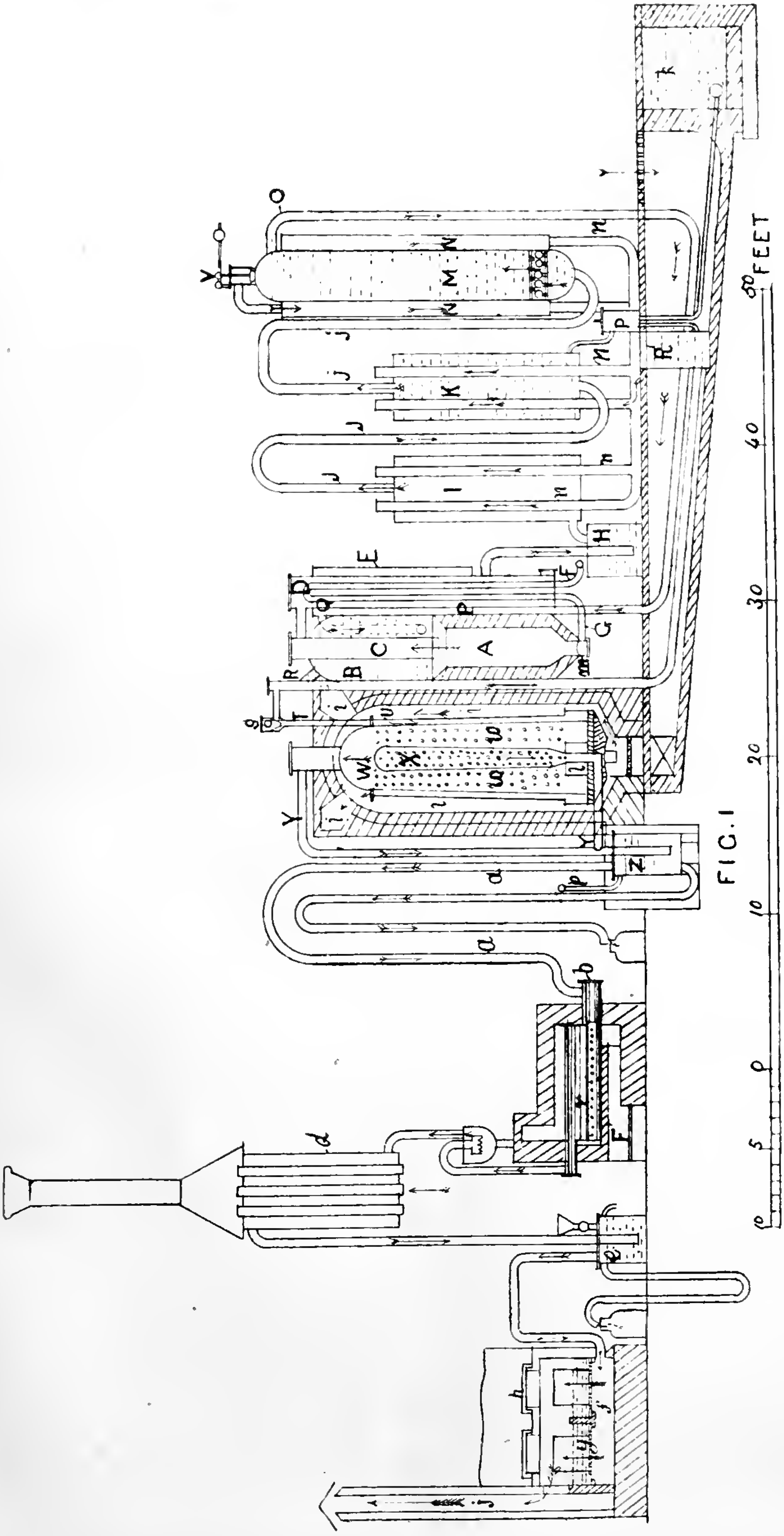

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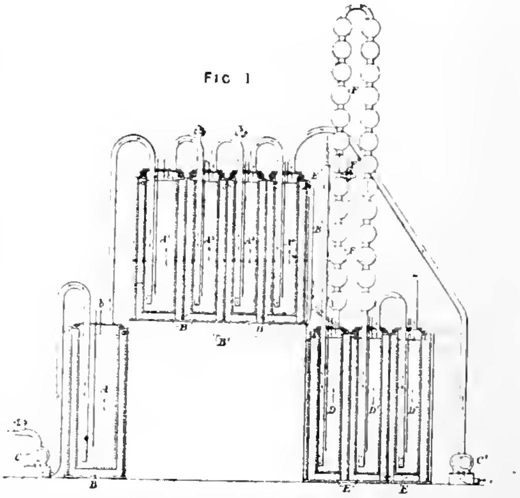
FIG. I

retort, filled with the peroxide of iron or manganese, and kept at a red heat. In passing through the oxide, the hydrochloric acid is decomposed into steam and chlorine. The escaping gases are cooled to condense the steam and, after washing, are dried by being forced through sulphuric acid. The dry chlorine is then led into a lime chamber, which is filled with a movable perforated floor and gas-tight doors. The perforated floor is covered with lime and the gas enters the chamber under the false floor and being forced through the lime is quickly absorbed. It is claimed that the sodium sulphate produced by this method is of superior quality, while the bleaching powder can be made stronger and at less cost than by any other process. Fig. 1 shows a vertical sectional elevation of a works for the manufacture of sodium sulphate and bleach at one operation. A is a vertical iron cylinder lined with fire bricks, having a boiler B set on the top of it. A is charged with pyrites through the central tube C, and a blast of air blown in through the pipe F G. The sulphurous acid passes up C and enters at the top of the condenser D and forces its way down into the bottom of the washing vessel H. The gas then enters the condenser I and passes by the pipe J into the bottom of the absorber K; in bubbling up through the water in K the greater portion of the gas is absorbed, while the remainder passes into a second absorber M, fitted with a cup and ball agitator, where the last traces of sulphurous acid are retained. The nitrogen and excess of air escape by the valve V and enter the annular space N; being here relieved of pressure, the gases rapidly expand, thereby keeping M cool. They then pass through the condensers by pipes n and escape into the air. The water charged with sulphurous acid enters the boiler at Q; here it is heated by the heat of the burning pyrites and gives off its sulphurous acid. The hot water overflows at R, while the gas passes by the pipe T into the annular space U, formed by the concentric iron cylinders W. In the centre of the latter a tapering pipe X is fixed, perforated with a number of small holes. The interior cylinder W is also perforated with small holes, through which the gas passes from the annular space U. These combined cylinders are set in a furnace, the fire gases of which surround the cylinders. The annular space W is filled with salt, and a blast of air being turned into S here mixes with steam and sulphurous acid from B. The mixture of the gases and vapours passes through into U, then by the perforations in the cylinder through the salt, which is rapidly decomposed. The hydrochloric acid gas escapes into the perforated tube X and thence into the condenser Z by the pipe Y. Through the pipe P air is forced into Z and the mixed gases pass by pipe a into the decomposing retort b, which is made of iron, with a perforated pipe r fitted into the bottom. Here the decomposition of the hydrochloric acid takes place and, after the escaping gases have been cooled, washed and dried by sulphuric acid, the chlorine is forced into the bleaching-powder chamber f.—S. H.

Improved Treatment of Hydrochloric Acid Gas for the Production of Chlorine Gas. W. Donald, Pembrey. Eng. Pat. 62, Jan. 3, 1887. 8d.

THE object of this invention is to obtain chlorine from hydrochloric acid and to recover the by-products formed during the process. Hydrochloric acid gas, dried by passing through a vessel charged with concentrated sulphuric acid, is passed into a vessel containing a mixture of strong nitric and sulphuric acids, where it undergoes decomposition according to the following equation: $2HCl + 2NO_3H = 2H_2O + N_2O_4 + Cl_2$. The sulphuric acid present absorbs the water formed by the reaction and thus prevents an unnecessary dilution of the nitric acid. The decomposing vessel ought to be kept at a temperature of 0° C., while the escaping gases should not be warmer than 30° C. These latter then travel through a series of vessels containing dilute nitric acid, whereby nearly the whole of the oxides of nitrogen become absorbed, while the last remaining traces are arrested by passing through a sulphuric acid scrubber. The apparatus employed is shown in Figs. 1 and 2. A, A^1, A^2, A^3, A^4 are a series of closed cylindrical stoneware vessels, each resting in a separate tank, through which a continuous flow of refrigerated brine is kept up. The gaseous hydrochloric acid is forced by means of a blower C into the drying vessel A. The dried gas then passes into the decomposer A^1, thence in succession through the absorbers A^2, A^3 and A^4, from which it is drawn off by a second blower C^1. D, D^1 and D^2 are vessels of similar construction as A and serve for converting the lower oxides of nitrogen collected in A^2 and A^3 into nitric acid. Each vessel rests in a separate tank E. The vessel D is heated by hot water from the outside, whereas D and D^2 are cooled by refrigerated brine. The liquor from A^2 and A^3 is run into D, where it is heated while a slow current of air is passed through, the lower oxides of nitrogen being thus oxidised into nitric acid. From D the air passes through a tower F, carrying with it free oxides of nitrogen which during their progress undergo further oxidation, the necessary water being supplied to the tower. The condensed gases flow back into D, while those uncondensed pass into D , which is charged with nitric acid, and are ultimately scrubbed in D^2 with sulphuric acid. The oxidation of the gases is also assisted by compounds rich in oxygen, such as manganese peroxide, manganese nitrate, and so forth. The recovered acids are again used for the process.—S. H.

FIG 1



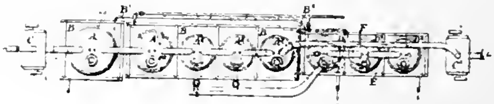


FIG 2

Improvements in the Production of Sulphide of Zinc and Chloride of Ammonium. H. Kenyon, Manchester. Eng. Pat. 16,118, Dec. 9, 1886. 6d.

IN the galvanising of iron, zinc waste is obtained containing zinc, iron, lead, manganese, chlorine and ammonia. It is dissolved in hydrochloric acid and the lead precipitated from the solution by the addition of sulphuric acid. The precipitate is filtered and the filtrate treated with ammonia, agitating well in order to oxidise iron and manganese. Sulphuretted hydrogen is then passed into the clear solution, until all the zinc is precipitated as sulphide, while the ammonia is converted into ammonium sulphide. The former is separated by filtration and the solution of ammonium sulphide treated with an equivalent quantity of zinc chloride, to obtain a precipitate of zinc sulphide and ammonium chloride.
—S. H.

X.—METALLURGY, Etc.

Composition of the Refined Lead from Przibram. Dingl. Polyt. J. **264**, 463.

The analyses of the refined lead from Przibram for the successive quarters of the year 1886 gave the following results:—

	I.	II.	III.	IV.
Silver	0·0019	0·0019	0·0017	0·0016
Copper	0·0021	0·0018	0·0020	0·0031
Bismuth	0·0024	0·0021	0·0023	0·0020
Antimony	0·0027	0·0024	0·0021	0·0026
Iron	0·0012	0·0016	0·0014	0·0013
Zinc	0·0010	0·0010	0·0009	0·0008
Nickel	trace	trace	trace	trace
Lead (residue)	99·9887	99·9892	99·9896	99·9885

—G. H. M.

Improvements in Extracting Gold, Silver and other Metals from Ores or Compounds containing the Same. A. Parkes, London. Eng. Pat. 13,073, Oct. 13, 1886. 6d.

The crushed ore is mixed in a reverberatory furnace with caustic lime and soda, the approximate proportion by weight of three parts of caustic lime to one part of caustic soda, and with carbonaceous matter; if reducible compounds of lead or copper are not present in the ore they should also be added. On fusion a metallic bath, containing practically the whole of the precious metals, will be produced, from which the latter may be subsequently recovered. Sulphur ores should not be roasted first; they may be worked as above or may be made to give an auriferous and argentiferous regulus which may then be treated; the use of the soda-lime flux is found to cause a rapid disintegration of the regulus, especially if it be sprinkled when hot with cold water. The peculiarities of any given ore may require a modification of the fluxes; thus, the addition of oxide of iron, barium carbonate, fluor spar or cryolite may frequently be desirable. A cupola may sometimes be substituted for the reverberatory furnace, in which case the ore will not be fine-crushed.—W. G. M.

Improvements in the Humid Reduction of Gold and other Ores. J. E. Baugh and C. Hinksman, London. Eng. Pat. 13,928, Oct. 30, 1886. 6d.

If the ore should be free from copper a small proportion of copper pyrites should be mixed with it. Otherwise, or after this addition, it is chlorinated in the furnace described in Eng. Pat. 11,766 of 1886. A chemical test is then made to prove the complete solubility of the gold, so that a further chlorination with free chlorine may, if necessary, remedy any defect in this respect. The charge is then leached with boiling brine, and the gold, silver and copper in the solution are precipitated simultaneously by means of iron or zinc. A more complete extraction of the precious metal than by previous processes is thus effected, especially in the case of low grade or pyritous ores. The chlorine is preferably to be obtained by treating chloride of lime with sulphuric or sulphurous acid, these substances, if desirable, being by-products of the process.

—W. G. M.

An Improved Method of Smelting and Recovering Metals from Ores and Dross. J. Nicholas, Ilford. Eng. Pat. 14,297, Nov. 5, 1886. 8d.

The matter to be treated may contain either gold, silver or tin; it is first heated, preferably to a red heat in a reverberatory furnace, and immediately plunged into a cold saturated or very strong solution of any alkali or chloride. It is thus disintegrated, may be fine-crushed with ease and the chemical effect will render the subsequent reduction more satisfactory. When dealing with tin compounds a furnace of special construction is recommended. It is so arranged that by the regulation of dampers the flame from the grate either plays over the bed as in an ordinary reverberatory, or is diverted into a flue beneath the bed as in a kind of muffle furnace. Thus, the access of oxygen to the charge is under perfect control.—W. G. M.

Improvements in Machinery for Coating Metallic Sheets or Plates with other Metals or Alloys. H. A. Stuart, Bletchley, and C. R. Binney, London. Eng. Pat. 15,320, Nov. 24, 1886. 8d.

This patent relates to tin and terne plating. The grease pot is arranged to give the smallest possible contact with the tin bath and is surrounded by a hot-air chamber, by which the temperature is kept under control. By an arrangement of conical rollers each plate on entering the bath is delivered at an angle with that last introduced, and driven forward within guides, which are adjustable for various sizes of plate, and thence through scrapers having a lateral motion to the finishing rolls. The motion is transmitted to the rolls by worm gearing, which imparts a more even rotation and gives, therefore, a more perfect surface on the plate than was possible with spur gearing.—W. G. M.

Improvements in the Process of Obtaining Alloys of Aluminium with certain other Metals. J. Clark, Birmingham. Eng. Pat. 15,946, Dec. 6, 1886. 6d.

Hydrated aluminium chloride is mixed with lime, iron, zinc, ammonia, or other substance which readily combines with chlorine, and with finely divided coke. After drying, this mixture is to be introduced into the (iron) blast-furnace, added to the cementation charge or blown through the metal in the Bessemer converter, with the object of producing an alloy of iron and aluminium, or of aluminium with spiegeleisen or other iron alloys.—W. G. M.

Improvements in and in Apparatus for Cleaning or Pickling Metals and in Utilising the Liquids that have been employed therefor. E. Vlasto, Paris, France. Eng. Pat. 16,923, Dec. 24, 1886. 8d.

All the operations of pickling and washing are conducted in the same vessel. A series of reservoirs is arranged, one containing the acid, the others the different wash waters. A pipe from each reservoir runs over the pickling tub and supplies the required liquid through a branch provided with a cock. After sufficient time has elapsed, the liquid is raised by an injector, or by pumps, into a channel through which it returns to the original tank. Several pickling vessels may be arranged side by side, in which case each reservoir will be placed in direct communication with every tub. When the wash waters become too highly charged with impurities, the first washings are set aside for extraction and replaced by the liquid previously used for the second washing, the second by the third and so on. When sufficiently saturated, the valuable metals contained are recovered *e.g.*, the copper from brass pickling by the addition of zinc, zinc oxide or carbonate, which precipitate copper, copper oxide or carbonate respectively.

—W. G. M.

A New or Improved Method of Extracting Tin from Iron in Tin Scraps and in Apparatus therefor. R. H. W. Biggs, London. Eng. Pat. 4584, March 28, 1887. 8d.

Hydrochloric acid at a temperature of 190—212° F. and a strength equivalent to 17° B., is introduced from an overhead cistern, with or without further dilution, into a revolving asphalte-lined metal cylinder, where it attacks the tin scraps. When these have been sufficiently stripped, the liquid is run into a tank beneath; the washings which are next obtained are then run into a series of tanks in which they are cooled to ensure the separation of any lead that may be present. Afterwards the tin is to be obtained by adding zinc or nitric acid and the sponge compressed and melted. Instead of rotators, tubs with revolving beaters, or other arrangements, may be employed.—W. G. M.

Improvements relating to the Production of Sodium and Potassium and to Apparatus therefor. O. M. Thowless, London. Eng. Pat. 12,486, Sept. 14, 1887. 8d.

To avoid the formation of compounds which, in the ordinary process of manufacturing sodium and potassium, tend to lessen the yield of metal, the caustic soda or other compound, itself heated, is introduced into previously heated carbonaceous matter. This is effected by setting the vertical retort containing the coke in a furnace, the flue of which passes beneath and thus warms a side chamber leading into the retort. This chamber is provided with a door for the introduction of the soda compound and with a sliding grating between it and the retort to regulate the supply of soda to the latter. On the opposite side of the retort is a covered hopper or chute for the admission of coke. Above all is a pipe leading to a condenser of the usual description. Beneath the retort is a door for the removal of ashes and for the purpose of cleansing.—W. G. M.

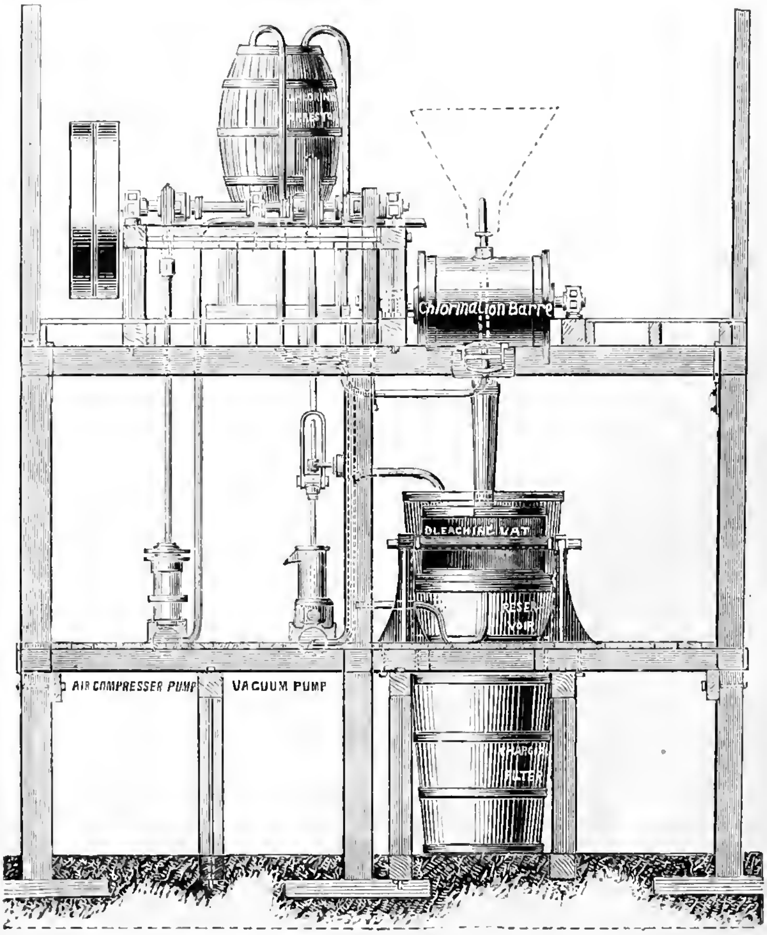
The Newbery-Vautin Chlorination Process. Engineering, **44**, 354—356.

This process, which is said to be in successful operation in Queensland as well as other places, for the extraction of gold, is based upon the fact that over 90 per cent. of the gold in roasted and crushed gold quartz is converted by the action of chlorine into soluble gold chloride, which may be removed by washing on a suitable filter, and that gold chloride on passing slowly through a charcoal filter suffers decomposition, the metal being left in the charcoal. When the latter is fully charged, it is burnt, and the ashes are fused with borax in a crucible, and a button or nugget obtained.

In the old styles of chlorination treatment, the time varied from 36 to 90 hours; now this is accomplished in from 3 to 6 hours. In the new process the chlorine is reduced to the liquid state under a pressure of 4 atmospheres, and the pressure applied not only makes it possible to obtain a strong solution of chlorine with the water in the revolving barrel, containing also the roasted and pulverised ore, but forces that solution into contact with the gold through every pore and crevice of the ore.

Should copper be present with the gold, the aqueous solution, after running through the charcoal filter, is brought into contact with scrap iron, by which any copper is precipitated. Silver will be found as chloride amongst the tailings on the filter, and it is proposed to remove it by washing with alkaline thiosulphate (hyposulphite).

Dry crushing is strongly recommended for treating the whole body of ore from a mine, and for this a stone-breaker should be used that will reduce the pieces to about ¾in. cubes if necessary. For subsequent crushing, Kroms rolls have proved very satisfactory. They will crush with considerable evenness to a 30 mesh, which is generally sufficient. The crushings are then roasted in the ordinary way in a reverberatory furnace, and the whole of the roastings are chlorinated as described. It is claimed that over 90 per cent. of the gold can be extracted at much the same cost as demanded by processes in general use, which, however, only extract some 50 per cent.



Referring to the cut, the crushed ore is put in the hopper above the chlorinating barrel, which revolves. The latter is made of iron, lined with wood and lead, and will stand a pressure of 100lb. on the square inch, and its capacity is equal to the reception of 30cwt. of ore. The charge falls from the hopper into the chlorinator, water, chloride of lime and sulphuric acid are added, and the manhole lid is fastened down. On the side of the barrel is a valve connected with an air-pump, through which air to the pressure of 4 atmospheres is pumped to liquefy the chlorine generated, after which the valve is screwed down. The barrel is revolved from one to four hours at the rate of ten turns per minute. The chlorinator is then stopped and the gas and compressed air is allowed to escape from the valve through lime-water, to prevent pollution of the air and to recover the chlorine. A glance at the figure will make the foregoing explanation clearer.—W. S.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

Loss of Nitrogen in the Manufacture of Bone-fat and the Analysis of Bone-fat. H. Bornträger. Rep. Anal. Chem. **7**, 694.

BONES, after being crushed, are extracted with petroleum spirit under a pressure of two atmospheres in order to remove the fat. After distilling off the petroleum spirit it was found that the water originally contained in the bones passed over and that this contained on an average 0·64 per cent. of ammonia. The residual fat contains 92·2 per cent. of fat (good bone-fat should contain 95—96 per cent.) and 2·8 per cent. of ash, which consists of calcium carbonate and phosphate.—C. A. K.

A New Oil Plant. L. Richter. Landwirthsch. Versuchs. Stat. **33**, 455.

THE seeds of *Lallemantia iberica*, a plant belonging to the Labiatæ and found in the Taurus and Caucasus, contains 33·52 per cent. of fat, which has a specific gravity of 0·9336 at 20—21° and solidifies between 34 and 35°.
—C. A. K.

Vegetable Fats. H. Jacobson. Chem. Zeit. Rep. **11**, 218.

THE fats of the bean, vetch, pea and lupine contain considerable quantities of phosphorus by means of which the amount of the lecithin in them may be quantitatively determined. Bean-fat contains 19·27 per cent., vetch-fat 20·83 per cent., pea-fat 50·25 per cent. and lupine-fat 58·00 per cent. of lecithin respectively. The presence of lecithin in these fats can be further shown by the isolation of its decomposition product cholin. After saponification with caustic soda and extraction with ether, all the above fats yield cholesterin together with amorphous substances. The cholesterin thus obtained differs from that of animal origin in many of its properties, especially in its melting point. Pea-fat and lupine-fat contain small quantities of ceryl alcohol. The solid fatty acids of the above four fats consist mainly of palmitic acid and contain also other acids of higher melting point than stearic acid.—C. A. K.

Oxidation Products of Palmitic Acid. M. Gröger. Monatsh. Chem. **8**, 484—497.

THE oxidation of palmitic acid in alkaline solution gives rise to:—1. *Acids of the oxalic series:* Oxalic, succinic and adipic acids. 2. *Volatile fatty acids:* Acetic, butyric, caproic and caprylic acids. 3. *Oxy-fatty acids:* Oxyvaleric and dioxypalmitic acids. The more dilute the permanganate solution employed the higher the carbon value of the acids obtained.
—A. G. G.

An Improved Lubricating Composition. F. T. Archer, G. W. Hardy and F. J. Archer, London. Eng. Pat. 14,835, Nov. 16, 1886. 4d.

CAREFULLY-RENDERED tallow, Russian mineral oil, black antimony and gum camphor are mixed together warm and stirred while cooling.—W. L. C.

Improvements in the Manufacture of Lubricating Grease. W. Hicks. Eng. Pat. 1893, Feb. 7, 1887. 4d.

FIBROUS material of any kind, torn into shreds, is mixed with melted tallow, fat or grease.—W. L. C.

Improvements in Apparatus for Treating or Purifying Paraffin Wax. R. Tervet, Musselburgh. Eng. Pat. 4, Jan. 1, 1887. 11d.

THE novelty consists in the use of a series of narrow vertical "cells" or casings with "permeable sides," placed in a suitable heating chamber and arranged so that the heat may act on all sides. Metal moulds are fixed above the cells for receiving the paraffin wax in a melted condition and moulding it into suitable forms for being dropped into the cells. Bars with inclined sides are inserted between the cells and moulds, for closing the latter whilst the melted paraffin is being poured into them. The inventor also describes the construction and arrangement of the closing slides and accessory parts of the mould, as well as the slides for closing the cells and combining them with the other parts. The specification contains three sheets of drawings.
—D. B.

XII.—PAINTS, PIGMENTS, VARNISHES AND RESINS.

Improvements in the Manufacture of White Lead and other Lead Salts, and Apparatus employed therein, Parts of which are applicable to other Materials. J. C. Martin, Richmond. Eng. Pat. 1054, March 18, 1879 (Second edition). 8d.

THE specification describes improvements on Eng. Pat. 1300, April 4, 1877. The solutions of lead are made by dissolving in acetic, nitrous or other suitable acid small flakes or splashes of lead prepared by running the molten metal in thin streams upon a moving or stationary surface, such as that of an iron disc cylinder or cone, which is kept cool and wetted by jets of water or by occasional immersion in water. The second part of the invention consists in mixing hydrated lead oxide or lead suboxide with carbonate of lead to impart to the latter greater density and thus improve its quality for painting purposes. The mixing takes place when the materials are wet and the whole is ground up when dry, with or without the addition of more of the lead oxides, by means of apparatus which is fully described, with drawings, in the specification.—E. E. B.

A Process of Producing on Paper, Textile Fabrics, Wood, Leather, Skins and other light Materials a Transparent Waterproof Coating. F. H. Froedman, Dublin. Eng. Pat. 885, Jan. 20, 1887. 4d.

THE material is coated with a mixture of glue, gelatine or other colloidal substance, and either the bichromate of potash or of ammonia, dried and exposed to light to render the compound insoluble. The material is then placed in a bath of sulphurous acid, which renders the waterproofing compound transparent and almost colourless. The process of rendering gelatine insoluble by means of chromium salts is not claimed, but only the use of the sulphurous acid in connection with it.—E. E. B.

Improvements in Paints and Paint Compounds. H. J. Allison, London. From G. W. Banker, Brooklyn, U.S.A. Eng. Pat. 12,031, Sept. 6, 1887. 6d.

THE use of the oil extracted from the seed of Indian corn is claimed as a substitute for linseed or other oils now used for the manufacture of paints. The "corn" oil being one of the semi-drying oils, it is usually desirable to add a drier to it.—E. E. B.

Improvements in Waterproof Compositions or Paints. J. C. Lyman, London. From J. H. Lyman, Hadley, U.S.A. Eng. Pat. 12,632, Sept. 17, 1887. 4d.

THE compound is prepared by boiling "facticious or artificial maltha" (the solid residue which remains after the distillation of petroleum) with "benzine," and adding, in special cases, oil and turpentine, also some pigment such as Venetian red if a coloured product be desired. If the paint is liable to be subjected to a great heat, some non-combustible substance, such as asbestos, must be incorporated with it.—E. E. B.

Improvements in the Process or Method and Means for Rendering Fabrics and other Articles Water-repellant. Clara B. Warner, London. Eng. Pat. 13,593, Oct. 7, 1887. 4d.

THE solution is prepared by dissolving indiarubber in pentane and "benzine" in equal parts, and adding pentane or heptane. The articles are dipped into this solution, after it has been clarified by standing for a few days and by occasionally passing hydrobromic acid gas through, then drained in a chamber where evaporation is impossible, the solvent expelled by a current of steam or hot gases and the articles finally dried in the "finishing chamber," preferably by means of a current of hot air. Not only is the above process claimed, but also the use of wire gauze or bundles of wire in the pipes leading to and from the evaporation chamber, to prevent the possibility of an explosion in it; and, further, the use in the evaporation chamber of steam or gas from which the soluble solvent can be recovered by condensation.
—E. E. B.

XIV.—AGRICULTURE, MANURES, Etc.

Experiments with Manures on Summer Cereals. G. Andrae. Sächsische landw. Zeit. 1885, 791.

IN these experiments, Chili saltpetre, potash salts, and soluble phosphate were tried separately and mixed together:—(1) For barley, after potatoes lightly manured with dung, on a soil of medium quality; (2) for oats after similar crop and manuring, on soil 16 years in cultivation; (3) for oats after sugar beet on old cultivated land. The season was unfavourable. Only the Chili saltpetre, used by itself or mixed, yielded a profit.—D. A. L.

Destruction of the Ammonia Ferment. A. Ladureau. Annales Agronomiques, 1885, 522—525.

WITH the object of preventing the loss of nitrogen, as ammonia, from manure heaps, experiments were tried to arrest ammoniacal fermentation in solutions of urea by the addition of free phosphoric acid, superphosphate, lime, ferrous sulphate, phenol, sulphuric acid, boric acid, hydrochloric acid and ferrous chloride, but without success. Therefore the addition of magnesium salts is suggested, to fix the ammonia in the manure as ammonium magnesium phosphate.—D. A. L.

Field Experiments with Different Phosphates. Kremp. Braunschweig. landw. Zeit. **55**, 105—107.

THESE experiments were conducted with oats on a moderate loamy soil, containing 1·90 per cent. of humous matter, poor in lime and moderately porous. Superphosphate, bone manure and Thomas slag were tried separately and in conjunction with Chili saltpetre; the phosphates were without effect, but the nitrate produced a good increase in yield. Probably the soil had sufficient phosphoric acid in it beforehand.—D. A. L.

Effect of Lithium Salts on Vegetation. J. Gaunersdorfer. Landw. Vers. Stat. 1887, 171—206.

NUMEROUS investigators have worked on this subject and have come to different conclusions as to the effect of lithium on vegetable life. Focke found lithium a constant constituent of many plants and concluded that it was normal to some plants and accidental in some others when they were grown on a soil containing lithium. The author has made numerous investigations in this direction and found that lithium is always present in some plants (all varieties of Cirsium), but that these plants will develope quite normally without it, hence he concludes that it is not necessary to the existence of these plants and therefore is simply accidental although an almost constant constituent of such plants. Lithium is one of those substances which can act injuriously on vegetation; it checks development and causes pathological changes in the organs and to most plants even minute quantities are poisonous, the leaves becoming speckled with dried-up spots; and even those plants in which its presence is natural are affected in a similar manner sooner or later; this was proved by experiments with lithium sulphate on *Cicer arietinum.* When lithium is present in a plant not a trace is detected in young leaves, buds or organs of reproduction, as they are wanting in hardened portions, and only mere indications of it are observed in leaf-stalks, stems and roots; but it is found accumulated in the hardened woody fibres of fully grown leaves. Consequently by these leaves falling off, this objectionable metal is gradually removed both from the plant and soil; even plants which do not generally contain lithium can withstand a little in the soil, which, however, ultimately gets removed through the leaves. It is shown that lithium is carried upwards by the transpiration currents, but it can also move transversely through the hardened cell walls. In experiments with lithium sulphate on plants in the ground, it was found that merely watering with the solution was not sufficient to test the effect, since the lithium was retained in the upper layers of soil and was only gradually brought within root-range by subsequent watering with water.—D. A. L.

The Wild Potato of Paraguay. F. Nobbe. Landwirthschaftl. Vers. Stat. **33**, 447.

THE author finds that the composition of the tubers does not differ materially from that of ordinary potatoes.
—C. A. K.

Free Phosphoric Acid and Superphosphate. M. Weilandt. Landw. Versuchsstat, **34**, 207—215.

THE author has continued Ritthausen's experiments on this subject (*Ibid.* **20**, 401) and finds when dilute phosphoric acid acts on precipitated barium, calcium and strontium carbonates, more or less of the sparingly soluble dibasic salts are formed in accordance with the concentration of the acid solution and duration of the reaction. The salts produced are amorphous except when concentrated solutions of the acid are used. When a current of carbonic anhydride is allowed to act simultaneously with the phosphoric acid the amount of sparingly soluble salt formed is increased. Solutions of superphosphate act very energetically on marls and with less vigour on the crystalline forms of calcium carbonate, much of the phosphoric acid becoming sparingly soluble during the reaction.—D. A. L.

Experiments to decide whether Nitrates are essential for the Cultivation of Cereals. O. Pitsch and L. Campagne. Land. Versuchsstat, **34**, 241.

THIS is a continuation of former investigations and confirms the previous results. Cereals can develop completely and assimilate large quantities of organic substances and proteïn, when cultivated in ground which during their period of growth is quite free from nitric acid. The absence of nitric acid from the soil appears to hinder the growth of the portions of the plants above ground after they begin to shoot, for a time, but then they continue to grow readily and in a normal way. The root net-work was found to be exceptionally strong and extensive in the case of soil manured with nitric acid; more so than when manured with ammonium salts.—C. A. K.

Estimation of Ammonia Nitrogen in Soil and the Amount of Assimilable Nitrogen in Uncultivated Soil. A. Baumann. Landw. Versuchsstat, 1886, 247—303.

THE author, recognising the unsatisfactory nature of the methods of estimating ammonia in soils, has made a great number of experiments with the more usual methods.

Schlocsing's Method.—In the cold soda produces a continuous evolution of ammonia with humus soils. The amount of ammonia obtained from several samples of the same soil is almost exactly the same when the conditions of experiments are similar; hence with two samples of the same soil the results by this method agree whether the soda is in contact with both samples for 48 hours or for a week. It is evident that this method is not suitable for the estimation of ammonia in soils rich in humus: at any rate if employed at all, it is quite inadmissible to allow the soda to act more than 48 hours. When humus soils, after boiling with magnesia water, are treated with soda they yield considerable quantities of ammonia within 48 hours; soils free from humus do not behave in this manner. *Boussingault's method* the author finds is accurate, but the ammonia in the hydrochloric acid extract of the soil must be estimated azotometrically and not by titration. *Knop's azotometric method* is quite useless for soil analysis, inasmuch as the humus in the soil causes a contraction in the volume of gas produced and the greater the quantity of humus the greater this contraction becomes; even the addition of borax does not make the method usable. The author has therefore adopted the following method:—200grms. of soil are mixed with 100cc. of dilute ammonia-free hydrochloric acid (1:4). if the reaction is strongly acid 300cc. of distilled water free from ammonia are added, and the whole allowed to remain for two hours with frequent agitation; after filtering 200cc. of the filtrate (corresponding to 100grms. of soil) is transferred to the azotometer, about 5grms. of freshly ignited magnesia usta added and a current of ozonised air aspirated through the liquid, with frequent shaking, for ten minutes. The azotometric determination then proceeds in the ordinary way. The ozonising destroys the humus matter which would otherwise vitiate the results in the manner already noted above. Numerous ammonia determinations were done by this method. The amount of ammonia present in uncultivated arable soils varies with the character of the soil. Loamy soils are richest and those containing most clay also have the largest quantities of ammonia; chalky and sandy soils are poor in ammonia; but sandy soils rich in humus contain organic matter which is readily decomposed by soda in the cold, with evolution of ammonia. Such substances play a much more important part in vegetable nutrition than has hitherto been supposed when judging a soil; the amount of organic matter (vegetable) has, however, no influence whatever on the actual amount of ammonia in soil. The amount of ammonia-nitrogen in the most varied soils fluctuates between 0·004427grm. and 0·02894grm. per kilo. of soil. The amount of ammonia in an untilled and unmanured soil, judging from those kinds examined, appears to be a constant quantity and is scarcely altered by season or weather; it does, however, decrease with the depth. the ammonia being retained by the upper layers. Thus, from a depth of 1 to 25 centimetres the amount of ammonia is nearly uniform, from 40 to 45 centimetres there is a marked falling off, whilst at about 80 centimetres down only traces of ammonia are present.

Nitric Acid in Uncultivated and Unmanured Soils and Forest Soil:—The watery extracts were tested qualitatively with brucine and diphenylamine and when nitric acid was present it was estimated by the indigo method. Examination of numerous soils leads to the conclusion that uncultivated and unmanured soils contain an exceedingly small quantity of nitrates, more especially forest soils, which have frequently none at all or at the most only traces. Tests were made to a depth of 30 centimetres. The absence of nitric acid is attributed to low temperatures, dryness of the soils and condition of the nutritive matter being unfavourable for the development of nitrifying organism. Drainage experiments were made to illustrate how very small the nitrifying power is in soils free from animal matter and containing only small quantities of vegetable residues. Details are given showing the progress of these experiments; in course of the year the following amounts of nitric acid were obtained by draining the soils to a depth of 1·20 metres:—

Kind of Soil.	Nitrogen as Nitric Acid in Kilos. per Hectare.
Sandy soil	25·59
Loamy soil	20·90
Chalky soil (poor in humus)	50·24
Moor land (rich in humus)	4·17

In no case was either ammonia or nitrous acid detected in the waters.

At Rothamsted, a heavy, loamy soil, both unmanured and uncropped, has yielded in drainage water the following average quantities of nitrogen as nitric acid per annum, for eight years. Drainage from a depth of 40 inches (about 1 metre) 34·94lb. per acre (about 39·13kilos. per hectare); from 60 inches 38·90lb. per acre (about 43·57kilos. per hectare).

It is pointed out that the nitric acid produced in unmanured and uncultivated soil is not sufficient for the nitrogen requirements of forest trees, hence they must obtain their supplies of this element from some other source, either ammonia or possibly the easily decomposable nitrogenous organic substances referred to above. The fertile black soils of Russia, for example, contain large quantities of such organic substances, but frequently only traces of ammonia and nitric acid. When soil is boiled in hydrochloric acid the amount of ammonia obtained is 10 or 20 times the actual amount of ammonia in the soil and is derived from substances in the soil which doubtless bear a great resemblance to amides.
—D. A. L.

Field Experiments. J. Vollmer. Bied. Centr. **16**, 530—532.

The author's numerous experiments point to the fact that it is useless and wasteful to use manures in excessive quantities. In comparative experiments with different phosphates on sugar beet, Thomas-slag, amongst other phosphates, proved of value in a heavy loamy soil.
—D. A. L.

Changes in Composition associated with the Development of Bacteria in Drinking Water. T. Leone. Atti della R. Accademia dei Lincei, 1887, 37.

The author, like many other investigators, has observed that during the development of bacteria in drinking water, the organic matter decreases with the simultaneous formation of ammonia, but as the organic matter continues to diminish, the ammonia changes to nitrites and ultimately to nitrates. It is asserted that many kinds of micro-organisms are capable of producing these effects and the results are obtained either in open or closed vessels and with many kinds of bacteria mixed together, or with one kind by itself. With regard to denitrification—the addition of nutritive gelatin to a solution in active nitrification stops that process, and even the nitrates already formed are reduced; but, provided no more gelatin is added, in a few days (when the organic matter is decomposed) nitrification re-commences—the author infers that the same organisms are either denitrifying or nitrifying according to circumstances. He has confirmed this statement by numerous experiments with all necessary precautions in sterilised waters and with carefully cultivated and isolated bacteria. Although this would appear to attribute a double function to these organisms, it is pointed out that such is not the case, but that their function is one of oxidation throughout.—D. A. L.

An Improved Process of Making Manure. J. Roxburgh, Melbourne. Eng. Pat. 10,060, July 18, 1887. 4d.

Layers of sea weed, blood and slaughterhouse offal, cut-up carcases of horses, etc., night-soil and urine are placed in the order named in a vat and treated with sulphuric acid. When the action has ceased, the mass is turned over and sprinkled with lignite dust or "Hunter's deodorising disinfectant." The semi-liquid mass is removed to an asphalted shed and arranged in layers of two feet with stable manure in alternate layers of three inches. The heap is allowed to ferment for two or three months, then broken down and the large bones removed, bone dust added, in the proportion of 2cwt. per ton, and the drainage liquor sprinkled over the whole. It is again allowed to ferment for four or six weeks, then broken down and mixed with a further quantity of bone dust, preferably dissolved, and gypsum equal to 5 per cent. of the mass. In two or three weeks the composition is ready for use.—J. M. H. M.

Manurial Experiments with different Phosphates. W. Roberts. Journ. d'Agricult. Pratiq. 1885, 877—880.

Experiments were made with the same quantity of phosphoric acid in different forms on wheat, potatoes, roots and buckwheat. The results show the superiority of superphosphate and the comparatively small value of reverted phosphate. Taking two cases of wheat for example, the profit over the unmanured in francs per hectare was as follows: in the first case the grain only is considered; in the second the straw is allowed for as well:—

Form of Phosphoric Acid.	Profit.	
Superphosphate	11·00	153·20
Phosphorite (Ardennes)	21·05	52·80
Precipitated phosphate	—	49·60
Reverted	7·55	26·65

—D. A. L.

Composition of Cereals in relation to the Soil. A. Atterberg. Landw. Jahrb. **16**, 757.

The author finds as a result of his experiments that the quantity of mineral constituents in the plants increases proportionately with the quantity of mineral matter in the manure, while the rate of increase of the other nutritive substances remains quite regular. Further, that when the quantity of any one source of food at the disposal of the plant decreases, less of it is taken up and assimilated. If the result of this is a poor crop, the nutritive substances, other than that the supply of which has been decreased, will have increased proportionately and will be taken up in greater quantity by the plants. —C. A. K.

The Phosphatic Deposits of Santa Maria di Leuca in Southern Italy. K. Walther. Chem. Zeit. **11**, 1157.

Coprolites and remains of bones, which contain 35 per cent. of calcium phosphate, form 50 per cent. of the total mass of these deposits. There are two beds of the phosphatic material, which cover an area of 95,000 square yards, representing a deposit of at least 2,960,000 cubic feet. (See also this Journ. 1887, 668.)—C. A. K.

Obtaining Manure from Distillers' Spent Wash. W. S. Squire, London. Eng. Pat. 12,772, Oct. 7, 1886. 4d.

The wash is run into tanks, the suspended matter allowed to subside, the clear liquor run off and neutralised by milk of lime. The precipitate thus produced, rich in nitrogen and phosphates, is filter-pressed, dried and sold as manure.—J. M. H. M.

XV.—SUGAR, GUMS, STARCHES, Etc.

The Use of Poisonous Substances in the Manufacture of Sugar. C. Scheibler. Chem. Zeit. **11**, 1263—1264.

This is a paper on the question of the danger in the employment of barium compounds in the manufacture of sugar (compare *Chem. Zeit.* **11**, 1214), and the author states that although a patent was refused him in 1882 by the German Patent Office on the ground of the employment of poisonous substances being illegal, yet since that date patents have been granted in Germany for the use of lead and barium compounds for the above purpose. The author is of opinion that sooner or later serious consequences will result from the employment of these methods.—G. H. M.

Maltose and Dextrose. Degener. Deutsche Zuckerind. **11**, 1094.

Maltose, owing to its being free from dextrin, readily fermentable, rich in albuminoids and having a pleasant taste, is considered by the author to have a great future and likely to replace dextrose in brewing, baking and in the preparation of wine, liqueurs, artificial honey, etc., employed in the form of a syrup or semi-solid product. —C. A. K.

Formation of Sugar in Beet. Girard. Ztschr. f. Zuckerind. 1887, 672.

A series of experiments on this subject has been carried out on a specially prepared plot of ground. The weight of the root was found to increase regularly at the rate of 10—12grms. daily, the weight of fibre, ash and organic substances other than sugar, also increased regularly, while that of the sugar and water varied and in opposite directions, so that the increase in weight of sugar plus water was constant. Heavy rains do not decrease the quantity of sugar in the root as generally supposed, but may tend to hinder or to prevent its formation; the decrease is only proportional. The roots are free from dextrose, and contain from 1·45 per cent. after 10 days' growth to 12·19 per cent. after 120 days' growth of cane sugar. By determining the size of the roots the author concludes that the portion of beet below the surface must occupy a space of 6—8cb.m. The ash of the roots increases in weight from 0·15—0·20grm. daily. The proportion of fibre, ash, organic substances other than sugar, and water in the leaves increases regularly, that of water doing so despite varying atmospheric conditions. Cane sugar is not formed in the root from glucose or glycogen compounds, but is formed directly in the leaves under the influence of light. The quantity of glucose in the leaves after a definite period of growth is the same at the end of the day or night, while on the other hand that of cane sugar will amount at the end of a sunny day to 1 per cent. and diminish during the night to a half or more of that amount owing to its passing down to the root where it accumulates. The experiments were conducted in 10 plots of land, from which the crops were collected at intervals of 10—14 days, the maximum time of growth extending over 120 days. Details of the increase in size and weight of the various parts of the plant during these intervals are given.—C. A. K.

Direct Method of Extracting Sugar from Beet by means of Alcohol. Herzfeld. Ztschr. f. Zuckerind. 1887, 714.

The extract with methyl alcohol (this Journ. 1887, 669) contains after concentrating it to a syrup, altogether 6·18 per cent. of nitrogen, showing the presence of organic substances other than sugar. The alcohol distilled off contains acids which tend on further extraction of the beet to invert the sugar. On diluting the residue with water after distilling off the alcohol the fat of the beet separates as an oily layer. This contains fatty acids in part readily, in part difficultly soluble in ether. On analysis, it gave 70·4 per cent. of C and 11·13 per cent. of H. It consists only partially of crystalline fatty acids and is readily soluble in ethyl alcohol (especially absolute). The beet examined contained no optically active substances other than sugar.—C. A. K.

On the Examination of Sugar for other kinds of Sugar than Cane Sugar. Dingl. Polyt. J. **264**, 622—626.

I. Estimation of Invert Sugar.—It has already been shown that the method established not long ago by a Special Commission for the estimation of invert sugar will not fulfil all the conditions demanded of it. According to the *Ztschr. d. Rübenzucker-Industrie d. deutsch. Reichs*, H. Bodenberger and R. Scheller have been examining this method and have compared the results obtained thereby with those obtained by use of the so-called "Soldaini's Reagent," which has been recommended by Degener.

With regard to the Herzfeld method, the authors find that a very slight departure in the method of working from that originally described may lead to wide discrepancies in the final results. They find also that the results by this method are influenced by variations in the following conditions:—(1) Manner of heating and cooling. (2) Presence of cane sugar. (3) The presence of the so-called "Bodenbender's Substance." And further, that these influences can only be completely eliminated by a double copper estimation, a process too tedious and cumbrous for commercial work. They give, however, an exact description of how this process must be worked. The authors conclude, finally, that an exact determination of a small quantity of invert sugar in the presence of cane sugar cannot be made by the use of Fehling's solution. In its place they recommend the Degener-Soldaini reagent, which is essentially a solution of basic carbonate of copper in a double carbonate of soda. They claim for it the following advantages:—(1) It remains unaltered on long boiling and throws down no oxide of copper. (2) It is very sensitive to invert sugar. (3) Chemically pure sugar may be boiled with it seven minutes over a naked flame, or 12 minutes on a boiling salt-bath, before shewing any reduction. (4) The Soldaini reagent keeps much better than Fehling's solution. The authors describe minutely the method of preparation of this reagent and the mode of its titration and application to the estimation of glucose. By using artificially prepared glucose-solutions of known strength, the value of the reagent is obtained in terms of metallic copper, to which the copper precipitate is reduced in a stream of hydrogen gas. Finally the authors maintain that for qualitative work Soldaini's reagent is indispensable, and for quantitative work, though they are not prepared to say that it overcomes all difficulties yet they recommend it as the best known reagent. For the preparation of the foregoing reagents see original article.

II. Quantitative Estimation of Raffinose.—At the suggestion of Professor Tollens, R. Creydt (*Ibid.* 153—180) has investigated the problem of the estimation of raffinose in presence of cane sugar. He starts his investigation by determining for each of the two bodies separately the specific rotatory power before and after inversion, and works up his results into practically useful formulæ. For cases where the optical method is not applicable, as, for instance, in the presence of still other optically active bodies, he makes use of a method based upon the well-known property of raffinose to yield mucic acid on treatment with nitric acid.—A. J. K.

XVI.—BREWING, WINES, SPIRITS, Etc.

Recent Improvements in the Manufacture of Spirit. Dingl. Polyt. J. **264**, 452—456, 566—568: **265**, 324—330, 366—373, 410—416, and 460—467.

Reinke has examined a new apparatus devised by Möller for the purpose of removing the fusel oil from corn spirit. The apparatus is placed before the condenser and acts as a filter for the vapour, from which it removes the mechanically carried up particles of liquid. It has been practically employed in Westphalia with every success.

Rempel and Pampe's work on the causes of the formation of bad raw spirit has been already noticed (this Journal, 1886, 330).

Coltelloni proposes to pass the vapour through a series of vessels containing liquid paraffin, which will remove the fusel oil, etc. The paraffin can be regenerated by boiling with water and clay.

Bendix, in the *Zeitschrift für Spiritusindustrie*, 1886, 227, discusses the question of the employment of ozone for the production of a fine spirit and the removal of fusel oil. He also proposes to remove all the air from the pores of the charcoal employed for the removal of fusel oil by treating it in a current of superheated steam for 1½—2 hours, the subsequent filtration to be conducted out of contact with air. The process has been tested in Eisenmann's distillery with satisfactory results.

Pampe suggests the regeneration of charcoal by means of superheated steam. He obtains a temperature of 600—700°, which is sufficient to render both the tube and char completely red-hot. The charcoal must, however, not be in a fine state, but should be as large as peas, in order that the steam may penetrate between the particles.

Schneemann discusses the question of the advisability of drying the residual products and comes to the conclusion that for large distilleries it is perhaps advantageous, but for distilleries where there is a demand for it as fodder it is not to be recommended.

Riehe is of opinion that the diseases of cattle caused by the use of these residual products as fodder are due not to the processes of manufacture (fermentation distillation, etc.) but to certain substances which are already present in the raw material.

The poisonous action of the residues from potato spirit is ascribed by *Kassner* to the presence of solanidine, which is formed from the solanine present in the potato germ by the action of acids in the mash.

H. Müller Thurgau has investigated the action of diastase and invertase under varying conditions of temperature and pressure with the following results:—1. The influence of temperature on the amount of diastatic action judged by the amount of maltose formed can be expressed by the following proportional numbers: The action at 0° is not inconsiderable, at 10° it is three times greater, at 20° about five times, at 30° about nine times and at 40° about forty times greater than at 0°. This, for the above temperatures, gives the ratio 9 : 20 : 38 : 60 : 98. The invertive action at 0°, 10°, 20°, 30°, 40°, 50° and 60° is in the ratio of 9 : 19 : 36 : 63 : 93 : 131 : 163. The enzymic actions differ from most physiological actions, inasmuch as they take place at 0° and also, on the other hand, continue at a much higher temperature than the latter. 2. Carbonic acid exerts a marked influence on diastatic action at ordinary pressures and increases it three-fold. An increased pressure also causes a marked increase in the diastatic action, both when the liquid for conversion contains air and also when carbonic acid is present. With the former it requires a pressure of 15 atmospheres to double the action, whilst with the latter 3 atmospheres are sufficient to effect the same result and at ordinary pressure twice the amount of maltose is formed in the presence of carbonic acid. Diastase also exerts a much more energetic action on ungelatinised starch in the presence of carbonic acid. 3. The amount of cane-sugar in solution between the limits of 2 and 20 per cent. exerts only a very slight influence on the energy of the invertive action; at the higher concentration the inversion proceeds slightly more slowly than at the lower. The amount of invert-sugar formed exerts a considerable influence on the further progress of the action. Alcohol exerts an unfavourable influence on the action of invertase, the presence of 10 per cent. decreases the action by about one-half. A slight addition (0·014 per cent.) of tartaric acid has a favourable influence on the action of invertase, but 0·1 per cent. slightly retards the action and a larger amount has a very decided influence.

H. Goldschmidt has found at least *one* mould-fungus in the air which has a diastatic action; this action appears to be exerted during the earlier stages of its growth. The mould appears to be a *Penicillium glaucum*.

L. Cuisinier concludes that, since dextrose is found in barley and malt, there must be another ferment present besides diastase. He has discovered this ferment and calls it *glycase*; it is present in unmalted barley and is most active after the grain has been steeped. Glycase converts ungelatinised starch slowly into dextrose, and it also gives the same product with starch-paste.

L. Errara has detected glycogen in yeast; it is present in considerable quantities in yeast in active growth. He considers that the glycogen is decomposed in the self-fermentation of yeast.

Boutroux has observed an acid fermentation of glucose by a micrococcus which resembles *Micrococcus oblongus*. *Hydroxygluconic* acid, $C_{12}H_{12}O_{16}$, is formed: this acid is not identical with zymogluconic acid formed by Micrococcus oblongus. Maumené considers that hydroxygluconic acid is probably identical with one of the acids formed by the action of very dilute nitric acid on sugar.

F. W. Dafert concludes from his researches that starch is an organised, more or less changing mixture of a large number of chemical substances—starch-cellulose, granulose, dextrin, sugar, proteïn-substances, amides, etc. The greater part of these substances consist of starch bodies, which differ the one from the other. He concludes, therefore, that starch has no formula.

L. Sostegni has drawn attention to the differences which exist in the numbers given by different observers for the proportion of dextrose formed from starch by the action of acids. He has examined this point, using pure rice-starch; at a mean of 11 determinations he finds the ratio of starch to dextrose as 93·2 : 100, whilst Salomon found 93·5 : 100. The author also examined the substances which remain behind on dissolving starch by means of dilute acids or by soluble ferments. He found this consists of about 20 per cent. of a fat, chiefly free fatty acid. The residue, freed from fat by ether, consists of cellulose.

E. Grimaux and *L. Lefevre* claim to have converted glucose into dextrin by treating the former with dilute hydrochloric acid and treating the product, after evaporation, with 90 per cent. alcohol. The product still contains fermentable sugar, which may be removed by fermentation with yeast: it then has a reducing power of 17·8 and rotating power $[\alpha]_D = +97 \cdot 48°$. It somewhat resembles dextrin in properties.

A. Moller gives the results of experiments undertaken by Dr. Hamberg on the physiological action of fusel oil and other alcohols present in crude spirit. The latter finds that the intoxicating action goes hand in hand with the volatility of the substance, and that the injurious effect which follows the continued excessive use of spirits is due to the ethyl alcohol, and not to the fusel oil, when the amount of the latter present does not exceed the ordinary limits.

Wittelshöfer has contributed an article to the *Zeitschrift fur Spiritusindustrie* dealing with Henze's apparatus for mashing and distilling. Provided certain precautions are observed, this apparatus compares very favourably with that usually employed.

Petermann gives a series of analysis of the Jerusalem artichoke, of which the following numbers are the mean :—

	Maximum.		Minimum.		Mean.
Water	79·43	....	75·04	....	77·68
Carbohydrates convertible into sugar	16·37	....	12·72	....	14·33
Carbohydrates not convertible into sugar	7·12	....	3·93	....	5·37
Fat	0·26	....	0·11	....	0·18
Proteids	1·56	....	1·06	....	1·35
Ash	1·39	....	0·92	....	1·10
True albuminoids	0·91	....	0·69	....	0·79

Of the nitrogenous substances, 59·1 per cent. are present as true albuminoids, the remaining 40·9 per cent. consist of amides, peptones, etc.

G. Heinzelmann mentions some abnormal constituents of potatoes. In certain samples he found an unusually large amount of acid, as much as 0·7 to 0·9° acid, which checked the fermentation. He also found in some samples a considerable amount of *soluble* carbohydrates (sugar, dextrin, etc.) in potatoes.

The employment of St. John's bread for the manufacture of spirit is suggested. It is largely used in Portugal and the Azores for this purpose, as much as 4000 to 6000 litres of refined spirit being produced in Portugal daily. The composition of the locust is as follows :—

Total sugar	40·00	per cent.
Proteins	5·21	,,
Fat	0·55	,,
Tannic acid	1·82	,,
Butyric acid	1·30	,,
Organic matter free from nitrogen	20·00	,,
Ash	2·30	,,
Ligneous fibre	5·00	,,
Water	23·80	,,

The sugar consists chiefly of cane-sugar, with a little invert sugar. The manufacture of spirit is more difficult on account of the butyric acid present.

A. Ralu proposes to use batatas (*Batatus edulis*) for the production of spirit. In order to overcome the difficulties attending the manufacture of spirit in the Azores, he has patented a method by means of which he reduces the batatas to meal, and imports this meal into America. Alcohol can be produced much more cheaply from the batata meal than from maize, wheat, rye, or other cereals.

Various methods for preparing the potato-mashes for the production of raw spirit are treated of. The original should be consulted for this.

R. Rempel proposes to cultivate yeast for distilleries by growing it in a mixture prepared from the residues and a grain-mash. He claims that this procedure has several advantages over the ordinary method; the yeast is free from disease-organisms and the cost less. *Wittelshöfer* also treats of the influences affecting yeast growth and fermentative power in distilleries, and concludes that the temperature and amount of acid play an important part in the activity or otherwise of yeast.

A series of instances of bladdery-fermentation are quoted, which show that this is due not only to faults in the malt and in the yeast, but also to mechanical influences in the mash tun.

J. Ben describes a coal from Westerland which possesses considerable power in the defuselisation of raw spirit, when the latter is filtered through it; it is very porous.

Korth states that the injurious properties of spirit-residues may be removed by the evaporation of the residues under high pressure, and subsequent prevention of the formation of acetic and butyric acids.

W. Windisch proposes to detect small quantities of aldehyde in spirit by employing metaphenylenediamine hydrochloride as a reagent. A strong aqueous solution of the reagent is added to the liquid to be tested drop by drop; it sinks to the bottom on account of its gravity, and there forms a more or less intense yellowish-red to pale yellow zone, the depth of colour depending on the amount of aldehyde present. 0·0005 per cent. of aldehyde may be detected by this reaction. The *m*-phenylenediamine must be chemically pure and kept in a dry state: the solution should be prepared fresh each time. The coloured zone should appear at the latest in 3 to 5 minutes, since the purest alcohol will give the reaction on standing, aldehyde being formed by atmospheric oxidation.

The permissible error in alcoholmeters is discussed by a writer in the *Zeitschrift fur Spiritusindustrie*. He states that this may amount in instruments graduated in $\frac{1}{5}$ or $\frac{1}{10}$ per cent. to 0·32 per cent., and in instruments graduated in $\frac{1}{2}$ per cent. to as much as 0·74 per cent. He therefore recommends the use of the normal alcoholmeter, and also considers that the instruments used for determining liquids poor in alcohol, should only be graduated between the limits of 10 and 50 per cent.

Wittelshöfer discusses the various tables in use for calculating the amount of true starch from the alcohol formed. He gives the preference to those of Conradi.

G. Portion proposes, in order to obtain complete saccharification of the starch, and consequent full yield of alcohol in distilleries, to allow a diastatic action and the fermentation to go on side by side in the fermenting vessels. In this way the sugar is removed as fast as it is formed, and the action of the diastase is not stopped by the action of the products of conversion (compare Müller-Thurgau, above); both the conversion and the fermentation then go on to their full extent.—G. H. M.

Swedish Malting Barley. C. G. Getterlund. Allgemeine Braur. w. Hopfenzeit, 1887, 94—96.

Swedish barley compares well with barley from Moravia, Bohemia and Silesia, when the following points are taken as indicating a good malting barley. Short, full, hard, clear, pale-yellow grain, neither red nor dark at the top, 1000 weighing 45—63grm. or 65—75kilos. per hectolitre; internally white, mealy, loose, not glassy; the barley must be quite clean and not less than 90 per cent. germinate within 120 hours. On the average, water should not exceed 14·16 per cent.: ash, 2·6 per cent.: nitrogenous matter, 10—11 per cent.: husk, 8 per cent. Extractive matter should be at least 60—65 per cent. and phosphoric acid 0·614—1·45 per cent. of the dry barley. The author suggests that results from analysis of northern (Swedish, Norwegian, and Finnish) barleys indicate a more certain diastatic action than the southern barleys.

—D. A. L.

New Colouring Matter for Wine. Ztschr. f. Nahrungsmittel-Unters u. Hyg. 1887, 141.

The berries of *Aristotelia Magni*, a shrub found in Chili and belonging to the Tiliaceæ, have lately been used for this object in France. They contain tannic acid.

—C. A. K.

Omeire. R. Marlott. Arch. Pharm. 1887, 744.

This is a drink resembling koumiss, prepared by the natives in south-west Africa, by filling gourd bottles, which contain remains of fermented milk, with milk, shaking well and then allowing to stand. It is a thick, half-coagulated liquid, possessing a pleasant wine-like smell and a slightly-sour taste; it contains a little alcohol.—C. A. K.

Preparation and Composition of Brewers' Pitch. J. John. Allegem. Ztschr. f. Bierbrau. u. Malzfabr. 1887, 2.

In view of the great importance of pitch in continental breweries, the author considers that a full examination of the properties and composition of the substance should be made. Before all things, it is necessary that the pitch should not communicate any taste to beer, and it should neither be too soft, nor so brittle that it will fall off the walls of the vessels. The pitch most generally employed appears to be mainly composed of resin and resin-oil, and the above-mentioned properties depend upon the correct ratio of these being maintained.

—G. H. M.

Improvements in and Apparatus for the Manufacture of Ozone and its Application to the Purification or Treatment of Alcoholic Liquids and other similar Purposes. J. C. Mewburn, London. From L. Teilliard, Tournus, France. Eng. Pat. 15,175, Nov. 22, 1886. 8d.

The inventor has devised a method for the preparation of pure supersaturated ozone by triple "electrisations" of oxygen under pressure and apparatus for carrying this out. He applies the ozone so obtained to the purification and ageing of spirits, etc. Full details of the methods employed and drawings of the apparatus used for both purposes are given in the specification.

—G. H. M.

The Manufacture of Alcohol from Manioc or Improvements relating thereto. W. P. Thompson, Liverpool. From S. Bensaude, Paris, France. Eng. Pat. 15,896, Dec. 4, 1876. 6d.

The manioc roots, after they are taken up and cleaned, are cut into pieces of a suitable size and dried in the sun. The dried root is then readily transportable and will keep until it can be brought to Europe and transformed into starch. The extracted starch is converted into glucose and fermented in the ordinary way.—G. H. M.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(A) CHEMISTRY OF FOODS.

Value of Pig-nut Cake and of Cocoa-Meal in the Production of Milk. Stutzer and Werner. Landw. Jahrb. **16**, 819.

Cocoa-meal containing a quantity of albumen equivalent to that of pig-nut cake acts very favourably in increasing the amount of butter-fat and dry substance in milk. The taste and appearance of the cocoa-meal butter is far better than that of pig-nut butter, while it is harder and more yellow in colour. Cocoa-meal fodder is therefore to be recommended, especially since, for the same quantity of albumen contained it is only half the price of pig-nut cake.—C. A. K.

Poisonous Action of Castor-oil Cake. F. Benecke. Ztschr. österr. Apoth. Ver. 1887, 421.

Castor-oil cake is favourable for the development of germs. Microscopical examination revealed large quantities of germs in the cake and also forms resembling budding germs. The author, therefore, considers it probable that germs are indirectly the cause of the poisonous effect, the germs converting substances present in the seeds into others possessing poisonous properties. It may also be possible that this action is only a subsidiary one and that a non-organised ferment, by absorbing oxygen, is the cause of the decomposition.—C. A. K.

The Accuracy of Hehner's Method for Testing Butter. W. Fleischmann. Milch-Zeit. **16**, 731.

According to the investigations made up to the present the amount of so-called insoluble fatty acids in butter-fat is 85·5—89·8 per cent. and in other fats examined 95·22—96·10 per cent. of the weight of the respective fats when pure. Taking the mean of these percentages as a starting point, the author finds that the accuracy of Hehner's method when applied to testing a mixture of fats (butter-fat and oleomargarine) for oleomargarine, increases with the quantity of the impurity present. But when used for estimating the quantity of butter in a mixture of fats, the accuracy increases with a decrease in the percentage of butter.—C. A. K.

Additions to Investigations on the Fermentation of Cellulose. H. Tappeiner. Ztschr. F. Biologie, **24**, 105.

In previous investigations the author had found that the cellulose in the digestive canal of herbivora is decomposed by fermentation into fatty acids and gases. He has tried to induce such fermentation in flasks filled with cotton wool and a 1 per cent. solution of meat extract by inoculation with the contents of the intestine, the result being compared with that produced in flasks similarly filled without the cotton wool. Fermentation sets in soon after the inoculation, with the formation of fatty acids and the liberation of small quantities of carbon dioxide, hydrogen and marsh gas. The cellulose remains unchanged and the fermentation, which only lasts a short time, proceeds similarly in the flasks with and without the cellulose. In another set of experiments the flasks were filled with cotton wool, Nägeli's salt solution and asparagine and inoculated with the contents of the rumen. Fermentation took place, the cotton wool was dissolved and volatile acids, together with carbon dioxide and some hydrogen, were evolved, which must have resulted from the fermentation of the dissolved cellulose. Cotton wool added to a concentrated solution of asparagine does not dissolve when the latter is caused to ferment, being protected against decomposition by the fermenting asparagine. The fermentation is nevertheless quicker and more complete in presence of the cotton wool.—C. A. K.

The Reichert-Meissl Method of Testing Butter and its Application for controlling the Sale of Butter and its Substitutes. R. Wollny. Milch-Zeit. 1887, 32—35.

On the ground of numerous analyses, the author contends that the Reichert-Meissl method of estimating small quantities of butter in margarine is, in its present form (*Chem. Zeit. Rep.* **11**, 210), of no value at all. The sources of error are:—(1) the absorption of carbon dioxide during the saponification, which can introduce an error of 10 per cent.; (2) the formation of "esters" during the saponification, which may cause a loss of 8 per cent.; (3) the formation of "esters" during the distillation, involving a loss of 5 per cent.; (4) the effect of the coherence of the fatty acids during the distillation, which, in extreme cases, may cause a loss of 30 per cent.; (5) the form and size of the distillation apparatus and the time during which the distillation lasts, causing an error of ±5 per cent. The following modifications of the process are proposed, which render it perfectly reliable:—5grms. of the clear melted fat poured off from any sediment contained, is treated in a 300cc. round-bottomed flask, with 2cc. of 50 per cent. caustic soda solution (free from carbon dioxide) and 10cc. of 96 per cent. (by vol.) of alcohol, and the whole heated on the water bath for a quarter of an hour, the flask being connected with a condenser. At the end of this time the alcohol is distilled off, the flask being placed for half-an-hour in a water bath and 100cc. of distilled water added. The flask is then kept for another quarter of an hour in the water bath and protected against the absorption of carbon dioxide. The clear soap solution is next treated hot (boiling), with 40cc. of sulphuric acid (30—35cc. = 2cc. of the caustic soda used) and two small pieces of pumice added. The flask is immediately connected with a condenser, a tube bent twice at an angle and having a bulb being interposed between the two. A gentle heat is applied until the insoluble fatty acids are melted, when the temperature is raised and 110cc. of liquid distilled off. This should occupy half-an-hour. The distillate is well shaken, filtered and 100cc. titrated with decinormal baryta solution, using phenolphthaleïn as indicator. From the number of cc. used, multiplied by 1·1, the result of a blank experiment, conducted under the same conditions (without the fat), is to be subtracted. This should not exceed 0·33cc. The exact size of the various apparatus used is stated.—C. A. K.

Casein and the Action of the Rennet Ferment in Cows' Milk. F. Schaffer. Landw. Jahrb. d. Schweiz.

Engling's conclusion that milk casein is a compound of albumen with calcium phosphate is confirmed by the author. Casein precipitated by rennet contains 5—8 per cent. of ash, consisting almost entirely of calcium phosphate. The calcium phosphate compound of albumen is readily decomposed by mineral acids and by acetic acid, so that casein precipitated by the latter only contains traces of ash. Small quantities of lactic acid produce the same result, for which reason casein obtained from milk that has stood for some hours contains less ash than that from fresh milk. The compound of calcium phosphate and albumen is present as a soluble substance in fresh milk and by the action of rennet it is converted into an insoluble body (casein). This action is purely a chemical one: it consists in the conversion of the tricalcium phosphate compound into one of albumen and acid calcium phosphate, and can be brought about by carbon dioxide. Rennet, which does not precipitate boiled milk, does so if after boiling, the milk is treated with carbon dioxide; the coagulation of milk by rennet is quicker in proportion to its acidity. Rennet alone cannot convert the tricalcium phosphate compound into the acid calcium phosphate one, the presence of a small quantity of acid being necessary for the change. The action of acids—*e.g.*, of acetic acid—differs from that of rennet, inasmuch as the acid calcium phosphate compound formed is further decomposed, so that finally an albumenoid substance free from ash results; this further decomposition is not effected by carbon dioxide. As the action of rennet in coagulating milk depends upon the freshness of the latter, the author proposes to examine milk by treating 100cc. with 2cc. of a solution made by dissolving a Hansen rennet-tablet (smallest number) in half a litre of water and determining the time required for coagulation at 35° C. With fresh milk this should not be less than 10 nor more than 20 minutes.—C. A. K.

Improvements in Processes for Preserving Crustacea and Certain New and Useful Chemical Solutions of Special Utility in such Connection. J. C. Mewburn, London. From J. J. Bate, Brooklyn, U.S.A. Eng. Pat. 8063, June 4, 1887. 6d.

One pound of boracic acid is added to 6lb. glycerin and 16galls. of water, and, preferably, also ¼lb. of bicarbonate of soda. The boracic acid may be replaced by 1lb. salicylic acid, or a mixture of the two acids. Crustaceæ boiled in this solution will keep for a longer period than if boiled in plain water. The flesh may be removed from the shells after boiling and "tinned" in the usual way, or the body in its entirety packed in some of the solution in an air-tight case. Either of these methods ensures the sound condition of the crustaceæ for a comparatively long period.—C. C. H.

(*B*) SANITARY CHEMISTRY.

On the Causes of Corrosion of Lead Pipes by Water. Max Müller. J. Prakt. Chem. 36, 1887, 317—340.

The extensive application of lead pipes for water-conducting purposes gave rise to many investigations on the action of water on lead, in order to find out the causes which lead to the frequently occurring destruction of lead pipes. The author attacked the same subject from a new point of view, by giving special attention to the nature of the gases dissolved in the water and their action on lead in the presence of saline matters. It is well known that distilled water, prepared in the usual manner, strongly attacks lead, with the formation of a bulky white precipitate, consisting of lead oxide, carbonic acid and water. One-third of a cubic metre of river water was distilled and portions of the distillate were taken at the commencement, middle and end of the distillation. The river water contained 0·00015 per cent. of ammonia. The three fractions were tested for dissolved gases, with the following result:—

Fraction.	Volume per cent. I.	II.	III.
NH_3	0·00115	0·0001	0·00008
CO_2	1·159	0·178	0·025
O	0·269	0·316	0·232
N (by difference)	0·612	0·702	0·513

These tests show that both ammonia and carbonic acid are chiefly contained in the first fraction, whereas oxygen and nitrogen are rapidly taken up by the distillate while exposed to the air. Lead strips were then suspended in the three fractions. After 24 hours the lead in Fraction I. was scarcely attacked. It was covered with a very thin greyish skin, but the water remained clear. Not so with the other fractions, the water being turbid and the lead perceptibly corroded. In order to find out the cause of the different behaviour of Fraction I.—which could be ascribed to the presence of a certain amount of ammonia or carbonic acid, or both—water free from ammonia was distilled and the distillate similarly divided in three fractions. The Fraction I. was again inactive on lead, whereas the Fractions II. and III. attacked strips of lead. These observations led to the conclusion that minute traces of ammonia do not corrode lead; the corrosion—*i.e.*, the formation of a white lead precipitate—rather depends on the amount of carbonic acid and oxygen present. Indeed, direct experiments, minutely detailed in the original paper, show that water containing twice as much carbonic acid as oxygen attacks lead most energetically. If carbonic acid be absent and oxygen present in the water, its action on lead is very feeble, whereas no perceptible corrosion takes place, if the water containing a normal amount of oxygen—about 0·3 per cent. by volume—also contains about 1½vols. per cent. of carbonic acid. These phenomena account for the fact that distilled water in the fresh state often shows another behaviour after a few days' standing. The Fraction I., at first inactive on lead, became active after some time—evidently from a loss of carbonic acid and absorption of oxygen. It was to be expected from these experiments that water containing neither carbonic acid nor oxygen would not attack lead; and this is, indeed, the case. As to the composition of the compound formed by the action of carbonic acid, oxygen and water on lead, the author could get no definite result, although one analysis showed $H_2O = 3·49$ per cent.; $CO_2 = 11·89$ per cent.; $PbO = 84·41$ per cent. In all the cases, where the water attacked lead, a small amount of the latter was found in solution and could be detected with sulphuretted hydrogen or potassium sulphide. If such water—although it was clear to begin with—be warmed, or even shaken with air, it turns turbid and forms a slight white precipitate. The solution of the lead proceeds very slowly; not until after the lapse of 24 hours are small traces to be found in solution. After three days the amount of lead in solution reaches its maximum, then it gradually decreases, until after a week or a fortnight all the lead has turned insoluble again. Most probably the basic lead carbonate is at first dissolved in an excess of carbonic acid; by and by a new formation of lead oxide takes place, which combines with the carbonic acid previously in excess, and the carbonate, deprived of its solvent, is thus precipitated. Previous investigators evidently overlooked the important part played by the carbonic acid and oxygen dissolved in water, and this circumstance accounts for their contradictory statements as regards the action of soft water on lead. The author also investigated the action of saline matters usually found in waters of natural origin. Small quantities of free ammonia in water quickly attack lead, but if carbonic acid is present at the same time, thus forming a carbonate or bicarbonate, no corrosion takes place. This statement, however, is only true as long as the quantities present are very minute; any considerable amount of ammonia will certainly dissolve lead. In the presence of air, a solution of the hydrate of calcium or sodium quickly attacks lead, which is soon found in solution and gradually forms deposits of small crystals. If air be excluded, no action on the lead takes place. We often find in buildings lead pipes embedded in cement or lime mortar, and the frequent destruction of the pipes gave rise to an opinion amongst builders that lead pipes must not be brought in direct contact with lime or cement. It is difficult to see how dry lime could corrode lead pipes, and the author thinks that in all cases in which a corrosion of the pipes has taken place the destruction may be traced to the simultaneous action of water. Wherever the presence of water can be excluded, no fear need be entertained for the safety of lead pipes. If free carbonic acid be rigidly excluded, sodium carbonate attacks lead, which is found in solution after some time. But the presence of free carbonic acid alters the whole state of affairs. Not only does sodium bicarbonate not attack lead, but it makes even active water inactive. This action of sodium bicarbonate is so characteristic and intense, that the addition of a small quantity of bicarbonate at once precipitates all the lead in solution. It was mentioned previously that lead carbonate is dissolved by free carbonic acid; but this statement must now be modified by the addition ot the words—if sodium bicarbonate be absent. This salt is, therefore, an excellent means for protecting lead from corrosion. River and surface waters nearly always contain calcium bicarbonate in solution and as this compound behaves the same towards lead as sodium bicarbonate, its presence, even in small quantities, protects the lead. A solution of gypsum attacks lead; but if, at the same time, calcium bicarbonate be present (as most frequently will be the case in river water), no lead goes in solution. The very same may be said of solutions of chlorides and nitrates; both dissolve lead only in the absence of a soluble bicarbonate. Organic matters will be found in river water in too minute quantities to have any effect on lead. But it should not be forgotten that surface water is frequently contaminated with sewage that may contain large amounts of ammoniacal compounds, which will dissolve lead under all circumstances. The conditions under which water will take up lead from lead pipes are therefore very simple and by an analysis of the saline matters this can now be ascertained beforehand.—S. H.

Improvements in Purifying Sewage and other Foul Liquids and in making Oil, Alkali, and Cement from Sewage Precipitate, and in Apparatus for that Purpose. W. Burns, Leith. Eng. Pat. 15,222, Nov. 23, 1886. 8d.

THE sewage is purified, firstly, by the injection of gaseous HCl; this is followed, secondly, by the injection of SO_2; and, thirdly, by the injection of chlorine. It is then successively passed through charcoal and peroxide of iron, chalk, clay and finally coal-dust and caustic lime. The sewage thus defecated is allowed to settle in tanks, the effluent from which is run on to a filter, composed of charcoal and iron turnings. The sludge is drained, made into bricks and calcined in retorts; the gaseous products are utilised and the cinder rendered into cement.—C. C. H.

An Improved Deodorising, Decolorising and Filtering Medium. O. Bowen and J. Cobeldick, London. Eng. Pat. 15,240, Nov. 23, 1886. 6d.

SHALE, such as found at Lyme Regis, is broken into about 1in. cubes, mixed with 15 per cent. of alumina or aluminous earth and furnaced from four to six hours at a temperature of 900—1200°F. The product is used as a filtering media for the purification of sewage; when exhausted, it can be regenerated by a fresh furnacing with 20 per cent. of alumina.—C. C. H.

XVIII.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

An Improved Method of Galvanising Iron and Steel. J. T. Dann, London. From A. Schaag and Messrs. Flürscheim and Bergmann, Eisenwerke, Germany. Eng. Pat. 14,020, Nov. 1, 1886. 4d.

ACCORDING to this method, the zinc is electrolytically deposited upon the article to be coated from a solution of any salt of zinc with any salt of magnesia, mixed in variable proportions, anodes of zinc being used. Bichloride of mercury or muriate of ammonia may be added to expedite the process.—B. T.

A New or Improved Galvanic Battery. A. Wunderlich and O. Eisele, Brussels, Belgium. Eng. Pat. 14,286, Nov. 5, 1886. 8d.

ON a revolvable shaft are placed—first, a disc of copper or carbon; then a disc of zinc insulated from it. The space between the two is divided up into sectorial compartments, which hold the exciting liquids. Next, another plate of copper is put on with the zinc, and then a plate of zinc arranged as above. This is continued as far as convenient. The exciting fluid falls from jets in a trough above into the sectorial compartments and turns the whole like a water-wheel. There is thus a continual movement of liquid. The current is collected by brushes from the zinc and copper plates, which form the ends of the series.—E. T.

Improvements in or connected with Means and Apparatus for the Deposition or Obtainment of Metals by Electrolysis. F. E. Elmore, Cockermouth. Eng. Pat. 15,831, Dec. 3, 1886. 6d.

LIQUOR, rich in the metal to be deposited, is supplied to the surface of the cathode in the form of a spray, and the metal, as it is deposited, is pressed and rubbed by burnishers of suitable material, such as agate, which produce a fine, compact deposit and remove occluded gases. Moving or stationary cathodes are employed in combination with stationary or moving burnishers.—B. T.

Improvements in and relating to Secondary Batteries. H. H. Lake. From A. V. Meserole, New York, U.S.A. Eng. Pat. 4311, March 22, 1887. 6d.

THE inventor immerses plates of zinc and lead in a solution containing a suitable salt of mercury, sulphate of zinc and sulphuric acid. On passing a current through, mercury and zinc are deposited on the zinc plate in a spongy condition and are then able to occlude hydrogen very readily. The lead plate, which may be amalgamated, is peroxidised. The sponge may also be formed in other ways. This cell has an E.M.F. of three volts and suffers very little from local action.—E. T.

Improvements in Secondary Batteries or Accumulators. L. C. E. Lebiez, Paris, France. Eng. Pat. 7975, June 2, 1887. 4d.

THE inventor employs as positive electrode, carbon or other suitable material, on which peroxide of manganese has been deposited by electrolysis of a solution of a manganese salt, such as manganese sulphate. He employs a solution of the same salt as exciting liquid and zinc, or lead coated with zinc, as the negative electrode. Such cells are said to be readily formed, are light and the positive electrode is very durable.—E. T.

Improvements in Primary Voltaic Batteries, and in the Preparation of the Elements and Solutions employed therein. W. Webster, London. Eng. Pat. 16,151, Dec. 9, 1886. 8d.

THE elements employed in this battery are zinc, immersed in dilute sulphuric acid, and carbon, either wholly or partially platinised, or platinised metal in a solution of nitrate of soda, sulphuric acid and water, in varying proportions, with or without the addition of chromic acid, or bi- or tri-chromates. The porous cells are partially coated with paraffin wax to prevent too rapid an interchange of the two solutions. The connections are made by means of mercury cups on the outer cell of the battery, so arranged as to enable any single zinc or carbon to be removed without interfering with the working of the battery. A compound siphon is employed to empty or fill several cells at once.—B. T.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

The Preparation of Menthol and Borneol. E. Beckmann. Chem. Zeit. **11.** 1265.

MENTHOL is obtained by cooling peppermint oil and recrystallising from alcohol the solid portion which separates out. The fluid product, which has been incorrectly described as menthan, or a fluid isomer of menthol, still contains a great deal of menthol dissolved in menthon, a substance which has also been obtained by Moriya and Atkinson by the oxidation of menthol, and which is easily converted into menthol. It has the composition $C_{10}H_{18}O$, and stands in the same relation to menthol ($C_{10}H_{20}O$) that camphor ($C_{10}H_{16}O$) does to borneol ($C_{10}H_{18}O$). The separation of menthon and menthol can be effected by hydroxylamine, which, when added to the alkaline solution of the mixture, converts the former into menthoxime, and leaves the latter unaltered. The menthol can then be obtained by dissolving the menthoxime in aqueous acid, from which the menthon very slowly separates as a colourless oil. In this way it was found that the greater part of the fluid residue from the preparation of menthol from Japan oil contained about 40 per cent. of almost pure menthol and 60 per cent. of menthon, and also that menthon is present to a considerable extent in American, as well as in Mitcham, peppermint oil. Menthon may be converted into menthol by treating it with sodium in ethereal solution. The first product of the action of sodium is a mixture of sodium menthol and sodium menthon; this latter, when treated with a further quantity of sodium and menthol, is completely converted into sodium menthol, from which the menthol can easily be separated. The easy conversion of the menthon of peppermint oil into menthol is of value in the preparation of menthol, and also for the improvement of the oil. By reduction, the bitter constituent can be removed, and the odour improved. Laurel camphor can also be easily converted into borneol, or borneo-camphor, by this treatment, and the employment of this substance, which is superior to ordinary camphor on account of its smell, taste, etc., need no longer be deferred on account of the difficulty in obtaining it.—G. H. M.

Erigeron Oil. F. Power. Pharm. Rundsch. 1887, 201.

THE ethereal oil of *Erigeron canadense*, obtained by rectification of the crude oil, boils at 176°, is colourless, neutral towards litmus and has a specific gravity at 15° of 0·8498. Its composition is $C_{10}H_{16}$: it is, therefore, a terpene.—C. A. K.

Erechthites Oil. F. Power. Pharm. Rundsch. 1887, 202.

THE oil of *Erechthites hieracifolia* is, when rectified, a colourless, strongly refractive liquid, boiling at 185—190°. It is a terpene, but by reason of its boiling point, probably belongs to the sesqui-terpenes—$C_{15}H_{24}$.—C. A. K.

Some Higher Homologues of Cocaïne. F. Nory. Pharm. Rundsch. 1887, 208.

COCAÏNE is the methyl ether of benzoyl ecgonine, and readily yields the latter on saponification, according to the equation—

$$C_{17}H_{21}NO_4+H_2O=C_{16}H_{19}NO_4+CH_3.OH.$$

Conversely, benzoyl ecgonine treated with methyl iodide and methyl alcohol yields cocaïne. With higher alkyl-iodides, higher homologues of cocaïne result. Merck has thus prepared the ethyl ether of benzoyl ecgonine, a body having the same physiological properties as cocaïne. The author has prepared monobromethylbenzoyl ecgonine by treating benzoyl ecgonine in a sealed tube with ethylenedibromide. It is an amorphous body, soluble in alcohol and water, insoluble in ether. Propylbenzoylecgonine is obtained by the action of propyl iodide and propyl alcohol on benzoyl ecgonine; isobutylbenzoylecgonine is similarly prepared. These are both crystalline bodies, possessing a very bitter taste and a powerful anæsthetic action.—C. A. K.

Solubility of Iodol in Ethereal Oils. E. Hirschsohn. Pharm. Ztschr. Russl. 1887, 513.

VARIOUS turpentine oils and other ethereal oils show differences in their power of dissolving iodol, so that this property may be applied in detecting adulterations. Iodol is least soluble in the oils of the coniferæ, the oil of the Siberian larch and that of the screw-pine being the only ones that dissolve it readily. The oils of the Aurantiæ show different solubilities and may be thus distinguished one from the other. 1grm. of iodol dissolves in 10cc. of curaçoa oil, in 30cc. of orange oil, and in about 50cc. of orange-peel oil; 40cc. of the latter are necessary when mixed with 20 per cent. of orange oil to dissolve 1grm. of iodol. The oils of the Compositæ and Labiateæ show the greatest solubility, but when admixed with oils of the coniferæ the solubility is considerably lessened.—C. A. K.

The Constituents of the Scopolia Root. Henschke. Ztschr. f. Naturwissensch. 1887, 103.

TWO new alkaloids, *Scopoleïn* and *Rotoin*, have recently been prepared on a manufacturing scale from *Scopolia japonica* (Japanese belladonna). The former was obtained by Eykmann, who also isolated a glucoside scopolin and a decomposition product of the same, scopoletin. The author finds that *Scopolia japonica* does not contain any new alkaloids, but mixtures in varying quantities of atropine, hyoscyamine and hyoscine. The commercial rotoin is not a base but a mixture of the sodium salts of fatty acids rich in carbon. Scopoletin is identical with the constituent of Atropa belladonna called chrysatropic acid (Kunz).—C. A. K.

Saccharine. Ztschr. f. Rübenzucker Ind. **36**, 949.

A REVIEW of our present knowledge on the subject (compare this Journal, 1886—75, 349, 359, 421, 546 and 616). The solubility of saccharine is increased if the solution is neutralised. Saccharine melts at 200° with partial decomposition, and yields a strong odour of bitter almonds. Saccharine has a strong antiseptic action. Stutzer found that meat-peptone solution, which developed bacteria in 12 hours, did not do so for 24 hours when 0·01 per cent. saccharine was added, whilst 0·02 per cent. prevented any growth for 40 hours, and 0·04 per cent. for 60 hours. Solutions of sugar, containing potassium phosphate and ammonium nitrate remained sound for 72 hours in the presence of 0·10 per cent. of saccharine.—G. H. M.

The Preparation of Iodised Oil. H. G. Macalister and W. Stewart, Glasgow. Eng. Pat. 13,865, Oct. 29, 1886. 4d.

OIL (kind not stated) is agitated with one-fifth of its weight of strong sulphuric acid, and after subsidence is washed with water or a saline solution. After a second subsidence, a small quantity of an alkaline solution (at about 20° Tw.) is added, with constant stirring. It is claimed that with oil thus treated, an alcoholic solution of iodine may be readily incorporated.
—W. L. C.

Improvements in the Preparation of Oils for Medicinal Purposes. H. Mackay. Eng. Pat. 14,729, Nov. 13, 1886. 4d.

Pure cod-liver oil is mixed with 3 per cent. of essence of hops.—W. L. C.

XXI.—EXPLOSIVES, MATCHES, Etc.

Report on the Circumstances attending a Fire and Explosion at Messrs. Roberts, Dale & Co.'s Chemical Works, Cornbrook, Manchester. Gov. Rep. No. lxxxi. Colonel V. D. Majendie, C.B.

This exhaustive report shows that the articles manufactured on the side of the works where the explosion occurred, were picric acid, nitrate of lead, nitric acid, hydrochloric acid (nitre cake and salt cake), tin crystals, tin solutions, nitrate of iron, nitrate of copper, aurin, Manchester brown, Manchester yellow, lakes for paper stainers and emerald green. Such raw materials as carbolic acid, sulphuric acid and litharge, the litharge being used for making nitrate of lead, were all present, the latter salt in very considerable quantity; some nitrate of strontium was also present.

A fire commenced the catastrophe, this breaking out at or near the stove used for drying the picric acid. The fire spread quickly, and in five or six minutes an explosion followed, but not one of an alarming character. This explosion came from the site of the picric acid stove as nearly as it can be located. It was followed in something under a minute by a second explosion of an appalling character, and attended with disastrous results in the shape of damage. One life was lost.

There is little doubt that the fire was caused by the carelessness of a workman, who was smoking. Several theories are advanced to explain the first and lesser explosion, but the second, which was so disastrous, was in all probability due to the blazing and molten picric acid coming in contact with the litharge placed in close proximity and with the nitrate of lead and nitrate of strontium. It would at once combine with these and form fearful explosives. Picric acid alone can scarcely be called an explosive, but if it comes in contact even with plaster or lime, it forms a picrate of highly explosive character, and it is shown that picric acid mixed with a little litharge in the cold, produces a mixture which explodes much more readily than picric acid alone.

Finally, the precaution is urged, that in the manufacture of picric acid the separation of the acid from all other substances or ingredients, contact with which would be likely to produce under favourable conditions a *picrate* or explosive mixture should be carefully seen to.

"At present picric acid and picrates appear to fall within the category of 'explosives,' and to be subject to the Explosives Act, 1875, only when they are 'used or manufactured with a view to produce a practical effect by explosion or pyrotechnic effect.'"

"In view of the present disaster," Colonel Majendie proceeds, "and of the results of my experiments it will be a matter for careful consideration whether it is not necessary in the interests of public safety to take advantage of the powers conferred by the 104th section of the Explosives Act, 1875, and to extend the definition of explosive to picric acid and all picrates, for whatever purposes manufactured, and to apply the same provisions of the Act, subject to such exceptions, limitations and restrictions as may appear reasonable. This point, however, is one which, in the interests of the trade, as of the public, demands the fullest and most careful consideration."

As to the storage together and in close proximity of the several substances which resulted in the formation of such fearful explosives, Colonel Majendie stigmatises it as the result of negligence.—W. S.

XXII.—ANALYTICAL CHEMISTRY.

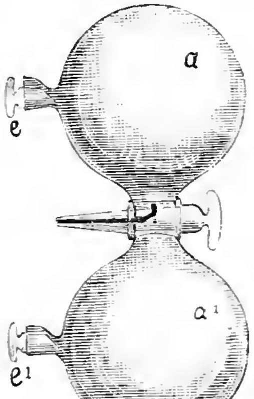
Congo Red as a Reagent for Free Acid. C. Wurster. Centralbl. f. Phys. **11**, 240.

E. Brucke (*Chem. Zeit.* 11, 315) concludes that since human urine does not affect Congo red solution, it does not contain any free acid or carbon dioxide. The experiments of the author show that the presence of ammonia or ammonium salts interferes with the reaction between congo red and acids, and therefore that as a means of proving the presence or absence of free acid in organic liquids such as urine, where ammonia cannot be excluded, it is valueless. Carbon dioxide, acetic acid and other organic acids have not the least effect on congo red in presence of even small quantities of ammonia or ammonium salts; the cause of this is that these acids are not able to decompose the ammonium salt of congo red. The action of inorganic acids is also interfered with by ammonium salts. Several drops of hydrochloric and dilute sulphuric acid can be added to a solution of Congo red in glacial acetic acid before any change in colour takes place, and then this only takes place gradually; a considerable quantity of the acid must be added before the blue coloration forms.

—C. A. K.

Separating and Extracting Apparatus. R. Schütze. Chem. Zeit. **11**, 1159.

The aim of the apparatus is to prevent the loss of solution which occurs during extraction and separation. a and a^1 are two glass vessels, either of the same size or of different sizes, connected by a three-way cock (as shown in figure). Tubulures e and e^1 fitted with stoppers, are fixed in the side of the vessels a and a^1; the edges of the tubulures are in part bent back, and the stoppers are provided with a hole, or are ground unevenly, so as to admit of the vessels a and a^1 being connected with the air by placing the stoppers in a certain position. The solution to be extracted, together with the extracting medium, is placed in either of the two vessels, the stop-cock between the two being closed. After extraction, e and e^1 are opened and the extract run from the one vessel to the other. The process can, of course, be repeated as required; the liquids can be poured off through e, e^1 or the three-way cock.



—C. A. K.

Laurent's New Polarimeter. Kanders. Oesterr. Ztschr. f. Zuckerind. **16**, 645.

This is a half-shadow instrument; it has a scale of saccharimeter degrees from −200 to +400, and a divided arc from −45° to +90°. The verniers are so arranged that 0° on the scale corresponds to 0° on the divided arc, and 100° on the former to 21° 40′ on the latter. The normal weight of sugar, which dissolved in 100cc. of water rotates 100°, is stated at 16·2grms (16·315grms. Kanders), while with the ordinary Laurent's polarimeter it is 26·048grms., so that the new form is 1·6 times more accurate. The results are reliable to 0·05°, and by having the scale extending to 400° very concentrated solutions may be examined directly; also by examining normal solutions in tubes 400mm. long further exactitude may be attained. The author has determined the specific rotary power of sugar with this instrument, using solutions containing varying quantities of sugar per 100cc.

of solution, and from his results has calculated the necessary tables in regard to the change in specific rotation.—C. A. K.

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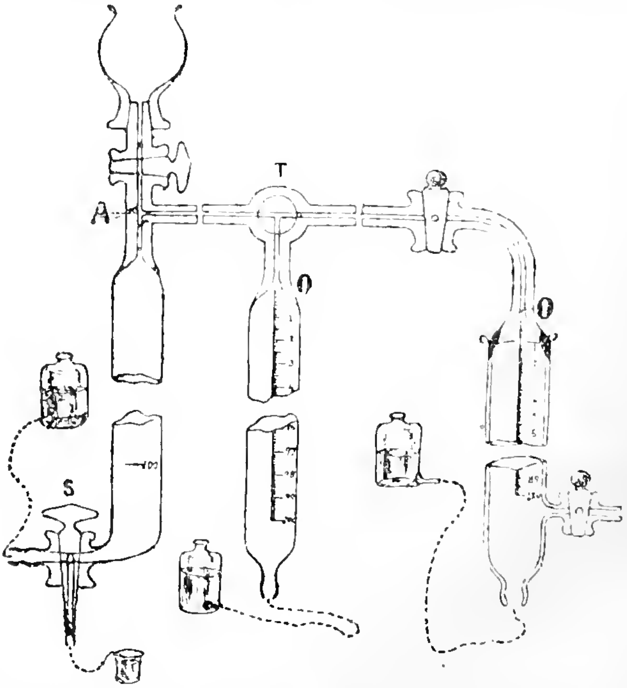
*An Improved Form of Elliot's Gas Apparatus.** J. B. Mackintosh. Amer. Chem. J. 9, 294—296.

A THREE-WAY T-stop-cock is attached to the measuring burette whereby connection can be made between any two of the burettes at will. In the measuring and explosion burettes the zero point O is taken at that point where the capillary tube expands into the burette. Water will remain in the capillary tube when the excess flows to the bottom of the burette and thus the adjustment to zero is rendered automatic. The absorption tube has a single graduation at 100cc. measured from A. Any gas remaining in the portion above A can be expelled by forcing water out of one of the other burettes, the cock S being closed.

In transferring gas from the measuring tube to the explosion burette its complete removal from the capillary tube is effected by passing water from the absorption tube or by letting it flow in from the funnel. This done, the stop-cock T is turned so as to connect the explosion and absorption tubes, while the measuring tube is completely shut off. The oxygen or air for the explosion can be admitted through the lower stop-cock of the explosion burette or through the funnel of the absorption tube. A supply of oxygen may be generated in the absorption vessel from potassium permanganate and hydrogen peroxide. After mixing the gases in the explosion tube, the explosion is made, the correction noted, the gas transferred to the absorption burette and finally re-transferred to the explosion burette and measured.—C. A. K.



Detection of Metals by Electrolysis. Mayencon. Journ. de Phys. Elément, 1887, 172.

THE gold in a solution containing 1 part in 1,000,000, and made by dissolving 0·005grm. of gold in aqua regia, and diluting the solution to 5 litres with water (acidified with sulphuric acid) may be detected in less than a minute by electrolytic deposition on a wire.—C. A. K.

The Application of Ammonium Dithiocarbamate in Analysis. J. Klein. Rep. Anal. Chem. 7, 629—639 and 645—654.

FOR the preparation of ammonium dithiocarbamate free from sulphocarbonate Mulder's directions (*J. Prakt. Chem.* 103, 178) are adopted, the ammonium generated from 150 parts of ammonium chloride and 300 parts of quicklime being passed into 600 parts of 95 per cent. alcohol, and there treated with 95 parts of carbon bisulphide. At 30° almost pure dithiocarbamate crystallises out, which is filtered, washed with alcohol, and dried between filter paper—$CS_2 + 2NH_3 = CS(NH_2)SH.NH_3$. The presence of any sulphocarbonate of ammonium is evident by its turning red on exposure to the air; it can thus be mechanically removed if present. If a very little of a solution of a sulphocarbonate be added to one of nickel sulphate which has been treated with an excess of ammonia and strongly diluted, a red zone is formed at the point of contact of the two liquids, and on shaking the whole solution becomes red. In this way the purity of the ammonium dithiocarbamate used in the following experiments was always tested.

In all cases a 5 per cent. aqueous solution of ammonium dithiocarbamate was used; it is advisable to keep a solution for use in preference to the solid, the latter being more liable to decompose after being kept for some time.

Determination of Copper.—A solution of copper sulphate treated with ammonium dithiocarbamate yields a yellow precipitate of copper dithiocarbamate—$Cu.(CS.NH_2.S)_2$. It the precipitation is effected in the boiling solution, the precipitate settles well and can be readily filtered. It dissolves in much hydrochloric acid after prolonged boiling and gradually becomes dark coloured, while ammonia and caustic soda darken the precipitate at once. It dissolves readily in nitric acid on warming, and is unaffected by water or long exposure to the air. Heated with sulphur in a current of hydrogen cuprous sulphide (Cu_2S) remains. For the quantitative determination of copper by this reaction, the solution (in absence of other metals) is acidified with a little hydrochloric acid, heated to boiling, and an excess of the 5 per cent. solution of ammonium dithiocarbamate added, the boiling is continued for 10—20 seconds, the precipitate allowed to settle, filtered, washed on the filter with hot water and dried. It is finally

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* See Chem. News, 1883, October.

ignited with sulphur in a current of hydrogen and the cuprous sulphide weighed. Results by this method agree closely with those obtained by precipitating the copper solution with sulphuretted hydrogen and weighing as cuprous sulphide directly. Copper in silver coins can be thus determined, the silver being first removed as chloride. (This, provided silver and copper only present.)

Determination of Zinc.—Zinc sulphate is precipitated by ammonium dithiocarbamate as a white precipitate, soluble in excess, and reprecipitated on boiling. Zinc dithiocarbamate is soluble in nitric and hydrochloric acids, insoluble in dilute acetic acid. In the quantitative determination sodium acetate and acetic acid are added to the solution of zinc sulphate: the solution is heated to boiling, ammonium dithiocarbamate added, and the boiling continued for a short time, when the precipitate is allowed to settle, filtered hot, washed, etc., and finally weighed as zinc sulphide, as in the previous instance. In the filtrations the filtrate is apt to be slightly turbid, but the quantity of zinc passing through is so small that it may be disregarded.

Separation of Copper and Zinc.—This depends on the solubility of zinc dithiocarbamate in hydrochloric acid. Hydrochloric acid (sp. gr. 1·05) is added to the mixture, which is then heated to boiling and precipitated with ammonium dithiocarbamate. The precipitated copper retains a small quantity of zinc and should be redissolved in nitric acid, evaporated down with hydrochloric acid and reprecipitated. The combined filtrates contain the zinc, which can be precipitated as dithiocarbamate, in acetic acid solution. An analysis of the mixed sulphates of copper and zinc, also an analysis of brass, gave accurate results by this method.

Separation of Copper from other Metals.—Copper is completely separated from iron, manganese and nickel by precipitation in the hot hydrochloric acid solution with ammonium dithiocarbamate. Cobalt solutions turn green when thus treated, and it is only after prolonged boiling that they become red again, and the separation does not appear to be quite complete under all conditions. Copper (and also zinc) is completely separated from the metals of the alkalis and alkaline earths, provided the solution is sufficiently dilute.

Action of Ammonium Dithiocarbamate on :—

1. *Salts of Aluminium and Chromium.*—In the cold no reaction occurs, but on warming sulphuretted hydrogen is evolved, and the hydrates separate. In the case of chromium small blue crystals, insoluble in cold hydrochloric acid, and consisting probably of chromium dithiocarbamate, were observed. Chromates are reduced by this reagent as by sulphuretted hydrogen.

2. *Salts of Iron, Nickel, Cobalt, Manganese, Zinc and Uranium.*—Ferric salts are reduced, while ferrous salts are not affected in the acid solution: an addition of ammonia causes the separation of a dark precipitate. Nickel and cobalt are not completely precipitated either in acid or alkaline solution. Manganese is only precipitated in alkaline solution, while the zinc precipitate is insoluble in acetic acid (v. *ante*). The separation of zinc and manganese on this basis does not work. Nickel, cobalt, and zinc treated with an excess of potassium cyanide are not precipitated by the dithiocarbamate. Uranium solutions are coloured red in the cold (*Debus. Annalen*, **73**, 26); on boiling a grey-black precipitate settles, insoluble in acetic acid solution, soluble in hydrochloric. The red coloration is destroyed by the presence of ammonium carbonate.

3. *Salts of Mercury, Lead, Silver, Bismuth, Copper and Cadmium.* (See *Debus. l.c.*).—With mercuric chloride a white, and with mercurous nitrate a black, metallic precipitate is formed. The precipitates with lead and silver are pale yellow, that with bismuth orange-yellow, and that with cadmium white. They are all more or less rapidly decomposed on boiling with water, and almost immediately by alkalis. The solutions of these metals treated with an excess of potassium cyanide are not precipitated. The bismuth and cadmium precipitates are fairly soluble in hydrochloric acid, the copper salt (v. *ante*) highly soluble, the lead salt readily so.

4. *Oxides of Arsenic, Antimony and Tin.* (See *Debus. l.c.*).—Mixed with an aqueous solution of arsenious acid, a yellow precipitate, probably, of sulphide of arsenic separates on standing. In presence of hydrochloric, sulphuric or acetic acid a white flocculent precipitate results, soluble in alkalis and reprecipitated by acids. The precipitate liberates no ammonia when boiled with caustic soda, but if it be first boiled with water and then with caustic soda ammonia is liberated, and on the addition of acid, fumes of sulphocyanic acid are given off. Arsenic acid is similarly precipitated in acid solutions. Antimony trichloride forms a pale yellow precipitate, which behaves similarly to the above, while antimony pentachloride also yields a pale yellow precipitate soluble in alkalis, but decomposed on boiling the solution. Stannous chloride in acid solution forms an orange-yellow precipitate, soluble in alkalis, reprecipitated by acids and decomposed on boiling with evolution of carbon dioxide and sulphuretted hydrogen. Stannic chloride behaves similarly, but the precipitate is yellow.
—C. A. K.

Laboratory Apparatus. E. Pollak. Rep. Anal. Chem. **7**, 597—599.

Fig. 1 represents a piece of apparatus specially adapted for chlorinations, since the separate portions are joined together by ground glass connections. The neck of the flask is fitted with a short tube open at both ends, into the side of which the delivery tube for the gas is fixed; this last is expanded at the bottom and contains several small holes. The upper portion of the short tube is fitted to the outside of a condenser, which, as shown in the figure, is cooled from the inside. Fig. 2 is a similar form of condenser, cooled from the inside, to be used for extractions. The exsiccator (Fig. 3) is provided with a manometer, to which the exit tube is attached. A cock is provided at the bottom of the exsiccator.—C. A. K.

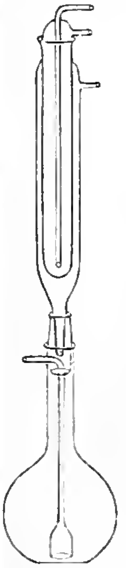


Fig. 1.

Fig. 2.

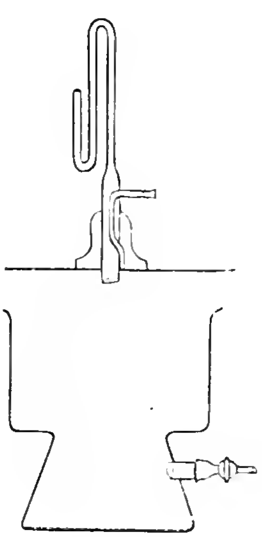


Fig. 3.

Action of Hydrogen Arsenide on Arsenious Anhydride dissolved in Hydrochloric or Sulphuric Acid. D. Tivoli. Rend. R. Acc. Sc. d. 1st Bologna, 1887, 98.

Arsenious anhydride dissolved in water yields no metallic arsenic when treated with hydrogen arsenide, but in presence of hydrochloric or sulphuric acid the following reactions take place:—

$$2AsH_3 + 2AsCl_3 = 6HCl + As_4.$$

$$6AsH_3 + 3(As_2O_2)SO_4 + H_2SO_4 = 4H_2SO_4 + 6H_2O + 3As_4.$$

The reaction is complete in the former instance, and nearly so in the latter.—C. A. K.

New Apparatus for Fractional Distillation. U. Gayon. Ann. Chim. Phys. 1887, 555.

THE author has made use of this apparatus for distilling off the alcohol from fermented solutions. A is the distilling flask, holding 3—4 litres, which is heated in a calcium chloride bath M, or better, by means of steam generated from the autoclave O, to which the cock *r* is attached. To prevent the augmentation of the volume of the liquid in A by the condensed steam the flask is surrounded by a water bath; M is a water manometer. The fractionating column consists of a series of glass tubes separated from one another by metal plates P (Figs. 2 and 3). The tubes are supported by iron rods T fixed in the metal plates at *t* (Fig. 3). The plates are open in the centre and are covered by pieces of tinned or silvered-copper foil full of numerous small holes of 1mm. diameter. The tube G holding the reversed glass siphon S is fixed as shown in Fig. 2. E is a small piece of tin foil, and C a piece of indiarubber. The longer limb of the siphon contains a small hole at O to allow the liquid condensed above the plate to run down to the next lower division of the dephlegmator. At the top of the apparatus the tube C (Fig. 1) is fixed, and inside it the tube D, which is connected with a vertical condenser at A (not shown in figure). In D a liquid of constant boiling point is placed and also some platinum wire to render the boiling regular. By this means a constant temperature is maintained at the top of the column. The tube C is connected with the exit tube T, in which the thermometer is fixed and from which a second tube branches off leading to the condenser. When in use the glass siphons soon become filled with the less volatile portions of the liquid distilled, causing the vapours to pass through the small holes of the plate O (Figs. 2 and 3). With a column consisting of 12 plates and with pure alcohol in the analyser D, the strength of the alcohol distilled from wine or other fermented liquids is 94—95 per cent.—C. A. K.

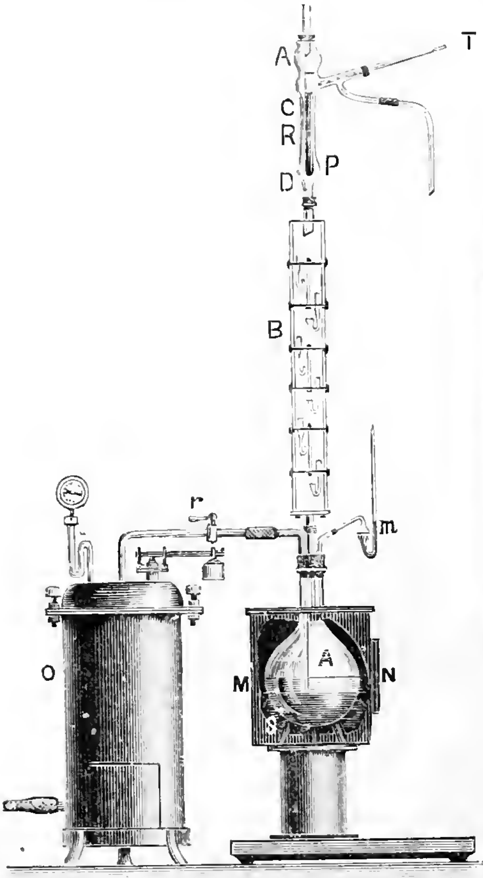


FIG. 1.

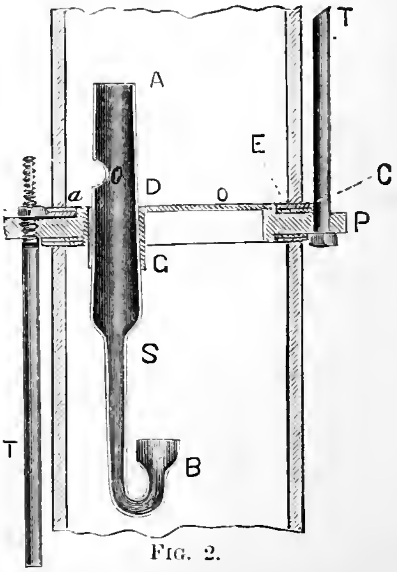


FIG. 2.

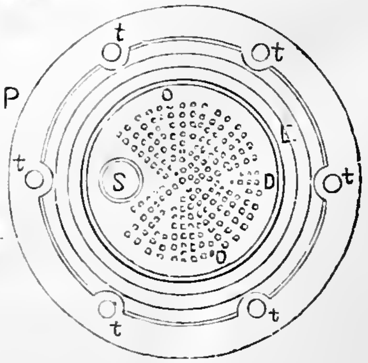


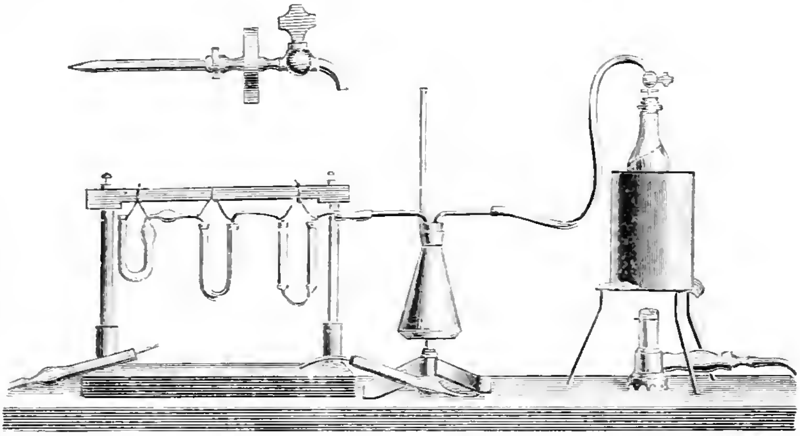
FIG. 3.

New Method for the Quantitative Determination of Phosphoric Acid in Thomas-slag. J. H. Vogel. Rep. Anal. Chem. **7**, 568—573.

0·5GRM. of the well-sampled slag is heated with 50cc. on dilute hydrochloric acid (sp. gr. 1·030—1·025) for 24 hours in a beaker with occasional stirring. With the exception of carbon and a little gelatinous silica everything goes into solution; this residue is filtered off and washed with 50—60cc. of the dilute acid. The filtrate is evaporated to dryness in a porcelain or platinum crucible and dried at 108—110° for half-an-hour. When cold the residue is treated with 10cc. of conc. nitric acid, and then with 20—25cc. of hot water. All but the last traces of silica are thus got rid of, and the determination of the phosphoric acid consequently rendered more accurate, the presence of silica, according to the author, involving low results. The small quantity of silica left in the solution is without effect, provided the molybdic acid precipitate is thoroughly washed. The silica, after the treatment with nitric acid, is filtered off and the phosphoric acid precipitated by ammonium molybdate as usual. Thomas-slag is similarly decomposed by other dilute acids (nitric and sulphuric), although hardly so effectually as by hydrochloric acid. The results obtained by the above method are slightly higher than when no removal of silica is effected, or when Brunnemann's method (see this Journal, 1887, 304) or the method proposed by the author, of treating the slag with a mixture of hydrochloric and nitric acids (see this Journal, 1887, 679) is employed.—C. A. K.

The Estimation of Carbonic Acid in Beer. C. A. Crampton and T. C. Trescot. Amer. Chem. J. 9, 290—293.

THE method applies only to bottled beer. The carbon dioxide is allowed to escape from the bottle by boring through the cork with a champagne tap, the thread of which has been turned off and the tube left smooth (see figure), and passes first through an Erlenmeyer's flask and then through U-tubes containing sulphuric acid, calcium chloride and soda lime successively, the whole being arranged as shown in figure. The Erlenmeyer's flask serves both to catch and to break up the froth coming over from the bottle. Towards the end of the operation the contents of the bottle are warmed to 80° and finally a current of air (freed from CO_2) is drawn through the system of U-tubes. With patent rubber-stoppered beer bottles the carbon dioxide cannot be determined in this manner and the method of total loss is adopted, the bottle, together with the drying tubes, connections, etc., being weighed before and after the determination. The authors find as a mean of 16 results 0·398 per cent. of CO_2, the quantities varying from 0·219 per cent. to 0·629 per cent. Most authorities give an average of 0·1 to 0·2 per cent. of CO_2 in beer.—C. A. K.



On Sulphurous Acid and Iodometry. J. Volhard. Annalen, 242, 93—113.

BUNSEN explains the well-known fact, that in his iodometric method the sulphurous acid is not completely oxidised to sulphuric acid unless the sulphurous acid solution is very dilute—(*i.e.*, 0·03—0·04 per cent. sulphur dioxide), by the supposition that in a more concentrated solution the sulphuric acid first formed is again reduced by the hydriodic acid. Now this explanation, though it has never been experimentally proved, has been universally accepted and is often cited as an instance of a reversable reaction. The author has carried out numerous experiments on the subject, with the following results:—(1.) The presence of even 10 per cent. of sulphuric acid does not influence the correctness of the results. The reduction of *sulphuric acid* is not therefore the cause of irregularities when strong solutions are used. (2.) When the iodine solution is run into the sulphurous acid solutions, the results are never so concordant (even with a 0·0153 per cent. solution; factor of iodine solution = 0·1013) as when the sulphurous acid solution is run into the iodine solution, when concordant results are obtained, even with a 2 per cent. solution of sulphurous acid. The necessity of an excess of the oxidising agent at the commencement of the experiment is therefore apparent. (3.) The supposition that possibly a portion of the sulphurous acid is converted into dithionic acid ($2SO_3H_2 + 2I = S_2O_6H_2 + 2HI$) was not borne out by experiment. The correct explanation can therefore alone be based on the following observations:—(1.) Sulphur dioxide is reduced by hydriodic acid: iodine, water, and sulphur (and a little hydrogen sulphide) being formed. (2.) A solution of hydriodic acid similarly reduces a concentrated solution of sulphurous acid. The iodine is not, however, liberated, but in presence of the water at once oxidises a further portion of sulphurous acid to sulphuric acid. The final result of the reaction is therefore a conversion of the sulphurous acid into sulphur and sulphuric acid:—$3SO_2 + 2H_2O + 4HI = 2SO_4H_2 + S + 4HI$. The ratio of sulphur, as sulphuric acid, to free sulphur was proved quantitatively. We here have a very neat example of so-called catalytic action. Now when iodine and sulphurous acid solution are mixed, hydriodic acid is formed, and this may cause a further reduction of a further portion of the sulphurous acid. This is of course more liable to occur, even when dilute solutions are used, when the iodine solution is run into the sulphurous acid solution than when the reverse takes place. It is interesting to note here that the prolonged action of alkaline sulphites exerts a similar action on sulphurous acid: sulphur and sulphuric acid being formed, hydro-sulphurous acid being formed as an intermediate product. When concentrated solutions are used, not a colourless solution, but a slightly yellow one, is obtained, which does not turn starch blue; the colour is therefore not due to free iodine.—F. W. T. K.

Examination of Crude Soda-liquors and Mother-liquors. W. Kalmann and J. Spüller. Dingl. Polyt. J. 264, 456—459.

THE authors propose to determine the composition of crude soda- and mother-liquors in the following manner, instead of by the method at present in use. The separation of the Na_2SO_3 from $Na_2S_2O_3$ by the author's method depends on the almost complete insolubility of $BaSO_3$ in alkaline liquids, whilst BaS_2O_3, in the state of dilution dealt with, remains in solution. Experiments carried out with solutions of known composition showed that only a very slight, negligable amount of BaS_2O_3 remained in the precipitate. The method of procedure is shortly as follows.

1. In a measured volume of the liquor the total alkali is determined with normal acid and methyl-orange as indicator. The amount of acid used corresponds to the amount of sodium carbonate + sodium sulphide + sodium hydroxide + half the sodium sulphite. (Methyl-orange is alkaline to Na_2SO_3, neutral to $NaHSO_3$.)

2. An equal volume of the liquor is titrated with a decinormal iodine solution, after acidification with acetic acid and addition of starch-paste. The iodine used corresponds to the amount of sodium sulphide + sodium sulphite + sodium hyposulphite.

3. Twice the volume of the liquor employed in (1) and (2) is precipitated with alkaline zinc solution, the liquid made up to a certain volume, one-half filtered off, acidified with acetic acid and titrated with decinormal iodine solution and starch paste. The iodine used corresponds to the sodium sulphite + sodium hyposulphite.

4. Three or four times the volume of the liquor taken in (1) and (2) is decomposed with barium chloride in excess, made up to a given volume with boiled water, and the precipitate filtered off; *a*, one-third or a quarter is titrated with normal acid. The acid used corresponds to sodium hydroxide + sodium sulphide; (*b*) another third or quarter of the filtrate is acidified with acetic acid and titrated with decinormal iodine solution. The iodine used corresponds to the sodium sulphide + sodium hyposulphite.

The calculation then is:—

$2 - 4b$ = A cc. of decinormal iodine solution corresponding to Na_2SO_3.

$2 - 3$ = B cc. of decinormal iodine solution corresponding to Na_2S.

$4b - (2 - 3)$ = C cc. of decinormal iodine solution corresponding to $Na_2S_2O_3$.

$4a - \frac{1}{10}B$ = D cc. of decinormal acid corresponding to NaHO.

$1 - (4a + \frac{1}{20}A)$ = E cc of decinormal acid corresponding to Na_2CO_3.

The numbers are then calculated on the litre of liquor. Analyses are given, showing the fairly concordant results obtained by the method, which answers well for all practical purposes. (Compare *Dingl. Polyt. J.* **237**, 308.)—G. H. M.

Liebermann's Reaction for Albumen. C. le Nobel. Centralbl. f. die Med. Wissensch. **25**, 625.

THE author confirms the accuracy of Liebermann's results (*Chem. Zeit. Rep.* **11**, 130. With a sample of pure peptone prepared from fibrin according to Kühne's method and which was not precipitated by either acids, alkalis, ammonium sulphate, or acetic acid and neutral alkaline salts, and which gave the red coloration with the biuret test, the reaction with hydrochloric acid gave no result. Whether the presence of albumen in urine can be detected by this test cannot be stated with certainty, but in one case in which it was present by the microscope and all the usual albumen reactions failed, this test answered extremely well.

The author has further succeeded in detecting globulin in urine by saturating a large quantity of the former with magnesium sulphate.—C. A. K.

Detection of Woody Fibre in Paper. E. Hanansek. Ztschr. f. Nahrungmittelrentersuch u. Hygiene, 1887, **1**, 153.

THE author examined several varieties of wood cellulose which did not give the usual colour reactions with aniline or phleroglucinol, and considers, therefore, that in order to detect woody fibre in paper both a microscopical and chemical examination should be made.
—C. A. K.

Separation of the Opium Alkaloids. P. C. Plugge. The Analyst, **13**, 197—200.

To the solution of the free alkaloids add sodium acetate.

(*a*) Precipitate: Narcotine and papaverine.

(*b*) Filtrate: Narceine, thebaine, codeine, and morphine.

(*a*) Dissolve in least possible quantity of HCl and dilute the solution so that 100cc. contains only 0·25grms. of alkaloids, and precipitate with K_3FeCy_6; precipitate is papaverine hydroferrocyanate, which may be weighed as such. Filtrate contains the narcotine, which can be obtained as pure alkaloid by addition of ammonia.

(*b*) Filtrate (from sodium acetate precipitate) concentrate on the water bath to small volume when the narceine crystallises out, only 0·16grm. remaining in 100cc.

(*c*) Filtrate contains thebaine, codeine, and morphine. Add concentrated sodium salicylate solution and allow to stand for 24 hours.

(*d*) Precipitate: Thebaine salicylate; weighed as such.

(*e*) Filtrate: Add HCl. The excess of salicylic acid is precipitated and may be filtered off, and the filtrate is shaken out with chloroform, which removes traces of salicylic acid, narceine, and thebaine.

(*f*) The solution, after extraction with chloroform, contains the codeine and morphine. Concentrate on water-bath, and add potassic sulphocyanate.

(*g*) Precipitate: Codeine hydrosulphocyanate, weighed as such.

(*h*) Filtrate contains morphine and a little codeine, which has escaped precipitation. Add a little ammonia, allow to stand for some time in a separating funnel and shake out repeatedly with chloroform, which removes the last traces of codeine. Separate the aqueous solution, acidify with HCl, heat to about 60° C., render alkaline with NH_3 and shake out the morphine with amyl alcohol.

The experimental results given are very satisfactory.
—J. W. L.

Detection and Direct Estimation of Starch in Solutions containing Dextrin. G. Burkhard. Chem. Zeit. **11**, 1158.

THE qualitative test for starch in presence of dextrin is to add alcohol to the cold solution until it just becomes turbid, when the solution is warmed until the turbidity disappears. The starch is then precipitated by tannic acid solution, filtered off, washed with alcohol, dried and tested for on the filter paper with a dilute iodine solution. In applying this method of separation to the quantitative estimation of starch the precipitation is similarly effected, the tannic acid completely removed by washing with alcohol, and the residue (filter paper and starch) heated with 1cc. of normal sulphuric acid and 20cc. of water for 4 hours to 115° C. in a paraffin bath. After the heating (which is done in a Lintner's pressure flask), the solution is filtered and the sugar formed determined by Fehling's solution. The quantity of sugar found, multiplied by 0·9, gives the amount of starch. Allihn's table for reckoning the quantity of copper solution used should be employed.—C. A. K.

Determination of Ash in Organic Substances. A. Köbrick. Chem. Zeit. **11**, 1159.

5—10GRMS. of substance are heated in a platinum dish to begin with, as the loss is less than when a platinum crucible is used, the tendency of the substance after being first ignited to creep over the sides of the vessel being reduced. If the sample examined be readily burned, the ignition is completed in the dish; if not, the residue is broken up, transferred to a platinum crucible, and heated in a current of oxygen. The oxygen is passed into the crucible by a pipe-clay tube (such as is used for the reduction of a metallic oxide in a crucible) and may be generated for the purpose from potassium chromate and sulphuric acid or from potassium permanganate and nitric acid, the gas being washed with water. The organic matter is burned away completely and quietly, so that there is no chance of loss by spirting. Any particles of carbon remaining in the ash, in case it is fusible, are removed by exhausting with water and concentrating carefully, when the light carbon particles remain on the surface and are readily oxidised.—C. A. K.

Notes on the Soda-Lime Method for Determining Nitrogen. W. Atwater and C. Woods. Amer. Chem. J. **9**, 311—324.

FROM a series of determinations of the nitrogen contained in animal tissues, the authors consider the soda-lime method quite reliable, results by this method agreeing accurately with those obtained by the volumetric process. The composition of the soda lime is without appreciable effect on the results; nor does a difference in the temperature of combustion, or of the length of the tube, affect the accuracy of the method. In testing the purity of the soda lime by sugar it was found to contain traces of nitrogen, while, when burnt with stearin or oxalic acid, it appeared quite free from it, the traces of nitrogen being, therefore, in the sugar, which it is advisable to replace for this purpose by the above substances.—C. A. K.

Testing of Commercial Quinine Sulphate. G. Kerner and A. Weller. Arch. Pharm. 1887, 712 and 749.

THE authors give the following directions for the ammonia test:—Allow the sample to effloresce completely in a warm place (40—50° C.), and then treat 2grms. with 20grms. of water in a suitable test tube. Heat the tube for half-an-hour in a water-bath to 60—65°, and afterwards allow it to cool for two hours in a water-bath at 15°. Both during the heating and cooling it is necessary to shake the contents of the tube well from time to time. Next filter the solution, take 5cc. of the filtrate and add to it ammonia of specific gravity 0·960. It is important that the temperature of the cooling bath should be as nearly as possible exactly 15° before filtering. The ammonia is added until the precipitate first formed is just dissolved. Pure quinine sulphate requires 3·4—3·5cc. of ammonia; when mixed with 3 per cent. of pure cinchonidine sulphate, 4cc. of ammonia are needed, and with 7 per cent. about 6cc. In the better classes of commercial quinine sulphate the quantity of cinchonidine sulphate at present is 2—6 per cent.

The authors contend that thus modified the ammonia method is the safest and simplest known for the detection and estimation of admixed alkaloids in quinine sulphate. Hesse's ether test, which differs from the above by the substitution of ether for ammonia, for cinchonidine, takes longer and depends too much on the quality of the ether employed.

De Vrij's chromate method (see this Journal, 1887, 151, 306, and 388) is open to the objections that pure quinine sulphate is not completely precipitated as chromate, and that the quantity of the precipitate, obtained by the addition of alkali to the filtrate, is not appreciably different with pure quinine or when 2—2·5 per cent. of cinchonidine is present; also less than 3·5 per cent. of quinidine cannot be detected. In Schäfer's oxalate method (see this Journal, 1887, 522) a portion of the cinchonidine remains behind with the quinine oxalate, while varying quantities of quinine pass into the filtrate. The bisulphate method (see this Journal, 1887, 455) is of use in the removal of cinchonidine in the preparation of quinine, but as a test it is unreliable, as the cinchonidine is not completely precipitated from the ethereal solution, and then it has to stand for 24 hours.

These criticisms, which are based on numerous analyses, show that the chromate and oxalate tests can only determine whether, in the sample examined, a certain small percentage of cinchonidine is exceeded or not.
—C. A. K.

Gypsum and Calcium Sulphide in Bone Charcoal. Ztschr. f. Zuckerind. 1887, 704.

IF, in determining the calcium sulphide in bone charcoal, the moist sample be dried at or about 100°, a portion of the sulphide is oxidised to sulphate, owing to the formation of hydrogen peroxide. The charcoal is therefore best dried at the ordinary temperature, and treated with hydrochloric acid after the addition of zinc (to reduce the ferric oxide), and the sulphuretted hydrogen absorbed in an ammoniacal silver solution, the silver sulphide formed being either weighed directly or else as metallic silver by reduction in a current of hydrogen. A better plan is to dissolve the sulphide in nitric acid, and titrate the solution with ammonium sulphocyanide, according to Volhard's method. With 20grms. of substance the results only differ by 0·003—0·005 per cent. The removal of gypsum from bone charcoal, by means of sodium carbonate, is best effected by using one mol. of the latter for each mol. of calcium sulphate, and is the more readily done the higher the temperature. Digestion for four days is sufficient, for, although the extraction is only completed after 15 days at ordinary temperatures, after the fourth day the quantity of calcium sulphide gradually increases, owing to the reduction of the gypsum in solution by bacteria (Beggiota alba ?). Washing with dilute hydrochloric acid does not appreciably diminish the amount of calcium sulphide present in the charcoal, but bringing the moistened substance in contact with air does, owing to the oxidation by hydrogen peroxide.—C. A. K.

Examination of Gun Cotton. Dingl. Polyt. J. **265**, 332.

IN a recent communication Wisser gives the results of experiments on the chemical examination of gun cotton. Moisture and calcium carbonate were determined in the usual way. The ash was found, after removal of the calcium carbonate, by treating a weighed quantity in a tared platinum crucible with concentrated nitric acid, carefully evaporating to dryness and igniting the residue; the increase of weight gives the ash. The nitrogen was determined with a Lubarsch's nitrometer. Mono- and di-nitrocellulose were found, when 5grms. of the cotton wool were treated first with 200grms. of a mixture of ether and alcohol in the ratio of 3 : 1 for 12 hours; then, with the same amount in the ratio of 2 : 1 for six hours, and finally with the same amount of 1 : 1. After standing some time the liquid was poured off through a tared filter, the residue washed twice with pure alcohol, twice with dilute alcohol, and then several times with water: it was then collected on the filter, dried at 60°, and weighed; the loss of weight gave the lower nitro-bodies. For the determination of the unnitrated cellulose a weighted quantity of the gun-cotton was boiled for 15 minutes in a concentrated solution of sodium stannate, which dissolves out the nitrated cellulose; the residue is filtered off, washed, dried at 100°, and weighed. The tin salt must be freshly prepared each time by melting caustic soda with tin and dissolving the product.—G. H. M.

Detection of the Adulteration of Olive Oil with Vaselin Oil. J. Birl. Archiv der Pharmacie, **225**, 310.

LATELY the fat oils have been much adulterated with vaselin oil; olive oil has also suffered in this respect, and is consequently unfitted for pharmaceutical purposes, since the oil adulterated in this way gives neither a proper plaster, soap, nor liniment. The author has now devised a new method for detecting vaselin oil in vegetable oil, which promises to be very useful. He tests the vegetable oil for mineral oil by titration with standard alcoholic potash. 65grms. of the purest potash are dissolved in 1 litre of 95 per cent. alcohol, and the solution made of such a strength that 10cc. are neutralised by 10cc. of normal sulphuric acid; this solution will keep well. 10grms. of the oil to be examined are heated to boiling for 10 minutes in a porcelain dish with 40cc. of the potash solution; water is then added until the volume is 100cc. The mixture is again warmed with shaking, whereby the soap formed goes into solution, and titrated with normal acid in the ordinary way, using phenolphthalein as an indicator. Pure oils require 6cc. of acid (with the exception of castor oil and the oils from the *Cruciferæ*, which require 7—8cc.), vegetable oil with 10 per cent. of mineral oil requires 8cc., with 20 per cent of vaselin oil 11cc.; the adulterated oils of commerce, examined by the author, required 14 to 17cc. of normal sulphuric acid. (Compare Focke, this Journal, 1886, 176.)—G. H. M.

Trade Report.

(From the Board of Trade and other Journals.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

RUSSIA.

Customs Decisions.

(Poud = 36lb. avoirdupois. Gold rouble = 3s. 2d.)

The following decisions affecting the classification of articles in the Russian Customs Tariff have recently been given by the Russian Government.

Ozokerite, not bearing traces of chemical purification by means of sulphuric acid.—Section 16. Duty, 5 copecks per poud gross, with an addition of 20 per cent. on each rouble of duty leviable.

Ozokerite chemically purified with sulphuric acid.—Section 26, Part 6. Duty from 30 copecks to 1 rouble per poud, with an addition of 20 per cent. on each rouble of duty leviable.

Essences containing spirit.—Section 77. Duty, 75 copecks per bottle.

Starch paste, with an admixture of chloric zinc.—Section 45. Duty, 1 rouble per poud, with an addition of 20 per cent. on each rouble of duty leviable.

Pigment of coal tar.—Section 120. Duty, 15 roubles per poud.

Dry paper pulp, impregnated with coal tar.—Section 140. Duty, 2 roubles per poud, with an addition of 20 per cent. on each rouble of duty leviable.

SPAIN.

Regulations respecting the Importation of Alcoholic Liquors.

See *Board of Trade Journal* for December, p. 596.

UNITED STATES.

Customs Decisions.

Thymol or thymic acid, an article not enumerated by name in the existing Tariff Acts, upon investigation, is found to be commercially known as an acid, and to be used chiefly for medicinal purposes, both externally and internally, and it is therefore held that it is entitled to free entry, under the provision in the free list, No. 594, for "acids used for medicinal purposes, not specially enumerated or provided for."

Certain so-called "wool grease," which upon investigation is found to consist of an expressed oil of wool, commercially known as solid fat oil of animal origin, is held to be dutiable at the rate of 25 per cent. *ad valorem*, under the provision in section 92, for all "preparations known as expressed oils."

BRAZIL.

New Customs Tariff.

(Continued from October No. of the Journal.)

(*Note.*—Kilogramme = 2·204lb. avoirdupois. Milreis = 2s. 3d. —nominal value.)

No. in Tariff.	Articles, etc.	Rates of Duty.	
	XXVI.—METALLOIDS AND MISCELLANEOUS METALS.		
805	Aluminium	Kilog.	16,000
806	Antimony	,,	200
807	Arsenic	,,	450
808	Bismuth	,,	1,600
809	Bromium	,,	1,200
810	Cadmium	,,	1,600
811	Chlorine dissolved or chlorine solution	,,	500
812	Sulphur:		
	In sticks	,,	10
	Sublimate or flowers of sulphur	,,	30
813	Iodine	,,	2,500
814	Mercury, metallic, or quicksilver	,,	500
815	Nickel in cubes for galvanising, etc.	,,	800
816	Phosphorus, white or yellow, in lumps or in sticks	,,	650
817	Sodium	,,	2,500
818	Metals or metalloids, not otherwise mentioned	Gramme	30

TRADE BETWEEN SPAIN AND THE UNITED KINGDOM.

Imports into the United Kingdom from Spain.

PRINCIPAL ARTICLES.		Oct. 1886.	Oct. 1887.
Chemical products unenumerated ...	Value	£1,396	£6,394
Copper ore and regulus	Tons	6,415	5,378
	Value	£92,908	£96,758
Manganese ore	Tons	..	550
	Value	..	£1,650
Pyrites of iron or copper...	Tons	29,641	32,054
	Value	£55,880	£62,995
Quicksilver	lb.	3,825	12,600
	Value	£380	£1,200
Rags, Esparto	Tons	3,908	3,384
	Value	£23,019	£20,001

Total Value	1886.	1887.
October	£910,778	£1,134,399
November	£881,052	£918,301

Exports of British and Irish Produce from the United Kingdom to Spain.

PRINCIPAL ARTICLES.		Oct. 1886.	Oct. 1887.
Alkali	Cwt.	23,636	24,629
	Value	£7,725	£7,983
Caoutchouc manufactures	Value	£2,265	£2,397
Cement	Tons	1,065	240
	Value	£1,874	£417
Chemical products and preparations (including dyestuffs)	Value	£6,636	£3,870
Coal products (including naphtha and petroleum)	Value	£1,938	£2,563
Glass manufactures	Value	£564	£1,038
Manure	Value	£10,125	£23,272
Painters' colours and materials	Value	£2,393	£1,565
Paper of all sorts	Cwt.	712	517
	Value	£1,697	£1,275
Soap	Cwt.	597	146
	Value	£493	£146

Total Value	1886.	1887.
October	£301,133	£262,089
November	£212,815	£272,223

Summary Statement showing the Trade between Spain and the United Kingdom during the period subsequent to the Conclusion of the Commercial Treaty, compared with the corresponding Period of the previous Year.

Months.	Imports into the United Kingdom from Spain.		Exports of Produce and Manufacture of United Kingdom to Spain.		Exports of Foreign and Colonial Produce to Spain.	
	1885-86.	1886-87.	1885-86.	1886-87.	1885-86.	1886-87.
	£	£	£	£	£	£
December	924,165	867,183	241,868	253,238	69,910	59,020
January	635,256	818,935	240,097	235,826	69,676	31,821
February	940,906	890,692	244,033	297,122	52,034	37,317
March	845,407	906,072	286,698	327,115	67,113	74,493
April..........	781,457	799,058	273,115	246,897	96,222	108,699
May	759,616	780,764	222,129	265,780	55,343	78,922
June	699,338	718,561	262,576	302,019	86,162	69,344
July	495,361	681,501	221,722	264,521	51,785	50,077
August	548,550	660,821	233,447	313,297	44,102	43,623
September....	719,560	740,363	328,466	304,001	32,441	49,469
October	910,778	1,134,399	301,133	262,089	59,358	57,810
November	884,052	918,304	242,815	272,223	54,638	66,958

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

Industrial and Commercial Museum at Lisbon.

See *Board of Trade Journal* for December, p. 638.

Dutch Colonies.

Java Indigo.

The indigo crop of 1886 was satisfactory, both as regards quality and quantity. During the year 612,000kilos. were exported from Batavia, against 601,000kilos. in 1885, and an average export of 122,000kilos. from 1880 to 1884. The high prices which ruled at the commencement of 1886 could not be maintained, and the season closed at decidedly lower rates than the one preceding. Prices, in fact, were so low that the planters would not sell outright, but preferred to ship the bulk of the crop to Holland for their own account. The finest varieties are becoming more and more scarce. The 1887 crop does not look favourable as regards quantity, having suffered from excessive rains and insects.

Tunis.

Condition of the Country.

In a country which, like Tunis, depends for its commercial prosperity on the productions of the soil, there is little change from year to year in the totals of its exports and imports, unless a year of drought should cause a failure of the crops. Such a calamity has not befallen the land since France took it under her protection in 1881. In spite, however, of the continuance of agricultural prosperity, the trade of Tunis languishes. commercial failures are of unusual frequency, and small merchants find it increasingly difficult to obtain credit.

British Trade.

England continues to occupy the first place in the imports. Her pre-eminence is due to the cheapness and excellence of the products of Manchester and Glasgow. What is chiefly needed to give a stimulus to British import trade is the establishment of direct steam communication with Liverpool, which would permit of the introduction of British goods at cheaper freights. English commercial firms might then hope to sell in Tunis many articles which are at present hardly known in the Regency.

The Cork Forests.

The forests of Tunis cover an appreciable part of the surface of the country, and their care has been placed under the management of a separate department by the French. The explorations of the new department have resulted in the division of the forests into two main groups; one consisting of the cork tree and deciduous oak, locally known as "Zen," covering the north-western angle of Tunis where it abuts on the Algerian frontier and the sea, inhabited by the Kroumirs, and separated from the rest of Tunis by the river Mejerdah. These trees grow in a stratum of sandstone, which again reposes on the upper chalk, and they completely disappear where the latter stratum crops to the surface. They cover an area of about 360,000 acres, on 330,000 acres of which flourishes the cork tree, and on 30,000 the "zen." It is found that the former invariably grow on the southern slopes of the mountains; the latter on the northern slopes, and in the hollows of valleys.

Red Gum Trees.

The French railway company which owns the line running from Tunis to the Algerian frontier, has succeeded in planting a considerable number of the *eucalyptus resinifera* (red gum trees) and *acacia cyanophyla*. It is estimated that 300,000 trees have been planted along the line of railway. The cost of planting an acre with the eucalyptus amounts to £20, about 1,600 trees going to the acre of nursery ground. After planting out, it is probable that at the end of twenty years 600 trees will have survived, worth 8s. apiece. The bark of the *acacia cyanophylla* is rich in tannin, and valuable for the tanner.

Saleable Drugs and Chemicals.

The total value of drugs and chemicals imported during 1886 was £25,643, but there are no detailed figures given of the imports from the different nations trading with Tunis, and only this much can be said with certainty, that in the general imports, Great Britain occupies the first, and France the second place. The Germans have made many unavailing efforts to gain a footing in the drug and chemical line. There is scarcely any industry extant in Tunis in which chemical products can find employment, and the consumption is, therefore, limited to a few articles only. Painters' colours, ultramarine (but only the cheapest qualities, powdered and in ball form), indigo, and incense, are the only articles which are employed largely, and which it will pay to import direct. Most other goods are taken in small quantities, and can only be imported economically assorted with other goods. The same is the case with pharmaceutical articles. The laboratories of the Tunisian pharmacies are generally of a very primitive character, and, wherever possible, the pharmacist prefers to buy the preparations put up ready for sale. Manufacturing firms and wholesalers who sell crude products only have, therefore, little chance of doing a large trade, but not so firms who, in addition to quinine, iodine, magnesia, etc., also offer specialities, such as mustard plasters, fluid preparations, and patent medicines of all varieties.

Hayti (San Domingo).

Logwood.

The logwood trade has been much depressed lately, mainly in consequence of excessive competition. There is a very good demand—larger, in fact, than the supply—for the better varieties of logwood. In consequence a good deal of inferior wood is brought down from the interior, and these shipments give rise to claims on the part of the receivers in Europe. The exports from Hayti fell from 293,518,750lb. in 1885 to 273,526,277lb. in 1886. The decrease is principally owing to reckless destruction of the woods and to the haste with which young trees are felled before they have attained maturity, and by the wretched condition of the roads in the island, which are never repaired, and have now become so bad that it is impossible to bring down the fine trees which are still found plentifully in the interior. In the coast districts there is no wood left.—*Chemist and Druggist.*

MISCELLANEOUS TRADE NOTICES.

Exportation of Pine-Bark from Turkey.

The Belgian *Bulletin du Musée Commercial* for the 19th November last, states that Turkish pine-bark, used for dyeing and for the preparation of skins, is now forming an important branch of exportation from the Turkish Empire. The bark is usually sent, in the first instance, either to Syra or to certain parts of Italy. For some time the exportation of pine-bark from Turkey was prohibited, at the request of the Department of Mines and Forests, but this embargo has now been removed, and the trade is once more active.

Indiarubber Trade in Holland.

The *Moniteur Officiel du Commerce* for the 10th November last states, on the authority of the Belgian Secretary of Legation at The Hague, that a few years ago there existed no india-rubber manufactory in all Holland, and that the Dutch merchants were obliged to buy all their goods either in Germany or in England. At the present time two manufactories exist, but they are far from satisfying the requirements of the country, for there are still imported annually into Holland a value of 60,000 florins in articles of india-rubber and gutta-percha. The Belgian Secretary recommends the Belgian manufacturers of these goods to make their products known in Holland.

STATISTICS.

A Few Indian Statistics.

A recent statistical abstract relating to British India contains a mass of interesting information concerning our great dependency, and is well worth the perusal of anyone who is not afraid of three hundred closely-printed pages of statistics. The total population of India, according to the census of 1881, was 253,982,595 (including 55,191,742 in the native states), occupying an area of 1,378,044 square miles; the density of population in the provinces under direct British control being more than 25 per cent. greater than in the native states. As might be expected, a larger number of people are employed in agriculture than in any other branch of occupation; the next largest section being formed by those engaged in industrial pursuits. Chemical industries give employment to 81,033 workers, 19,813 of whom are women. No less than 762,787 persons (including 273,169 women) are engaged in the collection and preparation of gums and resins. The shellac industry, which is classed in one category with ivory, bone, etc., occupies 107,996 people, but in this branch women are more than twice as numerous as men. One solitary individual among what orators call the "teeming millions" is classified as a worker in surgical instruments; but on the other hand "physicians, surgeons and druggists" are well to the fore, their combined number being 188,818, of whom 113,579 are males.

The value of the sea-borne imports into British India (excluding Government stores and treasure) was 518,115,800 Rs. in 1886, against 531,493,110 Rs. the year before; but the latter figure, it should be added, was far above the usual average. Besides the sea imports, goods to the value of 49,916,030 Rs. in 1886, 53,314,030 Rs. in 1885, and 53,112,510 Rs. in 1884, were carried into British India overland. Among the imports by sea occur the following items directly or indirectly connected with the drug trade :—

	1884.	1885.	1886.
	Rs.	Rs.	Rs.
Drugs and Medicines	362.8140	358.2780	340.0830
Dyes	251.4220	214.9520	225.7180
Glass, and Manufactures of	560.0620	499.7010	505.2040
Gums and resins	115.6770	98.8070	96.9900
Quicksilver	40.1080	10.9430	23.5610
Oils	654.2270	1,229.4960	961.1300
Paints and Colours, etc.	239.2410	201.9640	211.8060
Perfumery	61.0120	66.2700	55.7110
Spices	557.1090	602.1650	718.6780

The following are among the exports:—

	1884.	1885.	1886.
	Rs.	Rs.	Rs.
Drugs and Medicines	134.2990	199.1950	192.6050
Dyes: Indigo	4,640.9910	4,068.9000	3,783.1600
Other (except Lac)	272.5920	317.2240	469.3690
Gums and Resins	397.2010	361.8890	193.1760
Lac (Dye, Shell, etc.)	556.7380	599.9820	586.6100
Oils	520.1740	564.7460	412.1980
Opium	11,294.4600	16,882.6060	10,735.5180
Spices	400.9300	514.5800	528.5670

For Government account 130,960 Rs. worth of drugs and medicines were also imported into India in 1886, against 152,280 Rs. in 1885, and 141,330 Rs. the year before.—*Chemist and Druggist.*

BOARD OF TRADE RETURNS.

Imports.

		Nov. 1885.	Nov. 1886.	Nov. 1887.
Drugs, unenumerated	value £	71,311	52,802	59,928
Chemical manufactures and Products, unenumerated—	value £	112,850	93,663	109,546
Chemicals and Dye-stuffs unenumerated	value £	148,820	190,100	135,393
Oils, not enumerated	value £	106,310	106,109	114,655
Alkali	cwt.	4,643	6,763	4,895
"	value £	3,827	5,614	4,091
Brimstone	cwt.	57,219	91,900	41,437
"	value £	14,110	21,117	11,028
Nitre (nitrate of soda)	cwt.	248,265	78,010	116,252
" "	value £	134,721	34,995	52,531
" (nitrate of potash)	cwt.	22,566	20,300	18,427
" "	value £	19,909	17,655	15,669
Quicksilver	lb.	35,551	75,300	28,000
"	value £	3,631	6,885	3,630
Bark (Cinchona)	cwt.	12,800	10,220	8,662
"	value £	91,340	59,819	35,558
Gum Arabic	cwt.	9,139	7,128	6,271
"	value £	33,027	31,373	27,119
Lac, seed, shell, stick, and dye	cwt.	7,236	3,781	2,700
Lac, seed, shell, stick, and dye	value £	22,990	10,217	7,302
Barks and tanning materials—				
Bark (for tanners' or dyers' use)	cwt.	23,259	25,636	11,076
Bark (for tanners' or dyers' use)	value £	7,752	9,804	2,625
Aniline dyes	value £	18,038	25,307	23,791
Alizarin & other coal-tar dyes	value £	29,154	19,836	29,941
Cochineal	cwt.	1,808	1,975	883
"	value £	10,980	12,633	5,473
Cutch and gambier	tons	1,360	2,601	2,217
"	value £	31,412	57,725	55,314
Indigo	cwt.	3,759	2,123	883
"	value £	69,147	45,488	20,204
Madder, madder root, garancine, and munject	cwt.	2,471	856	1,372
Madder, madder root, garancine, and munject	value £	3,612	1,072	1,481
Oils—				
Cocoa-nut	cwt.	8,808	23,579	697
"	value £	12,513	31,611	905
Olive	tuns	1,461	1,306	1,091
"	value £	58,950	48,468	39,712
Palm	cwt.	84,212	80,737	98,033
"	value £	93,452	84,810	95,208
Petroleum	gals.	7,412,816	8,278,727	9,410,373
"	value £	229,232	239,217	211,694
Seed, of all kinds	tuns	1,562	1,395	2,160
"	value £	43,261	36,162	53,272
Turpentine	cwt.	30,444	11,941	46,434
"	value £	40,460	51,551	62,538

Exports.

		Nov. 1885.	Nov. 1886.	Nov. 1887.
British and Irish produce:—				
Drugs and medicinal preparations (unenumerated)	value £	78,343	64,991	79,917
Other chemicals and medicinal preparations	value £	297,355	272,291	253,907
Painters' colours and materials	value £	95,163	106,049	114,779
Alkali	cwt.	579,160	552,584	600,682
"	value £	168,839	160,417	161,819
Bleaching materials	cwt.	127,071	115,113	172,670
" "	value £	11,889	49,950	65,187
Oil (seed)	tuns	5,643	6,198	7,704
"	value £	130,174	130,889	158,699
Soap	cwt.	30,291	37,787	36,419
"	value £	35,485	39,720	37,171
Foreign and Colonial merchandise:—				
Chemicals (unenumerated)	value £	17,886	10,528	17,859
Bark, Cinchona	cwt.	10,102	10,060	8,314
" "	value £	62,281	38,310	19,092
Cochineal	cwt.	1,217	1,341	935
"	value £	8,253	9,462	5,522
Cutch and gambier	tons	1,212	839	736
" "	value £	28,330	20,593	21,063
Gum Arabic	cwt.	4,325	1,115	5,101
"	value £	18,197	26,150	21,176
Indigo	cwt.	3,381	3,052	1,916
"	value £	71,472	61,544	40,684
Lac seed, shell, stick and dye	cwt.	5,588	4,522	4,999
" " "	value £	17,958	12,754	12,254
Oils, cocoa-nut	cwt.	3,947	12,178	6,317
"	value £	5,895	18,130	8,258
" olive	tuns	188	111	216
" "	value £	9,957	5,880	8,876
" palm	cwt.	28,510	50,676	55,059
" "	value £	36,383	49,275	53,116
" petroleum	gals.	45,023	51,071	50,091
" "	value £	1,785	2,176	2,223
Quicksilver	lb.	145,696	248,284	458,822
"	value £	11,406	23,256	44,182
Nitre (nitrate of potash)	cwt.	5,719	389	346
" "	value £	4,646	348	364

AN EXPIRING PATENT.

On February 17, 1874, an English agent of Professor Hermann Kolbe, of Leipzig, was granted a patent in this country for "Improvements in the production of salicilic acid, and of the isomeric and homologous acids." The statutory period of fourteen years, during which a patentee is allowed to reap the harvest of his brains, will soon be completed, and it is expected that this circumstance will have a considerable influence on the commercial position of the acid. It will be recollected that this patent was the subject of an expensive lawsuit in 1879, when the case Von Heyden v. Neustadt occupied Vice-Chancellor Bacon for ten days. Dr. Von Heyden, who manufactured the acid by Kolbe's process in Germany, sought to restrain the defendant Neustadt from importing into and selling in this country salicilic acid, manufactured by a process identical with Kolbe's, and for which a patent had been granted in Germany. This was not denied by the plaintiff, but on his behalf it was alleged by counsel and experts that Kolbe's process was well known for many years before it was patented in this country. Kolbe first announced in 1860 that he had succeeded in preparing salicilic acid artificially by acting upon phenol with metallic sodium, simultaneously subjecting the mixture to the action of carbonic acid gas. This process was known to chemists as a beautiful one for experimental or lecture-table purposes, but no one would have dreamed of working it on a commercial scale, nor did Kolbe. But when in 1874 there seemed to be a widening outlet for salicilic acid as an antiseptic, he was ready with a modification of his process, which simply consisted of substituting caustic soda for metallic sodium. It was this new process which was patented in this country, and which was the basis of the action against Messrs. Neustadt & Co. In this action Dr. Von Heyden was successful, and since April, 1879, only Kolbe's salicilic acid, and its compounds, have been used in this country. Consequently the manufacturers could fix their own prices, and they have done so. The expiry of the patent will affect this, whether it be on account of the probable manufacture of the acid in this country or through the importation of the products of other foreign makers. By one way or the other it is almost certain that the coming year will show a substantial fall in the price of salicilic acid.—*Chemist and Druggist.*

THE SUGAR BOUNTIES CONFERENCE.

The members of the International Conference on Sugar Bounties met on the 19th December, at the Foreign Office, and adjourned until April 5th. Baron Henry de Worms presided, and all the representatives attended. The sitting occupied over three hours.

The delegates in the course of the proceedings signed the following Protocol:

"The undersigned, Delegates from Germany, Austria-Hungary, Belgium, Denmark, Spain, France, Great Britain, Italy, the Netherlands, Russia, and Sweden, met at London on November 24th, 1887, to consider the bases of an agreement relative to the suppression of bounties on the exportation of sugar.

"In the course of the deliberations set forth in the minutes of the sittings, an agreement was come to on the principles laid down in the Report of the Commission. In order to give to this agreement a practical application, the President of the Conference placed before them a Draft Convention, which they have examined, and which they pledge themselves to submit to the consideration of their respective Governments, together with a request that those Governments will make known to the Government of Her Britannic Majesty, before the 1st day of March, if they give their adhesion to the principles of this Draft Convention, which is subjoined to the present Protocol. Every Government replying affirmatively will communicate to the British Government before the above-mentioned date a Draft Statement indicating the bases of application of the system of taxation on the quantities of sugar produced. The Draft shall state with what limitations and in what cases use would be made of the saccharometer. Each Government will, at the same time, declare whether, for the sake of uniformity, it would be disposed to admit what is known as the French method, generally employed in the commerce of several nations.

"As regards Article III. of the aforesaid Draft Convention, the French being of opinion that the system proposed for Belgium does not present those guarantees for the suppression of bounties with which the High Contracting Parties are bound to protect themselves, accept this Article with every possible reservation. The Delegates of Germany, Austria-Hungary, Spain, Italy, the Netherlands, and Russia support the reservations made by the French Delegates.

"London, Dec. 19th, 1887."

"Subjoined to the Protocol of Dec. 19, 1887.

"Draft Convention.

"The High Contracting Parties, desiring to bring about the total suppression of bounties, open or disguised, on the export of sugars, have resolved to conclude a Convention to this effect, and have nominated as their Plenipotentiaries the following, to wit:

"Who, after interchange of their full powers, and finding them to be in valid and proper form, have agreed to the following Articles:—

"I.

"The High Contracting Parties pledge themselves to take or to propose to their respective Legislatures such measures as shall constitute an absolute and complete guarantee that no bounty, either open or concealed, shall be granted on the export of sugars.

"II.

"The High Contracting Parties pledge themselves to adopt, or to propose to their respective Legislatures, a system of duties on the quantities of sugar produced and intended for consumption, as the only one by which the suppression of the bounties in question can be attained, and to place under one and the same *régime* the manufacture of glucose, and the manufactures for the extraction of sugar from molasses.

"III.

"As Belgium is not under the same conditions in respect of the application of the system of duties on the quantities of sugar produced, the existing *régime* established in that Kingdom may be maintained, subject to the following modifications:—

"The amount of duty shall be reduced from 45 francs to 25 francs from and after the day when this Convention shall come into force.

"IV.

"There shall be admitted to equal rights in this Convention all such States, or Colonies, or Foreign Possessions of the High Contracting Parties, as, though not adopting the system described in Article II., do not impose duties on sugars, or who undertake not to accord to sugars for export, either raw or refined, any drawback, repayment, nor abatement of dues or quantities.

"V.

"In case any State which does not impose dues upon sugar should intend to establish them, such State shall be bound to charge these dues upon the quantity of sugar produced and intended for consumption, or, at least, to give no drawback, repayment, nor abatement of dues or quantities.

"VI.

"The High Contracting Parties will communicate to one another the laws which may have been already repealed in their respective States, or are about to be, in relation to the purpose of the present Convention.

"VII.

"The States which have not taken any part in the present Convention are permitted to join in it on application. Their adhesion shall be diplomatically announced to Her Britannic Majesty's Government, and by it to the other Signatory Powers.

"VIII.

"The stipulations of the present Convention shall be applicable to the Colonies and Possessions of Her Britannic Majesty, with the exception of those hereinafter named, to wit:—

"The East Indies, Canada, Newfoundland, the Cape, Natal, New South Wales, Victoria, Queensland, Tasmania, South Australia, Western Australia, and New Zealand.

"At the same time the stipulations of the present Convention shall be applicable to any of the Colonies or Possessions above mentioned, from the date at which the Government of Great Britain shall notify the adhesion of such Colony or Possession to the other contracting Powers.

"Any one of the Colonies or Possessions above named which may have given its adhesion to the present Convention retains the power of withdrawal in the same way as the Contracting Powers.

"In the case of any one of the said Colonies or Possessions desiring to withdraw from the Convention, a notification to that effect will be made by the British Government to the Contracting Powers.

"IX.

The present Convention shall come into force on and after   . It shall remain in force for ten years from that date, and in the event of no one of the High Contracting Parties having given notice, twelve months before the expiration of this period of ten years, of its intention to bring it to an end, it shall continue in force for another twelve months, and so from year to year.

"Should one of the Signatory Powers denounce the Convention, their denunciation will affect only the Power making it.

"X.

"The present Convention shall be ratified, and the ratifications in regard to it shall be exchanged in London within   months at the latest, and sooner if possible."

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS AND MACHINERY.

APPLICATIONS.

15845 F. B. Hill and M. Shearer, London. Vacuum and pressure fluid pumps for gases. November 18

15938 R. Morris, London. Filters. November 19

16011 R. Horsburgh, Glasgow. A regenerative furnace. November 22

16016 J. Jackson, Manchester. Lead lined boilers and similar vessels. November 22

16013 J. Jackson, London. Gauges for measuring pressure or (and) vacuum. November 22

16051 R. Pol, London. Apparatus for the filtration of liquids. November 22

16220 J. Powell, London. Regenerative furnaces. November 25

16223 J. Hodgkinson, London. Furnaces for steam boilers, and mechanical stokers for supplying same with fuel. November 25

16381 H. Berghoff, London. Apparatus for filtration of liquids. November 29

16393 T. F. Cashin, Hastings. Furnaces and appliances for generating heat and steam. November 29

16534 E. Edwards—From E. Cambiaso, I. Colomba and G. N. Mangini, Italy. Apparatus for feeding coal to furnaces. December 1

16545 J. S. Sawrey and H. Colcet, London. Apparatus for separating liquids from solid matters in suspension therein. December 1

16594 J. S. Sawrey, G. E. Bellis and A. Moreom, London. Apparatus for separating liquids from solid matters suspended therein. December 2

1698 W. Mellor, Manchester. Mechanical stokers. Dec. 5

16715 J. Noble and B. H. Thwaite, Liverpool. Ingot and crucible heating arrangement. Complete specification. December 6

16787 H. E. Newton—From F. Theiser, Germany. Apparatus for condensing and cooling purposes. December 6

16805 W. T. Walker, London. Distillatory apparatus for use in chemical operations. December 6

16896 W. T. Walker, London. Apparatus to be used in chemical operations where it is required to drive off from liquids volatile constituents thereof. December 6

16952 W. H. Gilruth, London. Apparatus for treating vegetable or mineral substances to evaporate moisture therefrom. December 9

17049 I. S. McDougall and T. Sugden, London. Apparatus for effecting the separation of solid matter from fluids, applicable also for separating water or liquids from steam or other vapours or gases. December 10

17193 T. Pursall and W. Lister, Birmingham. Smoke consuming and fuel economising apparatus for boiler muffles, etc. December 14

17290 A. Knoop, London. Improvements in and relating to apparatus for evaporating brine and other solutions, for distilling or rectifying alcohol, and for similar purposes. Complete specification. December 15

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

791 A. H. W. Brown. Means for economising fuel and consuming smoke in furnaces. November 19

811 W. Waller. Steam boilers for heating and evaporating fluids. November 30

991 J. Y. Johnson—From H. J. Drory. Apparatus for spraying and burning liquid fuel. November 30

2870 J. A. Eaton—From S. H. Shaw. Apparatus for heating air to a high temperature. November 19

7772 G. W. Allen and H. J. A. Bowers. Water purifying apparatus. December 7

12169 P. Alfieri. Powder for preventing and removing incrustation in boilers. December 7

12357 R. M. Bryant. Anti-incrustation preparation. Dec. 7

13013 H. Wilson and A. Wilson. Apparatus for injecting air, gas, oil, etc., into furnaces, for increasing draught, reducing smoke, etc. December 7

14209 W. H. Rusden. Electrical apparatus for preventing corrosion and incrustation in boilers. November 23

14539 W. L. Horne. Vacuum apparatus. November 26

14758 A. Schrieber. Smokeless furnaces. November 30

15238 E. A. Cowper. Filter presses. November 8

15590 W. Creswick. Apparatus for drying, heating or cooling substances in a semi-liquid or powdered state. Dec. 17

II.—FUEL, GAS AND LIGHT.

APPLICATIONS.

15811 G. Watson, Birmingham. A hydraulic gas valve to be fixed between retorts and gas main on retort bed. Nov. 18

15852 J. H. R. Dinsmore, Liverpool. Improvements in and connected with the manufacture of illuminating gas from coal. November 18

16222 S. Cueler, London. Improvements in gas washers or scrubbers when more than one are employed. November 25

16396 J. H. Pearson, London. A method of preparing peat for firelighters and for fuel by means of preparations of coal tar. November 29

16483 J. Swift, London. An improved method for increasing the luminosity of circular flames in oil, gas or incandescent lights. November 30

16501 L. Wacks, London. An improved artificial fuel. December 1

16543 F. Pool, London. Improved appliance for scraping the insides of retorts in which gas is produced from steam and hydrocarbon, and the simultaneous removal of the deposit therefrom. December 1

16600 A. G. Browning and M. R. Waddle, Bradford. Improvements in the means or method of securing the lids of gas retorts and other similar covers. Complete specification. December 2

16631 A. F. Firth, Halifax. Improvements in or connected with pipes employed in the manufacture of illuminating gas. December 3

16866 R. Good, London. Improvements in apparatus for injecting liquids into gas retorts. December 7

17007 J. Swallow and N. Procter, Leeds. Method for converting gas-coke, smudge, small coal, and all descriptions of coal and coke residue into a flammable fuel by either hot or cold process. December 10

17223 J. Cobbe, London. Improved method of reflecting gas or other artificial light. December 14

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

16018 A. Thomas. Means for straining gas tar to be used as fuel. December 10

16053 B. H. Thwaite. Producing combustible gases from liquid hydrocarbons, and apparatus therefor. November 30

1887.

1150 J. S. Sellon. Apparatus for lighting by the consumption of gas and air. December 7

1190 J. Atterton. Apparatus for charging gas retorts. December 3

1684 W. H. Lindsay. Manufacture of artificial fuel. Nov. 23

1922 P. Haddan—From G. L. Barton. Method of refining crude and refuse petroleum and the like. November 26

1965 J. Birchall. Manufacture of gas and apparatus therefor. December 10

14531 J. Y. Johnson—From G. Mulheims and R. Zimmermann. Apparatus for moulding blocks of artificial fuel. November 26

15003 J. G. Hawkins and J. Barton. Gas retort lids, and method for ensuring gas-tight joint between the lids and mouthpieces. November 3

15009 H. W. P. Nugent. Gas retort and other furnaces.

15164 O. Knublauch. Production or recovery of cyanogen compounds from coal gas and other gases. December 14

15256 S. Pitt—From T. G. Hall. Process of refining hydrocarbon oils. December 10

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

APPLICATIONS.

16301 J. Lewkowitsch, London. Improvements in the extraction of organic bases from the distillates of coal and shale tars. November 26

16582 J. Dempster, Manchester. Improvements in apparatus employed in the continuous production or distillation of gas and other products from coal and other materials and minerals. December 2

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

16213 I. Levinstein, Manchester. A new or improved colouring matter. November 25

16484 J. Y. Johnson—From The Farbenfabriken vormals F. Bayer & Co., Germany. Improvements in the manufacture of azo dyes. November 30

16493 J. Y. Johnson—From The Farbenfabriken vormals F. Bayer & Co., Germany. Improvements in the manufacture of azo dyes. November 30

16810 R. Chadwick and J. W. C. Chadwick, London. Improved colouring matter for dyeing, painting, staining, or printing. December 6

16974 J. Imray—From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Poirrier and L. Roussin, France. Manufacture of orange and red azoic colouring matters. December 9

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

737 O. Imray—From The Farbwerke vormals Meister, Lucius and Brüning. Manufacture of colouring matters by the action of nitrosoderivatives of secondary aromatic amines upon phenols and oxycarbonic acids. December 3

1694 O. Imray—From The Farbwerke vormals Meister, Lucius & Brüning. Production of alkalised diamidobenzophenonaminechlorides, and conversion of the same into alkylised diamidobenzophenones and yellow colouring matters of the class of the "auramines." December 7

2985 O. Imray—From The Farbwerke vormals Meister, Lucius & Brüning. Manufacture of a methylene blue specially adapted for printing on textile fibres. December 17

3028 F. Raschig. Production of hydroxylamine. Dec. 14

3304 R. Reid. Separating solid matter from alizarin or other colouring matters or starch. December 10

4492 H. H. Lake—From K. Oehler. Manufacture of colouring matters. November 23

V.—TEXTILES, COTTON, WOOL, SILK, ETC.

APPLICATIONS.

15896 T. F. Wiley, Bradford. A new process or method of and apparatus for rendering textile fabrics waterproof or water-repellent. November 19

15899 T. F. Wiley, Bradford. Improvements in machinery or apparatus for water-proofing or rendering textile fabrics water-repellent. November 19

15900 T. F. Wiley, Bradford. A new or improved process and apparatus for rendering textile fabrics waterproof or water-repellent. November 19

The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

16339 A. C. Henderson—From C. Stocker, France. Improvements in the method of, and manufacture of non-inflammable cellulose matters. November 28

16653 J. B. Megemond, jun., M. E. Megemond, J. B. A. Megemond, and C. J. M. Raffard, London. Improvements in the manufacture of felt. December 3

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

5097 R. H. Collyer. Process and apparatus for preparation of rhea or other vegetable fibres for textile purposes. November 19

11182 W. J. S. Grawitz. Treatment of textile materials dyed with aniline black, December 7

VI.—DYEING, CALICO PRINTING, PAPER STAINING AND BLEACHING.

APPLICATIONS.

15972 J. Marshall, Walsden. Dyeing and painting a cotton velvet in two colours, and so producing a shot effect. November 21

16171 A. Bensinger, London. Process for producing designs on celluloid or like pyroxiline compounds. November 24

17102 G. A Schleber, London. Improvements relating to the bleaching, dyeing, and similar treatment of cloth and other fabrics, and to apparatus therefor. December 12

17106 J. Grunhut, London. An improved process and means of dyeing cotton and other fibrous substances in aniline black. December 12

17251 G. W. Liddiard, Manchester. Improved apparatus for dyeing, soaping, washing, and finishing yarn. December 15

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

818 J. Walker. Method and apparatus for dyeing or treating textile fibres. November 19

1351 W. Birch Machines for washing, soaping, dyeing, and dunging woven fabrics. November 30

VII.—ALKALIS, ACIDS AND SALTS.

APPLICATIONS.

16031 F. Foster, London. Generating carbonic acid gas. November 23

16254 The Tyne Alkali Company, Limited, and T. Gibb, London. Improvements in the treatment of solutions containing barium or strontium compounds, and the obtainment of products therefrom. November 25

17050 W. H. Beck—From P. de Lachomette, France. New or improved process and apparatus for the manufacture of sulphite and bisulphite of ammonia. December 10

17073 W. Mason and C. J. Whittaker, Accrington. Improvements in the process and apparatus for the manufacture of soda and ammonia salts by the ammonia alkali process. December 12

17095 W. White, and A. Richardson, London. Improvements in the packing of acids. December 12

17255 D. Herman, Liverpool. Improvements in condensers and towers for the condensation of acid and corrosive gases. December 15

17273 L. Mond, and G. Eschellman, Liverpool. Improvements in the manufacture of chlorine. December 15

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

1832 J. Mangnall. Generating carbonic acid gas, and apparatus therefor. December 10

1973 W. B. Cogswell. Bicarbonate columns. December 7

1974 L. Mond, and D. B. Hewitt. Manufacture of caustic soda or caustic potash, and of carbonic acid from mono or other carbonate of soda or potash. December 7

1993 E. Hermite, E. J. Patterson, and C. F. Cooper. See Class XVIII.

2966 J. J. Hood, and A. G. Solomon. Manufacture of sulphate of alumina. December 17

15164 O. Knublauch. See Class II.

VIII.—GLASS, POTTERY AND EARTHENWARE.

APPLICATIONS.

15875 S. Pitt—From M. S. Highie and G. G. Frelinghusen, United States. Improved process for the manufacture of earthenware and the compounds therefrom. November 18

16031 E. S. Baldwin—From D. Mitchell, New Zealand. An improved apparatus for cutting glass tubes. November 22

16142 G. J. Atkins, London. Improved process or means of producing a crystalline effect on the surface of glass or other vitreous substances. November 21

16168 T. Taylor, W. Tunnycliff, and W. H. Slater, Birmingham. Improvements in the ornamentation of china and earthenware surfaces. November 24

16355 J. Y. Johnson—From M. Aubriot, France. A new or improved process for producing cloisonne designs or decorations in enamelling glass and other substances. November 28

16359 E. M. Macdonald, London. An improved process or method for producing fixed drawings or paintings on porcelain, china, or on other suitable material. November 28

16487. T. W. Webb, London. Improvements in ornamenting glass. November 30

16621 J. Larmanjat, London. Improvements in the method of and apparatus for moulding, pressing, and drying tiles having inlaid patterns. December 2

16951 E. Stiff, Lambeth. Constructing water-tight tanks, cisterns, tuns, vats, and other vessels, of slabs of earthenware or other suitable material. December 9

16980 F. V. Macquaire, London. An improved refractory compound. December 9

17066 M. Erlich and C. Storck, Berlin. Improvements in the method of printing gold, silver, or platinum decorations on ceramic articles. Complete specification. December 12

17125 A. D. Brogan and A M. Malloch, Glasgow. Improvements in apparatus for rolling plate glass to produce rippled, dappled, vermicular chequered, or other patterns or designs thereon. December 13 .

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

12076 T. C. J. Thomas. Manufacture of glass. November 23

1887.

967 W. Cliff. Manufacture of fire-clay enamelled baths. November 23

1131 D. Rylands and B. Stoner. Means for blowing bottles or other hollow glass-ware. November 30

1441 P. Graham. Manufacture of hollow clay-ware, and "jollies" or machines therefor. December 3

2305 H. L. Doulton and W. P. Rix. Ornamenting pottery, tiles, or glass. December 14

3434 H. M. Ashley. Manufacture of bottles and other hollow glass-ware, and machinery therefor. December 17

9291 M. F. L. Ehrlich & Co., and C. T. Storck. Producing decorations in gold, etc., on pottery

13723 C. Amand-Durand and R. P. Engelmann. Decorating glass, and apparatus therefor. December 3

15096 S. Fenn and A. Fenn. Fireplaces of kilns or ovens for burning bricks, pipes, terra-cotta, etc. December 14

IX.—BUILDING MATERIALS, CLAYS, MORTARS AND CEMENTS.

APPLICATIONS.

15926 O. Bowen, London. Improvements in the manufacture of Portland cement. November 19

16117 S. J. Payne, West Shurrock. The improvement of the manufacture of hearthstones or similar kind of goods. November 23

16746 W. G. Watson, Heaton, and J. Judge, Wallsend. An improved machine for dressing and finishing building bricks, flooring tiles, and other clay articles. December 6

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

678 E. W. Jones and C. Brand. See Class X. November 19

14897 P. von Krystoffovitch. Manufacture of artificial granite. December 3

X.—METALLURGY, Etc.

APPLICATIONS.

15857 R. R. Gubbins, London. Improvements in treating or piling wrought scrap iron. November 18

15881 C. A. Meygret and P. Marino, London. A new alloy and process for manufacturing the same, and for electroplating and typing therewith. November 18

15884 J. Ashworth, Manchester. Improvements in or relating to miners' safety lamps. November 19

15931 W. Davis, Sheffield. Improvements in and apparatus and appliances for the manufacture of steel plates with thickened edges. November 19

16027 C. E. Tripler, London. Improvements for amalgamating and separating precious metals from powdered ore or earth. Complete specification. November 22

16118 L. A. Brode, Glasgow. Improvements in the manufacture of bricks or blocks of ironstone waste or dust, or ironstone, sand, or similar ferruginous materials for smelting. November 21

16183 J. B. Spence, London. Improvements in the treatment of ores containing gold for the purpose of extracting the gold therefrom. November 24

16192 J. P. Ogle, London. An improved arrangement of the amalgamated plates employed in the treatment of gold ores, in the supports for the same, and in apparatus connected therewith. November 24

16270 H. Hutchinson, London. Improvements in the treatment of refractory gold and silver ores. November 26

16346 H. B. Scott and W. Gentles, London. Improvements in tuyéres for blasts of furnaces, and for agitating molten material. November 28

16347 H. B. Scott and W. Gentles. Improvements in the smelting of copper and lead ores, and arrangement of furnaces for that purpose. November 28

16436 G. J. Snelus, London. Improvements in the manufacture of steel, and in apparatus therefor. November 29

16491 H. W. Buddicom, London. Improved apparatus for dipping or cleansing tin or terne plates. November 30

16495 W. R. Lake—From A. Vogelmann, Germany. Improvements in apparatus for extracting metals from their ores. Complete specification. November 30

16497 B. H. Thwaite and J. Noble, Liverpool. Improvements in the manufacture of steel, and in plant therefor. Complete specification. December 1

16553 A. Schanschieff and D. Marks, London. Improvements in extracting gold, silver, and other metals from their ores and alloys. December 1

16601 A. S. Ramage, Liverpool. Improvements in or relating to the chemical treatment or utilisation of scrap tin, or terne plates, scrap zinc, galvanised iron, and the like. December 2

16611 F. Caulfield and A. Allan, Glasgow. Improvements in preparing, compressing, and uniting materials for smelting purposes. December 3

16727 A. B. Cunningham, London. Improvements relating to the production of aluminium and aluminium alloys. December 5

16745 J. Noble and B. H. Thwaite. See Class I.

16770 W. Wood, London. Miners' safety lamps. December 6

16771 A. Fieldsend and J. E. Bott, Manchester. Improvements in the manufacture of crucible steel, and apparatus therefor. December 6

16781 W. Pilkington, London. Improvements in the manufacture of steel and iron shells for ordnance and machine guns. December 6

16828 A. J. Ash, Birmingham. Improvements in coating metals with zinc, tin, terne, and other coating metals. December 7

16853 W. L. Wise—From the Schweizhische Metailurgischie Gesellschaft of Lautfen, Switzerland. Improvements in apparatus for producing alumina and other metals and their alloys, and operating the same. December 7

16862 E. J. Ball and B. H. Brough, London. Improvements in appliances for amalgamating auriferous and argentiferous substances. December 7

16901 L. A. Groth—From J. Lotineaux, Paris. Improvements in safety lamps for miners. Complete specification. December 8

16910 C. M. Pielsticker, London. An improved method and apparatus for the production of metal bars direct from the molten metal. December 9

16911 C. M. Pielsticker. The removal of blow-holes from metals. December 9

16979 T. Anderson, London. Improvements relating to the tinning of hollow-ware and other articles. December 9

16991 J. Walls, Hindley Green. Improved miners' safety lamps. December 10

17033 A. Parkes, London. Improvements in the extraction of gold and silver from ores or compounds containing the same, and in solvents for such metals. December 10

17036 W. D. Allen, London. Improved means for carrying, turning, and otherwise manipulating ingots of iron or steel in the process of beating and forging. December 10

17037 W. Robinson, London. Improvements in ingot moulds. December 10

17111 M. Gledhill, London. Improvements relating to the casting of hollow metal ingots, and to apparatus therefor. December 12

17156 J. Bedford, London. Improved methods or processes of treating or purifying alloys of iron and manganese and other metals, for use when so purified in admixture with other materials. December 13

17169 D. Edwards, R. Lewis, and P. Jones, London. Improvements in apparatus for coating metal plates with tin or other metal. December 13

17288 S. Siemaug, London. Improved manufacture of compound castings for armour-plates and other purposes, and apparatus therefor. December 15

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

14308 J. H. James. Crushing and dressing tin and other ores, and machinery therefor. December 10

15477 E. Morewood. Coating sheets or pieces of iron or other metal with tin or other coating metal. November 26

16109 S. F. Walker. Miners' electric safety lamps. Dec. 14

16608 D. G. Fitzgerald. Production of coherent masses of peroxide of lead for use as battery elements, and in electrolytical and metallurgical operations. December 3

17649 K. W. E. Maruhn. Reducing slag and recovering metal therefrom. December 14

1887.

298 T. Allen. Machine for forging or shaping metal articles. December 3.

678 E. W. Jones and C. Brand. Manufacture of paving blocks from scoria or slag, and means therefor. Nov. 19

803 P. M. Justice—From W. V. Shelton. Production of alloys or bronzes. November 19

913 A. E. Tucker and F. W. Harbord. Manufacture of iron and steel. November 23.

1134 J. A. Yeadon and R. Middleton. Blocks or briquettes of fuel for smelting or analogous purposes. December 11

1261 D. McCorkindale and G. Dougall. Stoppers used in the manufacture of steel. November 26

1276 E. Cleaver. Manufacture of aluminium and aluminium alloys. November 30

2060 W. Gentles. Manufacture of copper. December 10

2935 J. Dickson. Preparing steel for roller bars and bed-plate bars for manufacture of paper and paper pulp. Dec. 14

4583 R. H. W. Biggs. Manufacture of dyes, disinfectants, artificial stone, artificial ivory, artificial manure, sodium chloride, zinc sulphate, and zinc carbonate. November 23

9231 J. Toussaint. Manufacture of wrought iron and steel, and apparatus therefor. December 10

14792 H. J. Allison—From J. B. D'Arcy Boulton. Casting metallic ingots. December 3

XI.—FATS, OILS AND SOAP MANUFACTURE.

APPLICATION.

16329 F. Rainbow, Luton. Incorporating mineral oils known as kerosine and petroleum oils into soap, or mixing with soaps. November 28

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

16925 Sir D. L. Salomons. Buoyant soap. November 26

1887.

1291 N. M. Henderson. Apparatus for treating or purifying paraffin wax. November 30

15054 M. J. Hortung and W. Gallagher. Lubricating oils and greases. December 7

XII.—PAINTS, PIGMENTS, VARNISHES AND RESINS.

APPLICATIONS.

15835 T. D. Harries, Aberystwyth. Enamelled composition. November 18

16263 F. M. Spence and D. D. Spence, Manchester. Improvements in the manufacture of certain pigments, and in the manufacture of certain products obtained in connection therewith. November 26

16894 S. J. Cluff, Dublin. Improvements in blacking. Dec. 8

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

955 H. H. Gunn. Manufacture of sulphide of zinc white. November 30

1382 E. Page and G. Brayfield. Composition for varnishing and reviving leather. November 30

XIII.—TANNING, LEATHER, GLUE AND SIZE.

APPLICATIONS.

15811 J. J. Carr, Scarborough. An improved paperhangers and painters' combined paste and size. November 18

15851 J. Palmer, London. An improved solution and treatment for unhairing hides and skins and preparing them for tanning. November 18
16469 F. H. Colley, Sheffield. Improvements in the process of tanning. November 30
17103 E. J. Lanvin-Schraen, London. Improvements in tanning and apparatus therefor. December 12

COMPLETE SPECIFICATION ACCEPTED.

1887.

1009 A. Smetham. Manufacture of waterproof leather. November 23

XIV.—AGRICULTURE, MANURES, Etc.

APPLICATIONS.

17094 H. D. Salomonson and J. Laubheimer, London. Improvements in machines with spiked appliances for reducing or pulverising superphosphates and other materials. Dec. 12
17181 L. G. G. Dandenart, Liverpool. Improvements in the method of manufacturing hydrated phosphates, and in apparatus therefor. December 14

COMPLETE SPECIFICATION ACCEPTED.

1887.

15309 J. Davenport. Manufacture of fertilisers or manuring compounds. December 10

XV.—SUGARS, GUMS, STARCHES, Etc.

APPLICATION.

16732 E. Breyer, London. Improvements relating to the purification of saccharine juices, glycerine, oil, alcohol and analogous substances. December 5

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

688 J. Karpeles. Process and means for concreting amber shavings. November 19
986 V. C. A. M. Bondonneau and A. J. M. G. Foret. Process and apparatus for acid saccharification of starchy materials. November 23
2572 C. D. Abel—From T. Rousselot. Multiple three-roll sugar-cane mills. December 7
2905 H. H. Lake—From La Compagnie de Fives-Lille. Diffusing apparatus for use in the treatment of beet-root, sugar-cane, etc. December 17
3304 R. Reid. See Class IV.

XVI.—BREWING, WINES AND SPIRITS.

APPLICATION.

15995 C. Billing, Liverpool. New or improved wines or beverages. November 21

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

17059 W. Gerdes. Treament of waste products of brewers for production of alcoholic liquor. November 23

1887.

1516 W. Adlam and F. Faulkner. Treating brewers' wort, and apparatus therefor. November 30
2005 C. Church. Brewing. December 3
2109 H. Grote. Process for removing fusel oil from crude spirits, or from the mash containing crude spirits. December 10
11232 R. Ranger. Apparatus for regulating the surface flow of wort from coolers. November 23
14737 T. G. Bowick. Purifying alcohols by means of hydrocarbons, and apparatus therefor. December 14

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

APPLICATIONS.

A.—Chemistry of Foods.

15832 R. H. Courtenay, London. An improved method of preparing and desiccating fruit and other substances in combination with whole meal from cereals and nuts, without the use of sugar in the prepared compounds. November 18
16100 W. H. Wells, Evershot. An improved dairy method for treating milk and its products. November 23
16592 C. R. W. Offen and A. T. More, London. Improvements in preventing the second or further fermentation of yeast, or any other ferment or raiser, where combined with wheat or any other cereal or admixture of cereals to be consumed or used as food. Complete specification. December 2
16652 F. Graeff, London. Improved method of preparing ferment of rennet. December 3
16935 C. Collin and L. Benoist, London. An improved method or means of preserving and preventing the putrefaction of animal and vegetable substances. Complete specification. December 8
16964 A. R. Rooson, London. An improvement in or relating to the preservation of fish and other substances, and a novel preparation of antiseptic material for use therefor or for other purposes. December 9
17268 M. Frischer, London. A composition of matter to be used as a preserved food. December 15

B.—Sanitary Chemistry.

15939 W. Webster, jun., London. Improved apparatus for the electrolytic treatment of sewage and other impure liquids. November 19

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1886.

15674 T. B. Brodbelt. Manufacture of cheese and apparatus therefor. November 30

1887.

1772 J. France. A new treatment of milk to prevent its turning sour. December 7
9950 L. Stollwerck, C. Stollwerck, and F. Baumer. Preserving fruit, vegetables, and other articles of food. Dec. 3
13049 I. Allegretti. A preserving system for perishable articles. December 14
14744 E. Scherff and C. Dreukham. Condensing milk and other fluids containing protein, and preserving same. Nov. 30

B.—Sanitary Chemistry.

1886.

12259 R. de Soldenhoff. Desiccation, incineration, etc., of precipitants of solids resulting from sludge or other substances liable to putrify, and apparatus therefor. November 26
16039 W. H. Hartland. Treating sewage and waste liquids for recovery or manufacture of manurial products, and apparatus therefor. December 7

1887.

1699 D. Craig. Utilising sewage sludge. December 7
2103 C. Wigg. Treatment of spent copper liquors and the application or the product for the purification of sewage and like matters. December 17
14857 A. Engle. Furnace and process for burning wet and offensive substances. December 7

XVIII.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

15858 W. Main, London. Improvements in dynamo-electric machines and electro-motors. Complete specfication. Nov. 18
15939 W. Webster, jun. See Class XVII. B.
15943 O. C. D. Ross, London. Improvements in galvanic batteries. November 19
16032 W. Main, London. Improvements in electro-motors and dynamo-electric machines. Complete specification. Nov. 22
16120 E. Tyer, London. An improvement in voltaic batteries. Complete specification. November 23

16124 T. J. Jones, London. An improvement of voltaic batteries. November 23

16296 A. F. St. George and C. R. Bonne, London. Improvements in primary and secondary galvanic batteries. Nov. 26

16305 H. C. Donovan and T. Weatherall, London. An improvement in voltaic cells. November 26

16455 H. Thame, London. Improvements in secondary or storage batteries. November 30

16669 M. Bailey and J. Warner, London. An improved secondary battery combined with a miner's lamp. Complete specification. December 3

16709 T. A. Edison, London. Improvements in electrical generators. Received December 5. Antedated June 13, under International Convention.

16849 G. A. Schoth, London. Improvements in the manufacture of galvanic batteries. December 7

16926 T. Fenwick, London. Improvements in the electrodepositions of metals. December 8

17097 F. Kinn, London. Improvements in secondary batteries. December 10

17157 H. H. Lake.—From J. O. Whitten, United States. Improvements in galvanic batteries. Complete specification. December 13

17186 R. E. Hides, Sheffield. An improved process of ornamenting metallic and other surfaces by the electro-deposition of metals. December 14

COMPLETE SPECIFICATIONS ACCEPTED.

1887.

700 L. Z. de Ferranti. Electric furnaces and apparatus for heating, lighting, and carrying on chemical processes. Dec. 17

1738 C. D. Abel—From Siemens and Halske. Dynamo-electric machines. December 23

1862 C. D. Abel—From A. Dunn and F. Hasslacher. Secondary batteries. December 7

1929 C. D. Abel—From A. Dunn and F. Hasslacher. Galvanic batteries. December 7

1993 E. Hermite, E. J. Paterson, and C. F. Cooper. Apparatus for electrolysing bleaching solution. December 10

14901 C. R. Goodwin. Electric batteries. December 3

15730 J. Vaughan-Sherrin. Galvanic batteries. Dec. 17

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATION.

17096 W. Black and W. Rennoldson, London. An improvement in the manufacture or preparation of materials for use in paper making and the like. December 12

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

APPLICATIONS.

16700 C. Wilson, Grimsby. Improvements in the manufacture of chemicals and medicinal tablets, pearls, and effervescing or other lozenges. December 5

16987 E. B. Ellice-Clarke and L. Chapman, London. Improvements in apparatus for the production of oxygen and nitrogen gases from atmospheric air. December 9

XXI.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

16083 W. H. Percival, London. Self-extinguishing or semi-inflammable match that can be applied to any kind of match. November 23

16116 E. Grüne, London. Improvements in the manufacture of Kieselguhr-dynamite. Complete specification. Nov. 23

16353 H. C. Zappert, London. Apparatus for dipping match splints for applying to them the ignitable tips or heads. Nov. 28

16453 J. A. Wanklyn, H. M. Maclure, and W. A. Brynn, London. Smokeless gunpowder. November 20

16721 W. P. Thompson—From the Compagnie Générale des Explosifs Favier, Belgium. New or improved explosive compounds, and improvements in or relating to the formation of cartridges thereof. Complete specification. December 5

16783 C. F. Hengst, London. Smokeless gunpowder. Dec. 6

16919 A. N. Newton—From A. Nobel, France. Improvements in detonators. December 8

16920 A. V. Newton—From A. Nobel, France. An improved explosive compound. December 8

17276 J. Y. Johnson—From F. C. Glaser, Germany. Improvements in the manufacture of explosives. December 13

COMPLETE SPECIFICATION ACCEPTED.

1887.

2318 H. H. Lake—From the Deutsche Sprengstoff Actiengesellschaft. Gelatinising nitro-glycerine. December 14

XXII.—ANALYTICAL CHEMISTRY.

APPLICATION.

17030 J. G. Jourdan, London. Improved apparatus for ascertaining and measuring the density or pressure of vapours and gases. December 10

9. 9.

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